Interagency Agreement DE-AI05-93ER75893
Modification: A002 (1995)
National Biological Service (NBS)
Southern Science Center

DOE/ER/75893--T1

Technical Report for 1995

Project Title: Theory and Use of Modern Microscopical Methods with Applications to Studies of Wetlands Microbial Community Dynamics

Per the agreement between DOE and NBS (formerly U.S. Fish and Wildlife Service), the Southern Science Center (formerly National Wetlands Research Center) granted funds to the University of Southwestern Louisiana to coordinate and offer a summer enhancement institute for science teachers. Following are highlights from that institute:

20 teachers from Louisiana attended the institute as students.

Institute faculty included staff members from USL's Departments of Biology, Mathematics, and Education and 3 principal scientists plus technicians from the Southern Science Center.

The institute began June 5, 1995 and ended June 30, 1995, and it featured daily lectures, laboratory exercises, examinations, and field trips.

- Assignments for students included journal keeping, lesson plan development, and presentations. The students' journal entries proved valuable for evaluating institute activities.
- Students received copies of lesson plans developed at the institute, videos entitled "Pond Life Diversity" and "Chesapeake: The Twilight Estuary," a guide to "Free-lining Freshwater Protozoa," a graphing calculator, 2x2 slide set of pond life, software or hardware (selected by the teacher to meet specific needs), a field manual for water quality monitoring laboratory exercises (Project Green), and a book on *Benchmarks for Science Literacy*.

Follow-up measures included the following:

- A newsletter disseminated by USL but written with teacher input
- Making equipment (such as a trinocular compound microscope and video monitor) and materials and supplies available to the teachers and their students in the classroom.
- Mentoring between USL and SSC staff and the teachers during the school year.

Attached to this report are copies of the institute agenda and lesson plans developed in the institute.

FINAL PERFORMANCE REPORTS

Consisting of

Technical Report
and
Final Evaluation Narrative

TECHNICAL REPORT

Interagency Agreement DE-AI05-93ER75893
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DISCLAIMER

TECHNICAL REPORT

PART I

Institute Agenda

DEPARTMENT OF ENERGY
SUMMER SCIENCE TEACHER ENHANCEMENT INSTITUTE 1995
FOUR WEEK AGENDA

Date/Time	Subject/Activity
	WEEK 1
June 5, Monday	**USL - Biology - Billeaud Hall**
8:30 a.m.	Coffee, Conversation and Introduction of Participating Teachers (Room 106 Billeaud Hall)
9:30 a.m.	Information Session with Director of Institute (Room 219 Billeaud Hall)
	Completion of Department of Energy Registration Forms and Information Sheets Pre-testing of Program Participants
11:00 a.m.	Tour of Dupre Library Facilities
11:45 a.m.	Welcoming Lunch (Room 106 Billeaud Hall)
1:00 p.m.	Afternoon Session with Dr. Jim Flaitz on Educational Technology (Room 219 Billeaud Hall)
	Overview of Educational Component of Summer Institute/LaSIP and Science Education Reform in Louisiana (presentation and discussion)
3:30 p.m.	Adjourn for the day
June 6, Tuesday	**USL - Biology - Billeaud Hall**
8:30 a.m.	Introduction to graphing calculators used as scientific calculators and as a grapher Dr. Vic Schneider (Room TBA)
12:00 p.m.	Lunch break
1:00 p.m.	Introduction to Computer Use (Room 303 Maxim Doucet)
3:30 p.m.	Adjourn for the day

June 7, Wednesday	**USL - Biology - Billeaud Hall**
8:30 a.m.	Lecture: "Endosymbiotic Theory" - Dr. Keith Roberts (Room 219 Billeaud Hall) Direct Filiation Hypothesis
10:15 a.m.	Coffee Break
10:30 a.m.	Lecture: "Whitaker's Five Kingdom Classification System" - Dr. Keith Roberts
11:30 a.m.	Lunch Break
1:00 p.m.	Lecture: "The Protozoa" - Dr. Bruce Felgenhauer Ciliophora Sarcodina
3:30 p.m.	Adjourn for the day
June 8, Thursday	**USL - Biology - Billeaud Hall**
8:30 a.m.	Lecture: "The Algae" - Dr. Keith Roberts (Room 219 Billeaud Hall) Bodonids/Trypanosomes, Euglenophyta - Euglena Chlorophyta - Green Algae
10:15 a.m.	Coffee Break
10:30 a.m.	Continuation: Chrysophyta - Golden Algae Pyrrhophyta - Dinoflagellates Phaeophyta - Brown Algae
11:45 a.m.	Lunch Break
1:00 p.m.	Using the campus as an extension of the classroom Dr. Claire Foret (Meet in Room 219 Billeaud Hall)
3:30 p.m.	Adjourn for the day
June 9, Friday	**USL - Biology - Billeaud Hall**
8:30 a.m.	Showing of Classroom Video Dr. Bruce Felgenhauer (Room 239 Billeaud Hall)
10:15 a.m.	Coffee Break

10:30 a.m.	Laboratory Exercises: Protozoa Diversity Lab Pond Collections/Identifications
12:00 p.m.	Lunch Break
1:00 p.m.	Continuation of Protozoa Diversity Lab Drs. Keith Roberts and Bruce Felgenhauer
3:30 p.m.	Adjourn for the day

WEEK 2

June 12, Monday	USL - Biology, Mathematics
8:30 a.m.	Dr. Vic Schneider (Room 219 Billeaud Hall) Functions as formulas, graphs and sets of data. 1. Plotting graphs from formulas 2. Plotting histograms for data sets
10:15 a.m.	Coffee Break
10:30 a.m.	More applications, group problem solving
11:45 a.m.	Lunch Break
1:00 p.m.	More applications, group problem solving
2:30 p.m.	Coffee Break
2:45 p.m.	Geometry and the microscope Lecture and group problem solving
3:30 p.m.	Adjourn for the day
June 13, Tuesday	**USL - Biology - Billeaud Hall**
8:30 a.m.	Dr. Keith Roberts (Room 239 Billeaud Hall) Demonstrations and laboratory experience: Culturing Protists Sterile Technique Differential Filtration Serial Dilution Preparation of Growth Media Pre-packaged Growth Media & Sources of Cultures
11:30 a.m.	Lunch Break

1:00 p.m.	Continuation of Sterile Technique Laboratory
3:30 p.m.	Adjourn for the day
June 14, Wednesday	**USL - Education**
8:30 a.m.	Integrating Technology into Science Classroom Teaching: Some Preliminary Considerations Dr. Jim Flaitz Lecture and demonstration (Room 303 Maxim Doucet)
10:00 a.m.	Coffee Break
10:15 a.m.	Developing Lesson Plans Based on Emerging Science Standards
12:00 p.m.	Lunch Break
1:00 p.m.	Lecture and Discussion - Small Group Planning (Dr. Jim Flaitz)
3:30 p.m.	Adjourn for the day
June 15, Thursday	**USL - Biology - Billeaud Hall**
8:30 a.m.	"Modern Methods in Microscopy" Specimen preparation Sectioning - Dr. Bruce Felgenhauer (Room 219 Billeaud Hall)
10:15 a.m.	Coffee Break
10:30 a.m.	Types of Light Microscopy - Visual Examples TEM: Methods of Preparation Sectioning Visual examples SEM: Methods of Preparation
11:30 a.m.	Lunch Break
1:00 p.m.	"Showcase of Electron Microscopy" Electron Microscopy Laboratory (USL Microscopy Center) Dr. Bruce Felgenhauer
3:30 p.m.	Adjourn for the day

June 16, Friday		USL - Mathematics
	8:30 a.m.	Analysis of graphs - maximums, minimums and inflection points Dr. Vic Schneider (Room 219 Billeaud Hall)
	10:15 a.m.	Coffee Break
	10:30 a.m.	Statistics packages on the graphing calculator
	11:30 a.m.	Lunch Break
	1:00 p.m.	Programming the Calculator
	2:45 p.m.	Testing for mathematics component followed by adjournment for the day

WEEK 3

June 19, Monday		USL - Biology - Billeaud Hall
	8:30 a.m.	Finish up on Microscopy Laboratory Practical with Drs. Bruce Felgenhauer and Keith Roberts (Room 239 Billeaud Hall)
	10:00 a.m.	Coffee Break
	10:15 a.m.	Speaker: Wilma Subra "Effects of the Oil Industry on Wetland Ecology" (Room 219 Billeaud Hall)
	11:30 a.m.	Lunch Break
	1:00 p.m.	Education Session: Dr. Jim Flaitz (Room 302 Maxim Doucet)
	2:15 p.m.	Coffee Break
	2:30 p.m.	Introduction to Project Green and Other Related Projects and Activities Brenda Grau (Room 303 Maxim Doucet)
	3:30 p.m.	Adjourn for the day

June 20, Tuesday | USL - Biology - Billeaud Hall

8:30 a.m. — Lecture Session: "Conceptualizing Coastal Systems"
Dr. Darryl Felder
(Room 219 Billeaud Hall)

1. Geographical and Historical Perspectives on Local Systems
2. Physical Constraints on Coastal Productivity
3. Diversity of Primary Producing Communities, Microbes as agents of Primary Production

10:15 a.m. — Coffee Break

10:30 a.m. — Lecture Session: "Phytoplankton Primary Production"
Dr. Darryl Felder
(Room 219 Billeaud Hall)

1. Light and the Aquatic Ecosystem
2. Nutrient Constraints on Production

11:30 a.m. — Lunch Break

1:00 p.m. — Continuation

3. Measurement of Phytoplanktonic Standing Crop and Primary Production

Research Applications Block 1: Our measurements of phytoplankton productivity in Colombian shrimp ponds; relate to nutrients: relate to infaunal bioturbation; slide presentation

Laboratory Exercise A:
(Rooms 239, 245 Billeaud Hall)

1. Set up light/dark BOD bottle experiments
2. Initiate 24 hour community metabolism monitoring
3. Phytoplankton collection, filtration, fixation
4. Chlorophyll extraction

3:30 p.m. — Adjourn for the day

June 21, Wednesday	USL - Biology - Billeaud Hall
8:30 a.m.	Lecture Session: "Benthic and Epiphytic Microbial Primary Producers" Dr. Darryl Felder (Room 219 Billeaud Hall) 1. Overview of biota 2. Substrates and settings 3. Measurements of production rates
10:15 a.m.	Coffee Break
10:30 a.m.	Research Application Block 2: Studies of benthic microbes associated with burrowing crustaceans; relate to nutrients and bioturbation; slide presentation
11:30 a.m.	Lunch Break
1:00 p.m.	Laboratory Exercise B: (Rooms 239, 245 Billeaud Hall) 1. Spectrophotometric measurement of chlorophyll 2. Light microscopic examination of previously filtered nannoplanktonic autotrophs 3. Recover and analyses L:D BOD bottles assays 4. Complete and analyze community metabolism measurements
2:15 p.m.	Coffee break
2:30 p.m.	Continuation of above
3:30 p.m.	Adjourn for the day
June 22, Thursday	Southern Science Center
9:00 a.m.	Welcome to NBS Lecture: Overview of Submerged Macrophytes Dr. Hilary Neckles Definition, Taxonomy, Morphology, Distribution Adaptations to aquatic environment Ecological importance, functions and values Worldwide declines
10:00 a.m.	Coffee break

10:15 a.m.	Lecture: Introduction to Laboratory Exercise Dr. Bill Rizzo Methods of measuring submerged macrophyte production Preparation for Lab
11:30 a.m.	Lunch break
1:00 p.m.	Laboratory Exercise: Photosynthesis of submerged aquatic vegetation
4:00 p.m.	Adjourn for day
June 23, Friday	Southern Science Center
9:00 a.m.	Lecture: "Constraints on Macrophyte Production Dr. Hilary Neckles Limiting factors-light, temperature, nutrients, salinity Lecture: Preparation for Laboratory Analyses Dr. Bill Rizzo
10:00 a.m.	Coffee Break
10:15 a.m.	Laboratory exercise: Biomass of plants used in previous day's experiment
11:30 a.m.	Lunch break
1:00 p.m.	Laboratory Analyses Calculations Graphical representation
2:30 p.m.	Discussion - Drs. Hilary Neckles and Bill Rizzo Ecological relevance of laboratory exercise Application to high school curriculum
4:00 p.m.	Adjourn for the day

WEEK 4

June 26, Monday	USL - Biology/Education
8:30 a.m.	Testing for Dr. Darryl Felder's Section (Room 219 Billeaud Hall)

June 30, Friday	USL - Education
8:30 a.m.	Participants will make presentations based upon their lesson plans - demonstrating integration of summer institute content, science standards, technology, and lesson planning skills Dr. Jim Flaitz (Room 303 Maxim Doucet)
12:00 p.m.	Lunch break
1:00 p.m.	Closing business DOE post test Scheduling for Fall Follow-up Dr. Pegge Alciatore (Room 123 Billeaud Hall)

TECHNICAL REPORT

PART II

Lesson Plans And Experiments In Wetlands Sciences

LESSON PLANS AND EXPERIMENTS IN WETLANDS SCIENCES

A MONOGRAPH PRODUCED BY
THE 1995 PARTICIPANTS IN
THE USL SUMMER SCIENCE TEACHER'S
ENHANCEMENT INSTITUTE

Edited by:
James Flaitz, Ph.D.
Pegge Alciatore, Ed.D.
The University of Southwestern Louisiana
Lafayette, Louisiana
1995

SUPPORT FOR THIS PROJECT WAS PROVIDED BY THE U.S. DEPARTMENT OF ENERGY

PREFACE

In 1993, The Biology Department of the University of Southwestern Louisiana, in collaboration with the (then) National Wetlands Research Center, proposed a science teacher enhancement project to the Federal Coordinating Council for Science, Engineering and Technology (FCCSET) Summer Teacher Enhancement Program, a program of the U.S. Department of Energy. That project was funded, and for each of the next three summers, science teachers from across Louisiana were selected to participate in an intensive, four-week long institute focused upon topics ranging from wetlands science to microscopy to graphing calculators.

In the summer of 1995, 19 high school science teachers arrived at the University of Southwestern Louisiana campus in Lafayette, Louisiana to spend four busy weeks engaged in activities designed to enhance their skills and knowledge relevant to wetlands science and related topics. They were introduced to topics such as coastal systems, phytoplankton primary production, benthic and epiphytic microbial primary producers, methods of dendrochronology, modern methods in microscopy, and use of the graphic calculator in the science classroom. Sessions were heavily weighted toward hands-on activities, with the goal of enhancing the participating teachers range of skills and expertise in science techniques and applications, and with the ultimate end of seeing those enhanced skills translated into improvements in their own science classrooms.

In direct support of this goal, a series of sessions were scheduled in which the emerging science education standards and related pedagogical literature were featured. The participating teachers were challenged to develop sample lesson plans based upon the topics and activities they had been exposed to over the four weeks of the institute, and to reflect in those lesson plans the goals and strategies promoted in the science education standards, as exemplified in such documents as Benchmarks of Science Literacy, and Project 2050: Science for All Americans.

As you review the lesson plans included in this monograph, keep in mind that these lessons are better employed as a source of inspiration than as a recipe to be directly imported into your own classroom. These teachers were challenged to design lessons that dealt with such issues as what learner outcomes would be facilitated through their lessons, where these particular lessons would interface with larger instructional goals, and what techniques they felt they had best grasped through their institute experience. For all readers, what we hope clearly comes through in your examination of these materials is the emphasis upon science as something that students (people) do, rather than on what they know.

Jim Flaitz

ACKNOWLEDGEMENTS

The success of the USL Summer Science Teacher Enhancement Institute has been the result of the diligent efforts of a number of individuals associated with the project. Project staff responsible for writing and administering the grant included *Dr. Pegge Alciatore*, Project Director, *Dr. Jerry Grau*, Director of the National Wetlands Research Center, and *Dr. Darryl Felder*, Department Head of the USL Biology Department. USL faculty who participated in developing and conducting the sessions included:

Dr. Darryl Felder-	(Biology)
Dr. Keith Roberts-	(Biology)
Dr. Bruce Felgenhauer-	(Biology)
Dr. Pegge Alciatore-	(Biology)
Dr. Vic Schneider-	(Mathematics)
Dr. Jim Flaitz-	(Education)
Dr. Claire Foret-	(Health and Physical Education)

National Wetlands Research Center personnel who participated by leading sessions and activities included:

Dr. Hillary Neckles
Dr. Bill Rizzo
Dr. Tom Doyle
Helena Schaeffer

Other National Wetlands Research Center personnel who assisted with liaison included:

Beth Vairin
Rhonda Davis

Graduate students who assisted throughout the project included:

Dan Duhon
Percy Jordan
Elison Blancaflor
Donna Stutson
Alan Gielen

From the local community, Wilma Subra lead a session on the effects of the oil industry on wetlands ecology.

The contributions of all of these individuals were invaluable in creating an intellectually stimulating and professionally rewarding experience for the participating teachers.

LESSON PLANS AND EXPERIMENTS IN WETLANDS SCIENCE

TABLE OF CONTENTS

PHOTOSYNTHETIC EFFICIENCY OF SELECTED SUBMERGED MACROPHYTES AS A FUNCTION OF LIGHT AND TEMPERATURE

Author: John Berry

Goal

1) The purpose of this lesson is to develop student appreciation for the efficiency of photosynthesis in our aquatic ecosystem; the students will determine specifically the effects of light and temperature on the rate of photosynthesis in Hydrilla sp. and or Elodea sp.

Overview

This lesson will reinforce general concepts of scientific activity such as: experimentation, investigation, scientific method. Students will participate in an inquiry oriented manner to:

1) Identify questions and concepts that will guide this investigation.

2) Help design and to conduct the investigation.

3) Use technology to improve investigation and communication.

This lesson will provide an activity that will address the larger topics of:

1) matter, energy and how living systems "reorganize" energy

2) the aquatic biosphere and how it relates to the natural interdependence of life

Sequencing

This lesson will be included in a unit that treats ecology. This lesson will occur after the sections which deal with biosphere and biomes and ecosystem structure. The students should have a knowledge of the interrelatedness of organisms within ecosystems as well as an understanding of life dependency upon abiotic factors. The sections which follows this will deal with populations and will reinforce the importance of abiotic factors (such as DO) as controlling agents of population growth. The actual laboratory investigation will follow extensive classroom (group activity) that will lead to the laboratory design. The groups will also have been exposed to filed experiences with an aquatic system. These activities will include collections and identification of aquatic macrophytes and habitat typing.

Objectives

1) The students will discuss why (DO) dissolved O_2 is important in aquatic ecosystems.

2) The students will define (BOD) and (COD).

3) The students will identify (DO) in aquatic ecosystems as an indicator of the "condition" of the habitat.

4) The students will develop and perform a laboratory investigation of DO in various light and temperature conditions with a specific vegetation.

5) The students will demonstrate proficiency in techniques dealing with titration, measurement, and taxonomy of aquatic plants.

Activity

The class will be divided into four groups, each assigned to one experimental aquarium. Each aquarium will be pre-set at a different temperature; approximately 40, 30, 20, 10 degrees Celsius for aquaria A, B, C, and D respectively. The plants collected would be previously acclimated to these temperatures. Plants will be sorted, and randomly placed in the incubation cores in each aquarium. The light level for each core will be achieved by wrapping cores in neutral density screening (affecting only light quantity not quality). The light levels for each core will be established and recorded in data sheets. Plant photosynthetic rate will be calculated from changes indissolved oxygen and are expressed on a plant biomes (as dry weight) basis.

Procedure:

1) The groups will sort plants and make dissolved oxygen measurements.

2) Place the plants in aquaria. Make sure the plant is in the light filed. Put cap assembly on core.

3) Turn on lights.

4) Record time and temperature.

5) Incubate plants for specified length of time (1-24 hours).

6) Label paper bags with aquarium and core number

7) The groups will make final DO measurements.

8) Record time and final temperature.

9) Turn off light.

10) Remove plants from cores and place in pre-labelled bags.

11) Place bags in drying area and allow plants to dry 24 hours.

12) Mass the dried plants and record mass in data table.

Notes:

1) The DO measurements will be done with a precalibrated DO meter.

2) Plants must be sorted to a uniform size and condition (subjective approximation). The plants within a given experiment must be of the same species.

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Analysis:

Students will be directed to text that will help them establish methods and calculations necessary to analyze their data. This will be a teacher supported group activity.

Presentations of data will be made by each group to include a written summary and graphical representations prepared for the overhead projector. (The data analysis will be demonstrated with graphical calculators.)

Materials

4 aquaria prepared for determinations of DO
dissolved oxygen meter or winkler titration reagents and apparatus
balance
drying apparatus
collection nets (for collections to be made in previous exercises)
DO bottles
overhead projector
graphing calculator
appropriate text material

Assessment

Learner outcomes will be assessed with the following tools:

1) Lab report that includes
   a) student qualitative analysis of data (conclusions)
   b) calculations of DO and photosynthetic rate
   c) summary of the experiment

2) Informal evaluation of group activity to identify desired learner behaviors during lab work (use checklist)

3) Subjective evaluation of group performance during presentation of laboratory analysis.

USING MICROSCOPES TO STUDY THE DIVERSITY OF POND MICROBIAL LIFE

Author: Renee-Claire M. Borne

Goal

The general purpose of this exercise is to broaden and enhance the students' awareness of the existence of organisms that are not easily seen in everyday life. This will help them to better understand and visualize the structure and appearance of animal and plant cells. Also, the tools and techniques needed to discover and examine these microorganisms will be explained, demonstrated, and experienced.

Overview

When students begin a unit in Life Science, they often are confronted with facts about cells; what they are, what is inside of them, how they reproduce, and the two basic types - animal and plant. What they most often do not receive is enough first-hand experience viewing living, working cells to relate what they have studied with what they have seen and know to be true. The students' environment is full of such cells, or microorganisms, which can readily be seen and examined, with the light microscope.

This activity is used as part of a lab rotation which is designed to introduce the students to the design and use of the light microscope, and also to demonstrate to the students the great diversity of microbial life within a freshwater pond ecosystem.

This lesson will incorporate the following Science Education Standards:

1) Initiating the lesson with questions about nature.

2) Actively engaging learners in the discovery of facts and the application of methods.

3) Use of a team approach.

4) Use of critical thinking to draw conclusions based upon observations made.

Context of the Lesson

This lab activity is used within a chapter which deals with cells and heredity. The other parts of the lab rotation will include research on hereditary traits such as twins and color blindness, a worksheet on mitosis and meiosis, and a lesson in the Multi-Media Lab on some related topic. The entire lab rotation takes four days to complete, with each student performing all four tasks. The lessons previous to this activity will have included vocabulary related to the topic, a discussion of mitosis and meiosis, plant and animal cell structure, and the role that genes play in heredity. The lessons following this exercise will deal with animal and plant diversity and adaptations through time.

Objectives

1) Students will know basic lab rules and requirements.

2) Students will know terminology associated with microscope use and basic cell structures.

3) Students will be able to use a basic light microscope to find and examine freshwater microorganisms.

4) Students will be able to recognize photosynthetic and non-photosynthetic organisms within a freshwater pond sample.

5) Students will have a greater understanding of, and appreciation for, the structure and function of certain one-celled organisms which exist in their environment.

6) Students will be able to apply this knowledge and experience to other plants and animals with which they are familiar.

Activities

Prior to this activity, the students will have been divided into four groups, each engaged in one aspect of lab rotation. Within each group, the students will work in pairs.

1. How to use a microscope: The teacher will provide a diagram of a light microscope, with all parts labeled. The teacher will then provide the students with microscopes and guide them through an introduction to the various parts and their uses. The teacher explains that, in order for something to be seen through the microscope, it must be translucent, which means that light is transmitted through it. The teacher then provides the students with prepared slides of plant and animal cells to demonstrate how very small objects are magnified by the different objectives.

2. Observing and comparing cells: The teacher will demonstrate how to make a slide using pond water which has been previously collected. This will include the use of a dropper or pipette to aspirate a small quantity of water and deposit one or two drops of water onto a clean, dry, glass slide. Next, the teacher will show the students how to scan several fields of view to locate and observe any organisms present, and to differentiate between the photosynthetic and non-photosynthetic types. The students will be instructed to observe any cell structures which can be seen. The students will then draw a representative cell of each type, label the diagrams, and write a brief description of what they observed, including a statement describing it as more plant- or animal-like. Each pair will prepare two slides, from two different water samples, and each person will be required to complete his/her own worksheet. However, they will be able to work as a team, and as a group, to help each other complete the tasks and to discuss their findings.

3. Discussion: The students will be directed in a discussion of their observations. Some topics could include basic cell structure, differences between photosynthetic and non-photosynthetic cells, differences that were apparent when they switched from 4x to 10x magnification, and anything else which the students may have discovered.

Materials

This list is based upon five pairs of students, plus one extra set for the teacher to use in demonstration.

6 light microscopes
2+ freshwater pond samples
Glass slides
6 droppers or pipettes
12 small paper cups
prepared worksheets
paper towels

Assessment

Assessment of student outcomes will take several forms. A short quiz will be administered to test the students knowledge of vocabulary, microscope parts, and cell structure. Students skills will be assessed by reviewing the worksheets which they will complete and turn in, and also by informal observations of the students during the lab activity and discussion period. Feedback will be provided to students in the form of a grade, including notes referring to areas of exceptional work or deficiencies.

PHOTOSYNTHESIS

Author: Ann Bowman

Goal

The unit of study in which this lesson is involved is the lesson of the concept of photosynthesis, its importance and process. Students will be introduced to the ideas of the factors that influence photosynthesis and man's contribution to those factors and the importance of the impact of man to his environment.

Overview

This lesson will orient high school students to the amount of oxygen that is produced by submerged aquatic plants and expose the students to the process of titration.

This lesson will link the teaching of science to the Science Education Standards in that it will include the methods of scientific discovery, which will include systematic observation, formulation of predictions, collection of data, analysis of that data, formulation of hypothesis, and the communication of that data/conclusions.

The lesson should reflect other important points that the students should utilize in effective teaching strategies. These inquiries will include:

1. Interest in nature as to oxygen production

2. Questions as to the processes of oxygen production.

3. Interest in group work.

4. Functioning in the process of group dynamics.

This lesson is structured to be carried out over a 6 day instructional time period. This will include a field trip to the local "wetlands" place to do the class collections. We intend to impart to the students the idea that water quality, species continuation, and environmental effects are crucially important and should in no way be ignored in any situation. While we are doing such activities, students will have the opportunity to practice such skills as measurement, mathematics, computation skills, thinking skills, communication skills, and observational skills. It is noted that the time devoted to this lesson is validated in view of such involvement.

Objectives

1. Students will know vocabulary necessary to understand and communicate photosynthetic processes and importance.

2. Students will demonstrate the knowledge of the basic photosynthetic formula.

3. Students will understand key concepts and principles in the process of photosynthesis.

4. Students will demonstrate proper water sample taking techniques.

5. Students will demonstrate proper titration techniques.

6. Students will apply results of the Winkler titration technique to oxygen production.

7. Students will draw inferences from the different data collected from the different groups' results.

8. Students will be able to apply results to different situations and their causes.

9. Students will be able to effectively communicate findings from oxygen production analyses.

Activities

Day 1:

Introduction to the importance of green plants. Demonstrate the necessity of oxygen in the functioning of cells/living things. Demonstrate the interaction of green plants and the respiration of living organisms. Introduce the basic formula of photosynthesis. Indicate the importance of water in that reaction, the importance of light, the place in plants where photosynthesis takes place, and the contribution of green plants.

Day 2:

Fill each of the BOD bottles by proper procedure. Place 3 light and 3 dark bottles on designated pole in lake, depending on the specifications for the specific group. Return to classroom and perform Winkler titration on the control light bottle.

Day 3:

Retrieve BOD bottles, return to classroom. Perform proper titration necessary to determine oxygen content of sample.

Day 4:

Comprise a class-wide table of oxygen values. Determine ramifications as to differences in values. Draw conclusions as to pertinent information as to oxygen/respiration processes.

Day 5:

Indicate the importance of photosynthesis; hence green plants, environmental concerns and global importance.

Day 6:

Exercise in recall.

Materials

BOD bottles (7 per group)
Water sample apparatus (1 per group)
Winkler titration apparatus (1 per group)
Materials/chemicals necessary for titration.

Assessment

Assessment of the lesson will depend on each individual involvement and outcome of the activity. Lab report sheets will be collected and graded. Personal involvement will be noted and scored. Skills will be assessed by informal observation and questioning. The students' ability to draw conclusions and their ability to communicate their findings will be assessed by required class presentations by each group. A short exercise in recall will be prepared to quiz students on their knowledge of basic vocabulary and processes.

DISSOLVED OXYGEN TEST

Author: Darlene Doiron

Goal

This lesson is related to the larger topic pertaining to Ecosystems. Before this lesson, students will have viewed such materials as The Twilight Estuary and Laboratory of Life. Students will also have used the classroom version of the Science Toolkit-Master Module (for Apple). The slide series on local water bodies will also have been shown and discussed. Necessary terms will have been introduced immediately preceding this lesson. Follow-up activities leading to a community action proposal could be included after this particular lesson, based on topics arising from discussions with local naturalist Jim Foret and local environmentalist Wilma Subra.

Overview

The lesson introduces 10th grade Biology students to a technique for measuring dissolved oxygen, which is essential for maintaining healthy lakes and rivers.

The Science Education Standards call for teaching methods that include methods of scientific inquiry. Students will be called on to make systematic observations, collect and analyze data and present interpretations of this data. This lesson on dissolved oxygen draws on fundamental questions about nature. Students perform tests to collect data. Working in teams, they will present evidence as to the presence or absence of oxygen, which can indicate levels of pollution.

The lesson can be linked to the Science Education standards in that students use scientific methods to gather data concerning a real world problem, water pollution.

The lesson is to be done over a five-day instructional period. The students will sample water from Bayou Teche and "Devil's Pond" in the New Iberia City Park.

This lesson plan falls under the heading of Ecosystems, which is covered in Biology and is explored in greater detail when the students take Environmental Science later as juniors. Terminology and concepts dealing with ecosystems will be explored during the unit, which will last approximately 4 weeks.

Evaluation for this segment will consist of approximately 25 items measuring knowledge and comprehension using multiple-choice, matching and short answer questions.

Objectives

1) Students will know basic terminology associated with water quality and procedures for testing water quality.

2) Students will be able to perform water quality tests

3) Students will be able to make inferences about the pollution of samples by analyzing data

4) Students will be able to present findings from the tests.

Activities

Day 1:

Overview of importance of dissolved oxygen in healthy ponds and bayous. Discussion of significance of local bodies of water in overall picture of Louisiana life. Students will receive handout from field manual for water quality monitoring.

Day 2:

Students conduct dissolved oxygen tests. Some groups collect from Bayou Teche near City Park while others collect from "Devil's Pond" in City Park.

Day 3:

Groups work to compile lab report, interpret data, assess relative "health" of Bayou Teche and "Devil's Pond" in terms of dissolved oxygen levels.

Day 4:

Groups present their findings to the class. It is possible that park superintendent and naturalist Jim Foret could share the story of how "Devil's Pond" was restored through a recent community project. He could help students to develop an ongoing plan of continuing stewardship of the pond and surrounding park.

Day 5:

Brief assessment of lesson objectives using 25-item quiz based on lesson objectives.

Materials

May use Hach test kit from school or may borrow materials offered from
USL Biology Department during Summer Science Teacher Enhancement Institute.
Materials Include:

Bottle with stopper
Dissolved Oxygen Reagent pillow #1 (manganous sulfate powder)
Dissolved Oxygen Reagent pillow #2 (alkaline iodide azide powder)
Sodium Thiosulfate
Mixing bottle
Clippers
Dropper
Measuring tube, graduate cylinder
Dissolved Oxygen Pillow #3 (sulfamic acid powder)
Instructions for these tests are found in the individual test kits or may be followed from the Field Manual for Water Quality Monitoring, pages 27-33.

Assessment

Assessment of the learning outcomes will be based on the objectives specified in the lesson plan. A short quiz consisting of approximately 25 items will be used to test the students on their knowledge of terminology and concepts. An additional (or alternate) assessment would come in the form of a student presentation of lab results. The students could extend the assessment by submitting a proposal for community action based on their findings. The community action could be as simple as a letter to the commission operating the Teche locks or to the City Park authorities.

APPLYING AQUATIC DATA TO PRACTICAL PROBLEMS

Author: Glenn M. Fontenot

Goal

The purpose of this lesson is to help 10th grade biology students obtain the necessary knowledge and skills to interpret and apply aquatic data to practical problems.

Overview

This Lesson:

This lesson uses some of the principles of the National Science Education Standards. It is designed to get the students involved with the concept of scientific inquiry. The science concepts such as the diversity of organisms, the organization of living systems, the evolution of living systems, and biosphere and interdependence are addressed. This lesson also links to the SCIENCE and SOCIETAL CHALLENGES, by involving natural resources, environmental degradation, and natural and human-induced hazards.

This lesson is designed to be carried out over a five-day period including a field trip to a nearby pond or stream.

The Unit:

This unit is concerned with the simplest eukaryotic organisms, their structure, their reproductive capabilities, energy procurement, and ecological and economic significance. Within this unit, the students will have completed the following: review previous material necessary to help reinforce the new material, and view material such as POND LIFE DIVERSITY. The previous lesson will have introduced the students to Protozoa (the largest group of Protists). The following lesson will deal with water quality which will help to extend the concepts and skills learned in this lesson and previous lessons.

Objectives

1) The students will know the main characteristics used to classify algae.

2) The students will be able to evaluate an experiment by analyzing data.

3) Using reference books, the students will be able to identify and classify algae.

4) The students will be able to effectively communicate findings from an experiment.

Activities

Day 1:

An overview of algae - Unlike most Protists, algae are autotrophic organisms.

Focusing questions for lecture - What are the main characteristics of all algae? What are the habitats of algae? In what ways are algae and protozoa alike? In what ways are algae and protozoa different? What are the main characteristics used to classify algae? Summarize the economic importance of algae. Toward the end of the class period, a class discussion will be conducted in order to informally measure what has been learned. Students will be assigned home-learning material that will help to reinforce the lesson.

Day 2:

Kinds of algae - The teacher will write the five phyla of algae on the board and have the students help in pronouncing each scientific name. The teacher will then explain how each phylum differs from the other phyla.

Focusing questions for lecture - What are the differences between diatoms and dinoflagellates? How does Spirogyra reproduce asexually and sexually? Summarize the alternation of generations in Ulva and contrast the structure and habitat of a typical brown algae with those of a typical red algae. A general discussion will be used to informally measure what the students have learned. Home-learning material will be assigned in order to reinforce the lesson. The last activity of this class period will be the selection of teams of four to five students to work together on the following day's lab activity.

Day 3:

At the beginning of the class period, the students will get into their assigned group and station. The purpose of this activity is to compare several species of algae, classify information, compare data, and evaluate the experiment. As the groups organize themselves, the teacher will give each group an instruction sheet with a comparison chart.

1. Examine each species of algae that your teacher gives you and complete the chart.

COMPARISON of SPECIES of ALGAE

Name of Phylum	Sketch	Relative Size	Distinctive Features

2. Observe one kind of algae without using any magnification. List the characteristics and structures that you observe, such as color and whether it has broad leaves, long filaments, and single cells or many cells.

3. Observe your specimen using the stereomicroscope. What additional details can you observe?

4. Rip off a small piece of the specimen and make a wet mount of it. Use a compound microscope to observe the specimen under both low and high power. What additional details can you see?

5. Repeat steps 2, 3, and 4 for each species of algae. Complete the chart as you make your observations.

Analyses and Conclusions

1. Classifying Information What characteristics do each of the species of algae that you observed have in common?

2. Comparing Data In what ways are the species of algae different?

3. Evaluating Experiments Algae contain pigments that allow them to carry out photosynthesis. Protozoa cannot photosynthesize. Describe the differences in the culture media you would use to grow protozoa and algae.

<u>Day 4</u>:

During the first thirty minutes of the class period, each group will make a five minute presentation of their experiment to the class explaining how they derived their findings. The groups will be encouraged to use the classroom computer and/or overhead projector system to make their presentation. The class will be permitted to ask questions related to the group's testing procedures and their findings. Preparation for the filed trip will include a brief lesson on the proper use of the equipment, and safety measures pertaining to both the use of the equipment and the field trip will be stressed.

<u>Day 5</u>:

The field trip will be to a local pond or stream. The students will collect samples and store them properly and take them back to the lab at school. The students will make wet mounts of the specimens collected and observe them under a microscope. Using reference books, the students will classify each specimen of algae identified into the proper phylum. The students will be asked to explain the relationship between the type and number of algae present in a pond and the ecological health of the pond.

Materials

Cultures of species of algae	Compound light microscopes	2 pair of scissors
Stereomicroscopes	Comparison charts	1 pair of waders
5 medicine droppers	1 sample net with 35 micron "screen" cloth	Reference Books
1 box of slides	3 five-gallon buckets (with lids)	
1 box of coverslips	1 box of sample bags (ziplocks)	

Assessment

Assessment of the lesson outcomes will be in three parts. The first part will be objective and will consist of 50 multiple choice questions used to measure knowledge and comprehension level. The second part will include the reviewing of the results obtained in the lab reports along with observations of the students during the lab periods. This will be used to measure the student's skills. The student's ability to draw inference and to communicate will be based on the presentation during class. This will be the third part of the assessment. The students will also be given the opportunity to work on any deficiencies.

PROTISTS IN OUR WORLD

Author: Steven J. Gilbert

Goal

The lesson will introduce the phyla of protozoa to students through hands-on activities. The students will use the scientific method and inquiry to study protozoa. This lesson addresses science concepts and theories related to living systems and environmental systems.

This lesson will incorporate the following Science Education Standards:

1) Use a team approach.

2) Initiating the lesson with questions about nature.

3) Use of critical thinking to draw conclusions based upon observations made.

4) Actively engaging learners in the discovery of facts and the application of methods.

Objectives

Day 1:

1) The student will explain, using the Endosymbiotic and Direct Filiation theories, how protists may have evolved.

2) The student will list the four phyla of protozoa.

3) The student will compare and contrast the methods of movement found in the four phyla of protozoas.

Day 2:

1) The student will list and identify the characteristics of six divisions of algae.

Day 3:

Content: The student will locate, identify, and classify protozoan organisms.

Process:

1) The student will develop skill in using the microscope.

2) The student will develop skill in observation.

3) The student will develop skill in classification.

Activities

Day 1:

1) As a motivational device, place a glass of tap water and a glass of pond water next to each other and ask students "Which is more appealing to during? Why?" Students should select the tap water and point to the appearance of the pond water as the reason. Then place the Leeuwenhoek quotation (see following page) on overhead and make some general "interest generating" comments.

2) Tell students "Today we are going to examine how protists may have evolved, learn about their classification and characteristics, and see what some of them look like". Objectives may be placed on board if desired.

3) Provide students with handout on endosymbiosis and direct filiation hypotheses and discuss.

4) Divide class into 6 groups of 4 to go to the lab. The students will observe slides of protozoa, and algae. The students will compare and contrast traits. The students will observe 4 types of protozoa and describe (20 minutes).

5) Using the students' lab reports, ask questions. Introduce transparencies 31 and 32. Discuss characteristics students observed.

6) Closure - assignment for students, "Where can you find these specimens?"

Day 2:

1) Reintroduce protozoa from previous day by looking and discussing transparency 33.

2) Inform students that they will have some time to observe specimens using video. Use tape made by Dr. Felgenhauer to show various examples. Remind students to take notes on video. Stop tape where appropriate to point out specific items or structural parts which are not part of the commentary and may be of interest in students.

3) Closure - assignment: Each student, if possible, bring in a sample of pond water for tomorrow, be sure the sample is labeled with location, time and day.

Materials

Microscope for each lab group
Pond water which the students brought
Slides and cover slips
Identification chart, see page 36

Teacher Notes

It is important to tell the students that they are not expected to see all of the organisms which were shown in the tape. The lab evaluation is based on the accuracy of observation and not the variety of organisms which are found.

Pre-Lab Discussion

1) Tell students they are going to be biological explorers and see which organisms they can find.

2) Demonstrate how to make a wet mount and review proper procedures when using a microscope, including the need for a low power objective lens as a first view, followed by higher power when a specific organism has been located.

3) Ask the students what type of hypothesis they could form for this type of activity. Students may not think this is possible, but some guidance should have them conclude that one can always hypothesize what organisms would be found in a particular area. Encourage them to make an hypothesis based on what they learned so far.

4) Ask students what type of data would be required. Eventually suggest that a sketch of what they see, not a copy of the identification sheet, is important. Suggest that a written description for each is also important and should be included.

5) Let students know you will circulate during the lab time and you expect each team to show you, through the microscope, an organism which they have isolated. Tell them they will be expected to identify and classify the organism.

Post-Lab

1) Compile, on the board, a list of all organism located and place a tally mark to indicate frequency. Discuss why some are not found, some are found frequently.

2) Discuss the questions from the lab report.

Suggested Evaluation

General lab technique and safety	10%
Showing and identifying organisms during walk around	20%
Constructing an hypothesis	10%
Descriptions and diagrams of specimens	30%
Conclusion based on observations	10%
Questions	20%

TEMPERATURE, DISSOLVED OXYGEN AND THE GROWTH OF MICROBES IN A FRESHWATER POND

Author: Linda Harper

Goal

The purpose of this lesson is to explore the relationships between the temperature of a pond and the dissolved oxygen content, and the temperature of a pond and the growth of microbes.

Overview

This lesson occurs over a time and uses a variety of teaching and learning strategies. Scientific inquiry is used as the basic method of investigation. The lesson employs the use of mathematical principles such as graphing and extrapolation. It also makes use of technology with such items as a graphing calculator for graphs and predictions. The lesson addresses societal concerns, such as human impact on fresh water aquatic systems, as a possible variable. The content addresses scientific concepts and principles related to the organization and interdependence of living ecosystems, their natural progressions, and the impact of human development on them. The lesson employs cooperative learning. It is structured so that students work in defined groups of 3 to 4 with a leader, recorder and at least one person in charge of carrying out experiments.

This instructional unit will occur in the spring of the year when the temperature variation is the greatest. The data will be collected weekly over a period of three months. The lesson builds upon the knowledge of the progression and interdependence that was previously taught. At this time the use of grahing calculators has already been employed to study exponential and linear population growth. It will be reviewed and employed again for this project. This will be taught concurrently with a unit on Louisiana's coastal wetlands and will be the more extensive of several experiments taking place at this time. This lesson helps tie up the year, but there is follow-up. More work on aquatic ecosystems is done the following year in Biology. The curriculum has been developed so that extension from one year to the next is possible.

Objectives

1) Students will understand principles and concepts of the interaction of temperature, dissolved oxygen and the growth of microbes in a freshwater aquatic system.

2) Students will employ water testing procedures, mathematical principles, and work with light microscopes to analyze data.

3) Students will draw well-grounded inferences from the analysis of their data and make predictions.

4) Students will effectively communicate their findings in an organized format.

Activities

Students will collect data, analyze data and communicate their findings. They will draw the appropriate graphs, work with a dissolved oxygen kit, a thermometer and a light microscope.

Instructional Resources

Instructional resources include teacher made worksheets, data sheets and questions, light microscopes, dissolved oxygen kits, graphing calculators and computer data.

Assessment Strategies

Students will prepare an ongoing portfolio of their findings. They will also journal thier findings about their project on a weekly basis. Assessment will be made on the basis of observation, evaluation of the portfolio and the journal, data sheet and worksheets, and a Laboratory Report. Questions referring to this project will also be included on a chapter exam on Louisinaa's Coastal Wetlands.

Procedure

Students will take 12 one liter water samples from a nearby pond, one per week, during the spring. At this time, they will also take the temperature of the water. They will retrieve their sample from the same spot each week, near the edge of the pond, directly below the surface. Students will find the dissolved oxygen content of the water. They will prepare a wet slide and a microbe count of the diatoms from each sample. If students do not know how to prepare a wet slide or use a light microscope, these procedures will need to be taught prior to this lesson. After 12 readings have been collected and recorded, students will work together to prepare a labortory report.

Day 1:

Data is placed on the board. Each group will place 12 readings of temperature, dissolved oxygen and microbe count on the board. Students will consolidate their material, average the data and make two graphs of each of the following (a graph for their specific data and a graph of the class's data) temperature Vs D.O. and temperature Vs microbe growth.

Day 2:

At this time a short lesson on linear and exponential graphing may be necessary, (in the form $y = mx + b$ and $y = x^2$). Included are two worksheets for graphing linear and exponential equations on a graphing calculator with appropriate questions to show what happens when:

a. the y-intercept is changed
b. the slope changes
c. the slopes of two linear equations are either parallel or perpendicular
d. the exponent of a exponential equation is doubled, tripled or halved.

Day 3:

Students will examine their graphs within their respective groups and determine what type of growth their graphs show. They will then prepare their Laboratory Worksheet.

Vocabulary

Exponential growth
Linear growth
Diatoms
Dissolved Oxygen
Biological Oxygen Demand
Postive or negative growth
Algae

Laboratory Report

Leader:______________________________
Recorder:_____________________________
Experimenter:__________________________
Other:________________________________

1. Write the equation of each graph from your data sheet and describe it in terms of linear, exponential, positive or negative growth.

    a. Graph A your group.

    b. Graph A the class.

    c. Graph B your group.

    d. Graph B the class.

2. As the temperature increases in the spring, what happens to:

    a. the growth of the microbes?

    b. the dissolved oxygen content?

3. In essay form, explain how the growth of algae and the amount of dissolved oxygen are related to the temperature of a freshwater aquatic system. What was the chain of events that occurred over the three month period that you recorded?

Take it one step further:

4. Was your section of the pond receiving more or less sunlight as the spring progressed? If so, could this have affected your results? How so?

Take it two steps further:

5. What other factors that have not been previously considered could have affected the outcome of your experiment? If so, what might these effects have been?

Data Sheet for pond readings

Leader:________________________
Recorder:________________________
Experimenter:________________________
Other:________________________

Date	Time	Temperature-C	Microbes	D.O.
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Data Sheet: Graphs Leader:______________________________

Group Graph of Temperature Vs D.O.

Class Graph of Temperature Vs D.O.

Group Graph of Temperature Vs Microbe Count

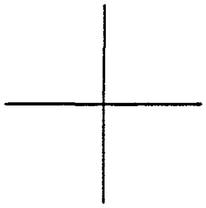
Class Graph of Temperature Vs Microbe Count

Name________________________________

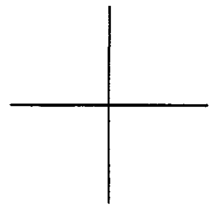
Graphing Equations in the form y=mx+b.

Graph the following equations on a graphing calculator. Draw an approximation of each graph on the graph to the right.

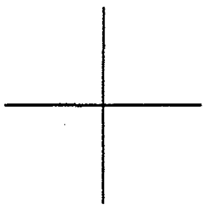
1. $y = 3x+2$



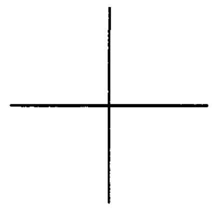
2. $y = 3x-2$



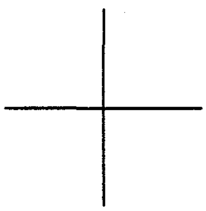
3. $y = 3x$



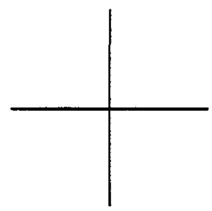
4. $y = -3x+2$



5. $y = -3x$



6. $y = x/3 + 2$



7. Compare graphs 1, 2 and 3. What happens when the value for b changes? How does a change in b affect the graph?

8. Compare graphs 2, 4 and 6. What happens when the value for m changes? What exactly does m describe?

9. Describe what happens to the line when you change a graph from $y = x/5 + 2$ to $y = 5x + 2$?

10. Describe what happens to your line when the graph is changed from $y = x + 2$ to $y = x - 2$.

11. Explain what the values of m and b describe in the equation $y = mx + b$.

Name______________________________

Graphing exponential equations

Set the limits on your calculator at y min = 0, y max = 20, x min = 0, and x max = 20. Graph the following equations on your graphing calculator. Draw an approximation in the space provided.

1. $y = x^2$

2. $y = x^4$

3. $y = 2x^2$

4. $y = x^{1/2}$

5. $y = 2x^{1/2}$

6. Describe how making the exponent larger or smaller affects the graph.

7. Describe how doubling the value of x affects the graph.

Name______________________________

Graphing exponential equations

Problem #1: There are 2 cockroaches in your closet. Every day 2 more cockroaches appear. How many cockroaches will there be after 20 days? ________ Make a chart of days to the number of cockroaches and graph the data.

Day	# Cockroaches	Day	# Cockroaches
0	2	11	
1		12	
2		13	
3		14	
4		15	
5		16	
6		17	
7		18	
8		19	
9		20	
10			

Graph:

Problem #2: There are 2 cockroaches in your closet. Every day they double. How many cockroaches are there after 20 days? ________ Make a chart of the days and the number of cockroaches and graph the data.

Day	# Cockroaches	Day	# Cockroaches
0	2	11	
1		12	
2		13	
3		14	
4		15	
5		16	
6		17	
7		18	
8		19	
9		20	
10			

Graph:

CALCULATING COMMUNITY METABOLISM IN A FRESH-WATER SYSTEM

Author: Amanda Harris

Goal

To calculate and graph community metabolism by monitoring fluctuations in dissolved oxygen concentrations in Vermilion Bayou.

Overview

The following activity will introduce students to the calculation of community metabolism by the diel oxygen data method. The focus is to promote scientific inquiry and the logical interpretation of data.

Objectives

1. Students will know key terminology associated with community metabolism testing procedures.

2. Describe how to use the diel oxygen method as a tool for estimating the community metabolism.

3. Using logic and evidence students will construct a graphic model.

4. Students will demonstrate how to gather, analyze, and interpret data employing simple equipment.

Activities

1. After separating into groups of three, each group will fix a BOD bottle for the initial (I) DO concentration. The dissolved oxygen (DO) titration will be performed on a sample taken at 6 p.m. to be recorded on the data sheet. The second DO sample will be taken at 6 a.m. the following morning by the teacher. The third sample will be taken at 6 p.m. on the second day.

2. Each group will fill the bottle by proper procedure. NOTE: Ensure that the water sample is to the top of the BOD bottle before closing as not to get an air bubble. Return the BOD bottle back to the lab for initial (I) value determination of dissolved oxygen.

3. Dissolved oxygen procedure

- Add the contents of pillow #1 (manganous sulfate powder) and pillow #2 (alkaline iodide azide powder) to the DO bottle.

- Insert stopper, making sure no air is trapped inside, and shake vigorously to mix. BE careful not to splash the chemical laden water. If oxygen is present in the sample, a brownish-orange precipitate will form (FLOC). If air bubbles form after the first shake, discard the test and begin again.

- Allow the sample to stand until the precipitate settles halfway. When the top half of the sample turns clear, shake again, and wait for the same changes.

- Add pillow #3 (sulfamic acid powder) to sample, and shake. The precipitate will dissolve and the water will turn yellow.

- Pour sample to the top of the mixing tube; pour the contents of the mixing tube into the square mixing bottle. Do this one more time.

- Add 1 drop of titrate (PAO) to the square mixing bottle and swirl. Be careful to hold the dropper straight up and down above the bottle.

- While swirling the sample to mix, continue adding PAO titrate to the prepared sample one drop at a time. Count the number of drops needed to change the solution from a blue to a clear solution. Hold the bottle against white paper to see color change accurately. Each drop equals 0.5 mg/l of dissolved oxygen.

NOTE: Values of samples taken are recorded on the spread sheet provided below and should be listed on the blackboard. (So we can determine the class mean value)

4. With information from the data sheets calculate the mean values to determine the p/r value of the water system. To determine the p/r value you must first derive a community metabolism graph by using the diel method. If the p/r value calculated is greater than 1 the system is autotrophic. If the value is less than one the system is heterotrophic.

GROUP	INITIAL (DO AT 6PM)	6AM	6PM (24 HR. LATER)
1	________	________	________
2	________	(SAMPLE	________
3	________	TAKEN BY	________
4	________	TEACHER)	________
5	________	________	________
6	________	________	________
7	________	________	________

Community Metabolism Equipment

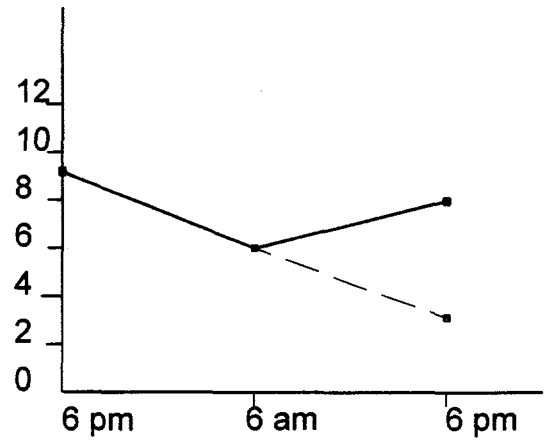
(Initial) late afternoon O_2, sample taken at 6 p.m.
Mean = _________mg/L

Early Morning O_2, sample taken by teacher at 6 a.m.
Mean = _________mg/L

(Final) afternoon O_2, sample taken at 6 p.m., the following day
Mean = _________mg/L

Calculations

The three values obtained are plotted as mg/L against time. A solid line for evening is drawn from the afternoon value to the following sunrise value. And then extrapolated down as a broken line for the 24 hr. period to represent total decline in oxygen content due to respiration. A solid line is drawn from the dawn value to the second afternoon value and extended to a point equivalent o 24 hr. after the value. The difference at the 24 hr. between the top and bottom line is gross community photosynthesis as milligrams per liter of oxygen. The difference between the first and succeeding 24 hr. value of the respiration slope is the total community respiration as mg/L of O. An example of diel oxygen data is shown at right.



Re: diagram.

At 6 p.m. the DO concentration at one station and depth was 9.m/L. AT 6 a.m. the DO had declined to 6.m/L. At 6 p.m. the second day the DO concentration increased to 8 mg/L. The broken line is representative of the night respiration slope. Total community respiration = m/L-m/L=m/L. Gross community photosynthesis = 8mg/L-3mg/L=5mg/L. The ratio of photosynthesis to respiration (p/r) = 0.83.

* If TI-82 calculators are available the p/r value will be graphed.

Tying it all together

The numbers derived from the experiment correspond to the high and low concentration of oxygen found in the water at a given time during the day. The community oxygen concentrations rise during the day but reach a rather steady level in the late afternoon. The afternoon sampling should occur during this plateau. A sample taken an hour before sunset is bets. This reading will represent the productivity or the photosynthetic reactions that are taking place by the autotrophic community. The early morning DO reading should be considerably smaller due to the oxygen being used in the respiration process during the night. However, upward changes in concentration occur rapidly as soon as light becomes available. Students should be able to explain the experiment in regard to the following equation:

$$6H_2O + 6CO_2 + \text{light} \text{ ---- } 6C_6H_{12}O_6 + 6O_2$$

Materials

2 BOD bottles
Carry bucket
Graduated cylinder
Dropper
Sodium thiosulfate
Pillow #1 manganous sulfate
Pillow #2 alkaline iodide azide
Pillow #3 sulfamic acid
square mixing bottle

Assessment

In a science class assessment should focus on the collection of data and the inferences drawn from the collected information. This would be assessed through the completion of a group lab report and a discussion of the conclusions drawn by the class. This information will also be recorded in their personal journal. And as always, there will be assessment by testing.

Connection with Science Education Standards

In order to reflect the methods of scientific inquiry the lesson would begin with questions to stimulate critical and creative thinking. Have them develop an hypothesis or make some predictions f the outcome. Students should work in groups. This technique encourages. In the collection of data students make notes regarding the smells, thoughts, images, and tactile sensations experienced at the bayou. How these sensations are processed will play a role in their decision making procedure. Also, through this cooperative effort the students will develop interpersonal and communication skills that they will need later in the work force. This lab encourages the integration of ecology, aquatic biology and water chemistry. The derived model at the end incorporates mathematical concepts and measurement skills. The focus is to create new ways of thinking about ourselves and how we relate to other life forms on the planet.

DETERMINING DISSOLVED OXYGEN BY TITRATION

Author: Tab Harris

Overview

The students will discover how dissolved oxygen is essential for maintaining healthy lakes and rivers. There is a balance between the need for oxygen by organisms and the rate at which plants produce oxygen that must be understood. The students will earn how to perform titrations and evaluate the results in relation to the ecosystem.

Objectives

The students should be able to:

1) Develop skills in titration and establish a data table.

2) Develop skills in titration and forming a conclusion.

3) Describe and utilize the Winkler method for determining dissolved oxygen.

Activities

Day 1:

Analysis for dissolved oxygen in tap water will be conducted. There will be a discussion of what dissolved oxygen is. The students will use this activity to become familiarized with the lab equipment. Students will be given a handout on the titration method to complete. Students will be asked to collect samples of water near their house to be analyzed.

Day 2:

Students will set up incubation of BOD bottles under a fluorescent light source for 24 hours. The previous day's handout will be discussed. The lab procedure will be distributed and discussed. Students will be placed in groups and informed on how they will be graded for the activity.

Day 3:

The students will get into their assigned lab groups and perform the lab procedure.

1) Dissolved oxygen in water samples will react with the chemicals and produce iodine. The amount of iodine is proportional to the amount of oxygen in the sample.

2) Uncap bottle a and b and remove water carefully, trying not to agitate the water.

3) Use a 1ml pipette to add 0.5ml of manganous sulfate solution to each bottle. Rinse the pipette thoroughly with water. Use a 2ml pipette to add 1.5ml of potassium hydroxide-potassium iodide solution to each bottle. Cap the bottles and then shake them to mix the solutions.

4) Uncap each bottle and use the 1ml pipette to add 0.5ml of sulfuric acid to each bottle. Your samples should now be brown in color. This indicates the presence of iodine in the solution.

5) An indication of the amount of iodine in the water in each bottle can be made by using sodium thiosulfate solution. The sodium thiosulfate reacts with iodine and removes it from the solution making the solution colorless. Use a clean dropper to add thiosulfate solution to each bottle. Count the number of drops required to make each sample colorless. Record all observations. What does this test tell about the amount of dissolved oxygen?

Day 4:

The class will discuss the results (collected data). Each group will complete a checklist to rate their performance. The students will take an objective test on the significance of dissolved oxygen and the titration method.

Materials

2 300ml glass stoppered BOD bottles
Pond water in an aquarium
Manganous sulfate solution
Alkaline azide reagent
Sulfuric acid
Sodium thiosulfate
Potassium hydroxide-potassium iodide solution
Medicine dropper
1ml bulb pipette
2ml bulb pipette

Assessment

The students will assess themselves by a checklist completed by both the members of the group and the teacher. The students will take an objective test. The students will also answer the following questions upon completion of the lab:

1) Why does the oxygen content of the 2 samples differ?

2) How do the 2 samples of water differ in the way they affect the environment?

3) Why is it necessary to use 2 bottles, one placed in the dark and one placed in the light, to draw valid conclusions from this investigation?

A Study of Water Quality in Black Lake, Campti, Louisiana, Lakeview High School, Chemistry and Environmental Science Joint Project

Author: Sharon Haser

Overview

The lesson involves junior and senior level chemistry and environmental science students working together to conduct several water quality tests on a local freshwater system, assimilating the results into quantified data sets and using the information to draw conclusions about possible causes and implications. In addition the students will be implementing peer teaching skills that will allow them to broaden their project's impact into the community later.

The students will engage in an extended investigation using scientific inquiry as the National Science Education standards suggest is crucial to productive learning in science courses. The project will be designed by the students to help them further understand methods of scientific data collection, interpretation and its application.

The project will be done in no less than one week's time allowing extra days if the students feel it is necessary to gain a clear understanding of the results. Approximately 40 students will participate in the project from two classes that meet simultaneously therefore two adjacent laboratory facilities will be used. Two instructors one from chemistry and environmental science respectively will teach the lesson. The project will take place in the late spring so that the students will have at least a general understanding of the topics of the project (perhaps separately) as they relate to their respective course work. Grouping students for the project will be cross disciplinary. One of the major goals of the project is to bring applications from chemistry and environmental science together since students at this school generally take on or the other of these courses but seldom both.

Objectives

1) Students will develop a plan for testing water quality.

2) Students will collect data and apply testing procedures relevant to water quality.

3) Students will draw conclusions based on the analysis of water quality data.

4) Students will communicate their conclusions to one another in order to gain a better appreciation for the expertise of fellow classmates in their respective areas.

5) Students will formulate ideas about the importance of good water quality in the community.

Activities

Day 1:

Discussion of the relevance and importance of the problem to be investigated, student planning of procedures involved, with attention paid to cross disciplinary grouping, time constraints and logistics, group research to verify planning strategies and formulate hypotheses.

Day 2:

Field trip for collection of samples.

Day 3 & 4:

Laboratory testing of samples; dissolved oxygen, fecal coliform, pH, temperature, total phosphate, nitrates, turbidity, total solids, and biochemical oxygen demand.

Day 5:

Analysis and interpretation of data, research implications.

Day 6:

Group presentations of results and implications.

Day 7:

Individual, group and self-evaluation of content, procedures and community applications.

Materials

Print: Chemistry text, Environmental Science text, Field Manual for Water Quality Monitoring, any other material available in the classrooms or school library the students choose to use.

Manipulatives: Graphing calculators, any available equipment for presentations

Laboratory supplies:

DO bottles with stoppers	Barometer
Gloves	Manganous sulfate powder
Alkalineiodide azide powder	Sulfamic acid powder
PAO titrate	Starch
Alcohol forceps	Absorbent pads
Petri dishes	Ampule
Filtration system	Pipettes
Syringe	Sterile filters
Wide range ph indicator	Hack pH test kit
Thermometers	50ml Erlenmeyer flasks
Sulfuric acid	Sodium hydroxide
Demineralized water	Clippers
Test tube holders	Droppers
Color comparator	Potassium persulfate
Phos ver 3 phosphate reagent	Nitraver6 nitrate reagent
Nitraver3 nitrite reagent	Turbidity meter
Balance	Beakers

Assessment

A brief objective assessment based on the lesson objective will be given to each student, group assessment will include teacher observations from a checklist of expectations and validity of results, also each student will write a subjective evaluation of the project's outcome and the possible impact on the community.

THE EFFECTS OF SALTWATER INTRUSION ON COASTAL WETLANDS

Author: Michael Lavergne

Goal

To make students aware of the effects of saltwater intrusion on coastal wetlands and its effects on plants.

Overview

This lesson is consistent with the nature of scientific inquiry in that it uses a lab which uses the scientific method to get results, the students are actively engaged, the students collect data over a period of weeks, they work in groups using the team approach and the lesson does not require them to memorize a large technical vocabulary.

This lesson should be used after a lesson on coastal erosion so they know the importance of plants to the stabilization of the wetlands. This could be followed by lessons and labs dealing with other factors effecting plants in the wetlands (turbidity of the water and its effect on photosynthesis, or factors effecting oxygen content of a wetlands area).

Objectives

1) The learner will describe the effects of saltwater intrusion on a fresh water environment.

2) The student will explain the effect of saltwater intrusion on the erosion of coastal wetlands.

3) The student will list the major causes of coastal land loss due to saltwater intrusion.

Lab objectives

1) The learner will develop skills in setting up and using a data table.

2) The learner will formulate and test a hypothesis.

3) The learner will form a conclusion based on data collected.

4) The learner will use correct scientific method to form a conclusion.

Activities

1) Begin by discussing what a wetlands area is and the decline of the wetlands especially along the coast of Louisiana. Discuss briefly the effect of global warming on sea level and how that might impact wetland loss.

2) Discuss saltwater and freshwater environments and how they differ with regards to plants.

3) Briefly describe the process of osmosis as it applies to some daily events they may be familiar with. (ex. saline solution instead of fresh water for contact lenses.)

4) Discuss how osmosis is used by plants to obtain water, and how an excess of salt can force water out of a plant rather than into a plant.

5) Ask students what would happen to the cells of their own bodies if they were given fresh water intravenously. This could lead into a summary discussion of the effect of salt water intrusion on fresh water plants. A few examples of the amount of life supported by these fresh water plants could be used as a closure for the lesson.

Lab:

1) Explain to the students that they should have an understanding of the effects of salt water on plants but in this lab they will get to see the results first hand.

2) At this point students should have an idea of the importance of wetlands plants. Students should be led in a discussion ending with a lab topic, namely "how much salt water is harmful, how long does it take to kill the plant, and do all plants react the same".

3) Ask students how we could answer these questions. They should end up with testing a single species of plant and using fresh water and salt water of varying concentrations.

4) Ask students to determine a measurable factor to determine the effects of salt water on the plants. A good one would be growth.

5) Here students should put these ideas together to come up with an experiment in which plant growth is compared using several plants in varying concentrations of water over a long period.

6) Each group will then be given 3 minutes to come up with a hypothesis on the effect of the salt water on the plant.

7) Students should be led to develop the following procedures:

   a. Place each plant in a separate container
   b. Measure each plants height at regular intervals
   c. Water each plant with the same amount of water at the same intervals
   d. Maintain data in both tabular and graph form

8) One possible data table could be:

PLANT GROWTH IN SALINE AND FRESH WATER

PLANT HEIGHT FOR EACH MEASUREMENT

	1	2	3	4	5	6	7	8	9
CONTROL									
PLANT A									
PLANT B									

A graph could be constructed using three colors to represent the three plants with the X axis used for measuring periods and the Y axis for height.

9) Tell them to begin but remind them they must accept or reject their hypothesis and form a conclusion in the end.

10) Lab report should include

a. the problems

b. background information

c. hypothesis

d. procedures

e. data in the form of a graph and table

f. conclusion

and the answer to the following questions:

a. What are the implications for fresh water plants if salt water intrudes into the wetlands and beyond?

b. Can you suggest any other investigation which could be important in this area?

c. What effect could global warming have on fresh water plants?

Post Lab

Discuss implications of results and review questions from lab reports.

Materials

Overhead projector for notes
Two types of freshwater plants
Soil
Salt water of varying degrees
Graph Paper

Evaluation

Lab technique	10%
Accuracy of data	10%
Hypothesis formation	10%
Conclusion	50%
Answer to questions	10%
Neatness and form	10%

LIFE IN A DROP OF WATER

Author: Sheila A. LeBouef

Overview

The purpose of this lesson is to help environmental science students understand that there are living organisms in a drop of water. This will be connected in a unit on water and water quality so that they can understand the significance of water treatment and sewage treatment, as well as why water is a major source of disease transmission. The knowledge gained from this lesson will aid the student in understanding the world around him/her, which is one of the major purposes of education. Students should understand why water must be treated before drinking as well as why flooding can cause disease.

Objectives

The student should be able to:

1) identify and classify organisms in a drop of water

2) explain the sewage and water treatment processes and what they accomplish

3) execute water quality tests on samples and interpret the results.

Activities

Day 1:

The students will use a microscope to examine a drop of tap water, a drop of rain water, and a drop of pond water. Each group of students will prepare three microscope slides using water from 3 beakers in the lab labeled tap water, rainwater, and pond water. The students will obtain their samples in medicine droppers, using a different medicine dropper for each sample. The first slide will have 2 drops of tap water on it. The second slide will have two drops of rain water. The third slide will have two drops of pond water. The students will have to record their observations and draw diagrams of any discovered organisms.

Day 2:

The students will participate in a class discussion of the results of the previous day's activity. The students will discuss and diagram the processes of sewage and water treatment. The students will then have to explain why they saw what they saw in their activity.

Day 3:

Students will view pond water again and classify at least three organisms in their sample using taxonomy manuals. Once again the students will make slides using a medicine dropper to obtain their sample and placing 2 drops of water on a microscope slide.

Day 4:

Students will test water samples for dissolved oxygen, chlorine, phosphates, carbon, and nitrates using Lab-Aids water testing kit. The water samples to be tested are the same tap water, rainwater, and pond water from the previous experiments. The students will record their results. The students will turn in a datatable that contains the entire class data on it.

Day 5:

The students will compare the data obtained as a class. The students will then interpret this data to determine whether or not they do things around their house that could add to the problems of water systems. The students will take an objective test.

Materials

Microscopes
Lab-Aids water testing kit
Samples (Teacher and student collected)

Assessment

The students will be assessed by their lab results, group evaluation by both teacher and students, and a written examination. Lab results will be assessed for proper completion of the lab. The group evaluation will be done using a checklist to determine if each individual participated and also to determine what knowledge they have gained. The written examination will contain multiple choice, completion and discussion items to evaluate if the students have retained the terminology, if they have understood the lab procedure, and if they can apply the results of the lab and the implications of this information to a real life situation.

EUTROPHICATION: ITS CAUSES & EFFECTS

Author: John Lemaire

Goal

Students will learn the value of water testing to determine if bodies of water are becoming eutrophic. Water testing and interpretation of data collected will be conducted by the students.

The lesson includes the methods of scientific inquiry, use of the scientific method, cooperative learning and format learning cycle.

Overview

The lesson that follows introduces students to the formation of eutrophic bodies of water. It is part of a unit about the different types of water pollution.

Objectives

The students will:

1) define eutrophication

2) know the symptoms of eutrophic water

3) define algal bloom

4) distinguish between benthic & planktonic plants

5) compare oligotrophic with eutrophic surface water

6) state the causes of water changing from oligotrophic to eutrophic

7) know that dissolved oxygen content of water is critical in the determination of eutrophication

Activities

Day 1:

Defining Eutrophication -- sources of nutrients: A comparison of oligotrophic & eutrophic surface water

Oligotrophic surface water is nutrient poor, oxygen rich, clear, support benthic plants, and supports populations of game fish, crawfish, snails, and aquatic insects. There is little detritus to be found and the population of decomposers and detritus feeders is small. People benefit greatly having water in this condition, this water is suitable for recreation such as boating, swimming and fishing.

Eutrophic surface water will have a large amount of phytoplankton due to large amounts of dissolved nutrients. Water tests reveal a high nitrate and phosphate content. There will be a few benthic plants due to the cloudiness of the water shading out the sunlight. The living things found in the water are not the same as those found in oligotrophic water. The surface of the water will be green due to the large population of algae. This periodic burst of green color is called algal bloom. It becomes more intense and lasts longer with time. The game fish that were there have died out. Catfish and other detritus feeders such as crabs can be found. Phytoplankton ha a high turnover rate, and causes a rapid accumulation of detritus that sinks to the bottom, decomposers feed on the detritus and their population soars! They consume the dissolved oxygen in the deeper water. Most of the oxygen produced by the algae in the water escapes near the water's surface into the atmosphere.

What are the sources of nutrients that change the surface water from oligotrophic to eutrophic? The major sources of nutrients fall into two large categories. One is a point source of nutrients, these are locations that actually release or "dump" substance into the water. Examples of point sources: sewage treatment plants, factories that discharge, and city storm drains. The other source of nutrients are called non-point sources. Agriculture is the most significant non-point source of nutrients. Phosphates and nitrates greatly enhance the eutrophic process. Human-induced eutrophication overloads an ecosystem by preventing the natural recycling of nutrients there is too much material for the system to handle. This process happens gradually because water and runoff are not uniformly mixed when they meet. Thus causing the gradual changes in surface water.

Day 2:

Preparations for field trip

The class will be divided into groups of four for field trip the next day. The teacher will demonstrate the proper use of the equipment prior to going to the selected site. Students will review "Life in a Body of Water" and the method of testing the dissolved oxygen content of water samples. Students will be given data collection sheets and an extra copy will be given to the group recorder and will be reviewed.

Day 3:

Examining a body of water for signs of eutrophication (Field trip)

The students will go on a field trip to observe, collect samples of a preselected body of surface water. Students are to record the flora & fauna observed at the site. The student teams will collect water samples to determine dissolved oxygen content upon their return to school. The student groups will follow the procedure for data collection as written in "Life in a Body of Water". Students will use dip nets to collect samples and examine their findings in the basins provided. Students will be looking for insect, amphibians, plants benthic and planktonic. Students will be provided a form to record their data. The students will classify the organisms upon reporting their findings to the class.

Upon return to school, students will test the water samples for dissolved oxygen content. Dissolved oxygen content is an accurate indicator of the eutrophic level of surface water. Water with consistently high oxygen content are considered to be an indicator of stable ecosystem, capable of supporting many kinds of aquatic organism. Students will follow the procedure as outlined in the Field Manual for Water Quality Testing for testing Dissolved Oxygen. (pp. 27-33) Using the dissolved oxygen testing kit. The results of each group will be reported, recorded and displayed for the entire class to see.

Day 4:

Analysis of data collected by students.

Reporting of results of each group. Observations of aquatic plants and animals will be reported and displayed. Review of the dissolved oxygen test will be reviewed by the class. Discussion of the physical influence & human-caused changes in dissolved oxygen will be included. What kinds of changes are to be expected when water shifts from oligotrophic to eutrophic? From the data collected the students will determine the eutrophic state of the surface water. (Integration of the lesson and the activity should be integrated here.)

This activity is an excellent lead entry into the approaches of combatting eutrophication.

Assessment

Students are to write a lab report of the activity they performed. It is to include a purpose, materials used, procedure, data collected, results and conclusions. A short quiz will be administered of about 20 objective items on the student's knowledge and understanding of terms and concepts. Feedback from these activities will provide the students and teacher the opportunity to address strengths and weaknesses.

COMPARING PLANT AND ANIMAL CELLS

Author: Lena McWain

Overview

This lesson introduces tenth grade basic Biology students to the study of the structure of function of plant and animal cells.

The Science Education Standard indicates that the teaching of the cell should discuss how cell structure relates to its function.

1) Initiating the lesson with discoveries that lead to the development of the cell theory.

2) Engaging students actively in discovery that cells are living and nonliving.

3) Use of cooperative learning.

4) Closing the lesson with an activity to focus on what has been learned.

This lesson is linked to the Science Education Standards in a variety of ways. The main objective of this section is to demonstrate the close relationship between the structure of a cell part and its function. The lesson will build on the discussion of cell diversity, component parts, and their function.

It should be noted that this lesson is designed to be carried out over a five day instructional period, including one lab practical. Students will have the opportunity to practice measurement skills, use critical thinking skills, and they will write and communicate within their groups and with the class and instructor.

Context

The unit within which this lesson is located deals with cells, Within this unit, students will be introduced to such topics as structure, transport, respiration, and reproduction.

Objectives

1) The learner will read and discuss the development of the cell theory.

2) The learner will list five differences between prokaryotes and eukaryotes.

3) The learner will draw and label the parts of plants and animal cells.

4) The learner will relate cells to tissue, organs, and organ systems.

Activities

The lesson will focus first on differences between living and nonliving organisms, the cell being the smallest part of these organisms. It is our hope that students will understand that organisms that function efficiently have an advantage over those less efficient ones. Students should also be aware of what occurs when cells come together for a specific function. The students will also observe and relate how cells depend on other cells for survival.

Materials

1 microscope slide
1 coverslip
Elodea plant
compound microscope
prepared slide of human cheek cell

Assessment

A short test of 30 items will be prepared to quiz students on their knowledge of basic cell terminology and concepts, and principles. The students will compare the structure and placement of organelles in the plant cell as they relate to that of the animal cell. Skills will be assessed by reviewing the results of their lab reports. The students will also discuss and compare models of the plant cell and the animal cell to recognize visual differences in the cells.

KINGDOM PROTISTA

Author: Richard P. Preston

Goal

The purpose of this lesson is for the teacher to familiarize each student with the Kingdom Protista. Each student, upon completing this lesson should be able to identify at least one example of each phylum within this Kingdom, understand how each organism eats and reproduces, and how their existence contributes the overall scheme of life.

Overview

Science Standards

According to the science standards under life science, all students should learn about the diversity of life. This lesson is based on that belief in that it shows how organisms of the same kingdom are different. This lesson also covers various other standards related to the thinking skills and laboratory preparation and field work.

Location

This lesson will occur after the lesson on the kingdom Monera which introduces various other concepts that will carry on to this lesson. It will be followed by the lesson on Fungi which is partially related to the previous lesson.

Objectives

1) The learner will demonstrate the proper way to collect water samples in the field for study.

2) The learner will demonstrate the correct way to prepare a wet mount and view it under a microscope.

3) The learner will differentiate the two large groups found in the Kingdom Protista.

4) The learner will successfully identify examples of various phyla found in the Kingdom Protista.

5) The learner will understand the general anatomy of organisms found in the phyla of the Kingdom Protista.

6) The learner will understand the importance of these organisms in the overall scheme of life.

Activities

Day 1:

Lecture on the classification of and the general description of each phylum within the Kingdom Protista; compare and contrast large groups (Protozoans and Algae); provide examples of each phylum.

Day 2:

Brief discussion of collecting water samples and discuss what we hope to see in these water samples. Take class to three different water sample places to collect specimens. Come back to class, set up samples in appropriate containers, and label each accordingly. Discuss and speculate as to which water sample will provide the best number of specimen. Assignment: draw and label organisms given.

Day 3:

Show pictures of what we will be looking for in water samples; view prepared slides under microscopes; finally, make wet mounts of water samples to look for various organisms; compare and contrast each water sample to see which had the richest supply of protists.

Day 4:

Lecture/discuss anatomy of classes or protozoans and algae (reproduction, eating, structure).

Day 5:

Quiz on recognizing various organisms and various structures of protozoans and algae. Give students a worksheet to do on various protists.

Day 6:

Pick up drawing assignment; show video on Kingdom Protista; discuss practical exam.

Day 7:

Practical Exam (Evaluation). Identifying various protists/knowing phylums.

Day 8:

Written Exam (Kingdom Protista). Protozoans and Algae.

Materials

Textbook	Overhead projector
Transparencies	Chalkboard
Chalk	Specimen buckets
Aquariums	Labeling pencils
Slides (glass)	Slide Projector
Prepared slides	Slides (picture)
Cover slips	Medicine droppers
Microscope	

Assessment

Practical Exam (identify organisms/parts; knowing what phylums organisms belong to);

Written Exam (testing knowledge of anatomy, reproduction, eating, structure, niche of main organisms);

Lab Grade (two parts): (1) preparing wet mounts and using microscope successfully and (2) collecting water samples;

Quiz and worksheet (mid-lesson assessment).

PRINCIPLES OF EVOLUTION

Author: Patricia Schneider

Goal

Evolution is the central unifying concept of biology -- almost everything biological can be explained in terms of evolution. Evolution is perhaps the best known but least understood concept by science students. The purpose of this lesson is to show that a change in organisms has occurred and that this change is the result of 'natural selection'.

Overview

Scientific theories are unifying explanations for many related observations. Like all scientific theories, the theory of evolution was developed through decades of scientific observation and experimentation. The modern theory of evolution began to take shape as a result of the work of Charles Darwin. Today virtually all scientists recognize evolution as the basis for both the diversity and relatedness of life on Earth.

The Science Education Standards indicates that the teaching of science provide students with experiences that will enable them to achieve an understanding of scientific concepts, laws, theories and models; and an understanding of the influence of science on societal issues, both contemporary and historical.

Learning science is an active process in which all students must engage. In this lesson students will be required to ask questions, construct explanations about phenomena, and to effectively communicate their ideas to others.

Context of the Lesson

This lesson is one of four chapters within Unit 3, Principles of Evolution. In the previous lesson the students discussed life and its characteristics. We addressed that universal philosophical question: "Where did life come from?" Here I employed the age old answer, "I don't know." Students were reminded that "not knowing" is what gets the ball rolling in science. The unit then focuses on the observation that evolution has occurred, followed with Darwin's reasoning that natural selection provides the mechanism that explains why evolution happens. It is here that the teacher will use methods to ensure that the students focuses on the facts. Once they have investigated "what life is and how it is evolving, then the actual evolution of organisms will be addressed. This will be done in a sequential manner, starting with the appearance of prokaryotes and moving through to the evolution of the vertebrates. The unit will then be concluded with a brief study of why man is classified as a primate, thus steering human evolution on to its present course. At the end of our chapter the students will be given an examination covering the concept studied within the chapter. The exam will contain 50 items, in the form of true-false, multiple-choice, and essay questions. As a part of the schools' policy of integrating science across the curriculum the students will also be required to write a short essay on their beliefs on the subject of how life came into being.

Objectives

1) Summarize the modern theory of evolution.

2) Outline the observations that led Darwin to conclude that species evolved.

3) Describe the process of natural selection and its outcomes.

4) Explain how comparing the anatomy and development of living species provides evidence of macroevolution.

5) Differentiate between the gradualism and punctuated equilibrium models of evolution.

6) Describe the process of species formation.

7) Propose your own plan of evolution.

Activities

Day 1:

Tapping Prior Knowledge: Students will be asked the following questions: Who was Charles Darwin? What is meant by the term 'Natural Selection'? What is a fossil? Students will then study a photography in their text. Students will then be asked how they think the insect got its name. Students will be asked to name an advantage of looking like a leaf. Students will be asked to predict what would happen to his insect's chances of survival if it found itself in an environment that had only plants with red leaves. Opening Questions: What does the word evolution mean? Students will then be asked to list examples of types of animals or plants that have changed over time. Demo: Students will be shown several different varieties (breeds) of domesticated dogs or cats. Students will be asked how these varieties originated. After the introduction is completed the students will break out into their small groups and work for 10-15 minutes on their given assignments. This procedure is one they are familiar with. Back in whole class, the groups will begin reporting their findings. Each group will be given 5 minutes to make their reports. Summary of the activities will follow the last groups' report. Assignment for the second days' class will be given.

Day 2:

Review of major points from lesson one. (Darwin's work). Several minutes will be now set aside to clear-up any questions about the groups reports, notes will be checked for accuracy. Students will now view the tape -- Evolution and Natural selection. The tape will be stopped at certain intervals and questions asked and discussed. At the end of the video, students will go into their small groups and complete the question and answer activity. One written report will be turned in from each group, to be graded.

Day 3:

Students continue their study of evolution with a day of lab activities.

'Act-1': Grab Box -- Each group is to pick up a box and list characteristics of the imprint and come up with what organism made that imprint. Each group will have only 5-7 minutes per box, then the samples must be passed on to the next group.

Each group will turn in their guesses. The group that gets the most right answers receive bonus points on the chapter exam.

'Act-2': Visual Strategy -- Still in their groups students will be asked to make a list of the similarities and differences among the horses in the transparency. They are to design their list around the following questions: What are the most noticeable changes that have occurred? How might these changes have been advantageous? What do the side branches on the family tree represent? Groups will compare their list in whole class discussion.

Day 4:

"Effective Reading Exercise" -- Taking Notes. Due to the content-rich nature of section 12-2, the students are going to take notes as they read. Each student is to read the sections and write summaries in their own words of each paragraph they read. Once everyone has finished or when members of the group finish, they are to go over their individual notes with each other. They are to identify any difference that occur in their understanding. Students are to refer back to their text to verify information that has not been understood in the same way by all members of the group.

Day 5:

Students will read aloud the section dealing with gradualism and punctuated equilibrium. The terms will be written on the board and defined by the students in their own words. Students will be asked to brainstorm and give examples of environments where gradualism might have occurred and where punctuated equilibrium might have occurred. Using the transparency - Gradualism vs. Punctuated Equilibrium the students will be walked through the diagram. The following questions will be asked: In which model do ancestral forms exist at the same time as new forms? Students will be given 3 minutes to write their answers to the questions. How does the punctuated equilibrium model of evolution differ from the gradualism model? Does acceptance of the punctuated equilibrium model mean that the gradualism model of evolution must be totally rejected? Why or why not? Their answers will be completed and turned in.

Day 6 & 7:

Opening Questions: What environmental factor contributed to the evolution of polar bears and brown bears into separate species? (Students should recognize that climate was the cause.)

Demo: Modeling Natural Selections: Students will be divided into their small groups and given the following material: a large sheet of aluminum foil, 10-one inch aluminum squares and 10-one inch white paper squares. (The foil will be crinkled and then flattened out before the squares are cut.) Procedure: In their groups, each student will be given 10 seconds to pick up as many of the pieces as they can (foil and white), scores will be recorded and an average for each group taken. Note: Students should conclude that the white squares were easier to see and that the camouflaged aluminum squares weren't. Questions: Relate this to survival of organisms. If the reminding squares could reproduce, which type would be more numerous in the next generation? Why?

Discussion: How does Natural Selection affect humans? (Using the idea of Sickle cell anemia and different body types in different regions of the world.)

Each group will present its outline of the process of natural selection using one of the following formats: commercial, poem, news cast, or some other approved form of their own.

Day 8:

Modeling Microevolution - Species Formation. Each group will be given a drawing of sets of overlapping rings. Students will be told that each of these 5 rings represent a population or race of an animal. In each ring, the populations will be labeled A, B, C, D, and E. It will be pointed out that population C, in the middle, is in contrast with B and D, and thus B and D can interbreed somewhat. Questions: What do populations A and E represent? Can A and E interbreed with each other? What will become of each population?

Each student will be given the following terms: divergence, isolation, natural selections, new species, and variation. They will be asked to make a sequential diagram for speciation using all of the terms. Each diagram will be orally discussed by each student (defending their choices).

Day 9:

Rewrap-up, review, renew, re-question. Discussion of possible 'test items'. Each student will be given time to tell what he/she got out of the chapter.

Day 10:

Major chapter examination.

Materials and Resources

Student text:	Modern Biology (Holt)
Transparencies:	Whale Evolution Horse Evolution Homologous Structures in Vertebrates Development and Vertebrate Embryos Gradualism versus Punctuated Equilibrium
Videodiscs:	Evolution and Natural Selection Evolution of Life on Earth
Laboratory Investigation:	Recognizing Patterns of Variations
Pictures:	Domesticated dogs and cats (file cards) Sets of drawings -- '5 Circles'
Grab Boxes:	Boxes of imprinted clay models
Modeling Materials:	Aluminum Foil and white paper squares

Assessment

Assessment of the level of student understanding of the lesson will be measured by their achievement of the chapter's objectives. Quizzes will be given covering basic terminology. A major chapter test will be given at the completion of the chapter also based on the lesson's objectives. Written reports, and answers to key questions will be reviewed and graded, again checking for the level of student understanding of the lesson's objectives. Participation of each student in their groups will also be judged. Feedback from each of these assessments will be provided to each student, so that they can improve their work, and so that I may better plan for more or different types of activities.

WATER AND SOIL CONSERVATION

Author: Nicholas D. Thomas

Overview

The following lesson plan helps eleventh-grade Environmental Science students to determine the relationship between water and soil in our environment and the recommended practices for conserving these sources.

The Science Teaching Standards indicate that teachers of science should design and manage a learning environment that provides students with time, space, and resources for learning science. This lesson is designed to meet that criteria by providing a setting which is supportive of science inquiry. The following lesson will include some effective teaching methods such as:

1) the use of print and media sources

2) use of resources outside the school

3) hands-on investigation

This particular lesson is designed to engage students in higher order thinking. Science concepts are incorporated into the lesson by studying living systems and their relationship to water and soil. This method allows students to be creative in the mode of science.

The content of this lesson is designed to be completed over a period of five days. During this five day period there will be group interaction and lab activities. There will also be a minimal amount of activity outside of the classroom environment, mainly in the form of an investigation of drinking water.

Context of the Lesson

The unit in which this lesson is located concentrates on the management of natural resources. This unit also includes related topics which include air quality, wildlife management, and soils management. Each preceding lesson concentrates on the conservation and management of our natural resources. There is also a heavy concentration on the preservation of a variety of ecosystems. This unit will be covered in a period of six weeks. A unit exam will be given to determine mastery of the concepts that were taught. The test will be designed in a manner which measures the students ability to think inferentially rather than simply recalling the information which was given to them.

Objectives

1) Students will be able to define water, soil, and related terms.

2) Students will be able to cite important relationships between land characteristics and water quality.

3) Students will be able to discuss major threats to water quality.

4) Students will describe types of soil water and their relationships to plant growth.

5) Students will be able to cite examples of enormous erosion problems world wide.

6) Students will describe key factors affecting soil erosion by wind and water.

7) Students will list important soil and water conservation practices.

Activities

Day 1:

Discussion and terminology frequently used in discussing water and soil conservation. Each vocabulary term will be discussed in detail. Understanding terms which relate to subject matter is vital to instructor-student communication. Following this activity will be an introductory lecture and discussion on the importance of water and soil conservation in relation to humans and various ecosystems. Students will be questioned at random as a tool for assessing their previous knowledge of content. Questioning will also be used as a tool for encouraging students to think inferentially. Student will be asked to familiarize themselves with the terminology in preparation for the next class.

Day 2:

Half of the class will be asked to write a few sentences on the importance of water in the environment. The other half of the class will be asked to write a few sentences on the importance of land in the environment. Listening to a random sample of each groups' responses will be the basis for the discussion of the nature of water and soil. Responses from each group will be given and used to help student understand the nature of water and soil. Allowing students to participate in the learning process helps them to build confidence in their ability to think inferentially about various subjects. The reaction of soil and water as one will then be discussed in its entirety. Students will be separated into five groups. Each group will be responsible for bringing in a sample of water from the following sources.

1) a safe spring or well
2) bottled pure water and
3) (faucets attached to)
   a. plastic pipe
   b. galvanized pipe
   c. copper pipe

The samples will be examined during the next class period.

Day 3:

Each student will be given a schematic drawing of a bay ecosystem. Included on the drawing will be an industrial plant. Students will be asked to analyze the activities taking place in the ecosystem without the interruption of an industrial plant. Students will then be asked to explain what happened when an industrial plant was introduced into the environment. This exercise will require students to think creatively being that there are no answers given on the drawing. Following this activity will be a short lecture on water conservation and improving its quality. In reference to the lecture, the samples of water that were collected will be gathered and analyzed. The method of analyzing will be done by tasting the samples. As students taste the labeled samples they will be asked to write a few reasons why the samples tasted as they did. The results of the taste test will be discussed during the beginning of the next class period.

Day 4:

For approximately ten minutes the results of the water samples will be discussed. The relationship of the location of the water and the taste of the water will be the main thought of the discussion. By observing these two variables, the class will be able to determine which source of water is safer and which is the most detrimental. Following this activity will be a short lecture on Land Erosion and Conservation. The class will then take a short field trip to a nearby farmer to study some conservation methods used in the local area.

Day 5:

An in-depth review of the lesson will be held. Students will be asked a series of questions which will be used as a tool for determining whether or not students have mastered the concepts that have been taught. Concepts which students did not grasp will be reiterated upon as necessary. *Students will be reminded to study in preparation for an evaluation during the next class period.*

Assessment

Students will be given an exam which will consist of multiple choice items. Each item will be designed in a manner which requires students to use their reasoning ability rather than the ability to simply recall information.

CHARACTERISTICS OF PROTOZOANS

Author: Harvey Ward

Goal

1) Identify and contrast the characteristics of protozoans.

2) Classify bacteria and identify the parts of a bacterium.

Overview

The following lesson introduces At-Risk 9th grade students to the world as seen through a microscope. Strange creature that he or she never dreamed could exist in something so common as a drop of pond water. The group of students that this lesson is intended for is geared toward the method of scientific inquiry that stress systematic observation. The student participating in this lesson will be encouraged to think logically and critically about the evidence and explanation as outlined in the National Science Education Standards. This lesson uses a team approach in applying technology in investigation and communication. As a result of the above the student will develop an understanding of the diversity of organism, the cell and the organization of living systems.

Objectives

1) The learner will be able to describe the habitats of protozoans.

2) The learner will be able to describe three major reproductive patterns in protozoans.

3) The learner will be able to list four major groups of protozoans.

4) The learner will be able to compare the movement in sarcodines and ciliates.

5) The learner will be able to analyze the feeding, digestion, and reproduction in amoebas and paramecia.

Concept Development

This lesson introduces protozoans with those first-time viewers in mind. Protozoans require a moist environment. Most live in wet places, but even survive in deserts, where they make a hard capsule around themselves and are dormant during dry times. There are virtually non-vertebrates that are not parasitized by protozoans. Most are harmless. In actual numbers, there are more protozoans than multicellular animals on earth.

Activities

1) Divide the class into groups of three to four students and assign a microscope to each group. Each group will examine a slide of amoeba and a slide of bacteria. Obtain a commercial culture of Amoeba proteus or Pelomyxa from a biological supply house. Adding water to peppercorns and letting them stand will yield a surface layer of suitable bacteria in about a week. Ask a recorder for each group to write the group's answer to the following question:

   What differences do you observe between the bacteria and the protozoans?

2) Write the following question on the chalkboard. Ask all students to write an answer.

   Where would you be likely to find protozoans?
   a. in mouth of teenagers
   b. in pond water
   c. on vegetables
   d. in intestine of earthworms and termites

3) Have students observe a photograph of a Radiolarians.

4) Tell them it is the remains of one type of protozoan. Ask them to assume they are scientists on an expedition in the Pacific Ocean. Their ship just dredged the bottom. They have examined the ooze under a microscope and see something similar to the picture shown. Pose the following questions.

   How would you describe the remains of this creature over ship-to-shore telephone to a friend at home who had never seen it?

   Why is radiolarian an appropriate name for these animals? (Radiolarian comes from a Latin word that means small sunbeam...the picture looks like a sun with sunbeams coming from it)

5) Tell students that bacteria belong to the Monera Kingdom and protozoans in the Protista Kingdom.

6) Pose the question: How can you explain your observation that the bacteria all stayed the same shape, but the amoebas changed shape?

   (Answer: The bacteria have a cell wall, Protozoans do not)

Materials

Picture of a Radiolarian	Amoeba proteus culture
Dried grass or hay	Medicine dropper
Glass slides	1 liter glass jar
Microscope	1 liter of tap water, or pond water if available

Assessment

Assessment of lesson will be linked to lesson objective.

Pencil and paper test with various types of test items to include but not limited to the following:

1) Writing of an essay contrasting the differences in protozoans.

2) Selecting from a list the four major group of protozoans.

Students skills will be assessed by reviewing the results of lab reports along with informal observation of student during the lab activities.

Using reference materials in library, have students look for pictures of other different type of protozoans.

FINAL EVALUATION NARRATIVE

Interagency Agreement DE-AI05-93ER75893
Modification: A002 (1995)

Interagency Agreement DE-AI05-93ER75893
Modification: A002 (1995)
National Biological Service (NBS)
Southern Science Center

Final Evaluation Report for 1995

Project Title: Theory and Use of Modern Microscopical Methods with Applications to Studies of Wetlands Microbial Community Dynamics

Per the agreement between DOE and NBS (formerly US Fish and Wildlife Service), the Southern Science Center (SSC, formerly National Wetlands Research Center) granted funds to the University of Southwestern Louisiana (USL) to coordinate and offer a summer enhancement institute for science teachers.

One principal goal of the DOE Summer Teacher Enhancement Institute was to instill in high school teachers of biological and environmental science general knowledge of the microbial communities structure and function in their wetland ecosystems. A second goal was to present mechanisms by which this information could be effectively and excitingly presented to high school students.

During the summer of 1995, 20 high school teachers from throughout the state of Louisiana were immersed in lectures, laboratories, and hands-on activities at the USL Departments of Biology, Mathematics, and Curriculum and Instruction and at SSC. Teaching methods employing real-time video and observations of the dynamic activities of primary producers were presented. Laboratory activities and investigations and field trips were carried out which augmented the lecture/discussions given by experts in their fields at USL and SSC.

In addition to providing dynamic lecture/discussions and meaningful hands-on experiences, funds from the institute grant were used to provide major equipment and supplies to be used by the teachers in their monitored follow-up academic year. A trinocular compound microscope and video monitor were made readily available to the teachers to use in their High School laboratories.

The first 3 weeks of the institute concentrated on the scientific investigation of the microbial world and mathematical applications using graphing calculators. The 4th week was used to incorporate this knowledge into a meaningful teaching strategy and lesson development an presentation.

To insure success of the institute, with success being defined as incorporation of learned materials and activities into the teachers curriculum, a graduate student was hired for the fall semester of 1995. The graduate student had been a part of the summer experience and was responsible for implementation of the program by visiting each teacher's classroom, lending equipment and supplies, providing directions and assistance, promulgating a newsletter, etc.

The assistant not only directly effected the implementation of the program but became a source of feedback for evaluation purposes.

Evaluation of the program and the participants occurred throughout the duration of the Institute in formal and informal ways. A pre-test instrument was administered at the onset of the Institute. Evaluation of the post-test demonstrated significant improvement. Objective exams were administered and evaluated by the individual professors on a weekly basis. The teachers were also subjectively evaluated through class participation, laboratory performance, and lesson plan presentations. Participants kept individual daily journals in which they evaluated all aspects of the project from content/activities to methods of evaluation. The project director read the journals weekly and used this information for evaluation purposes. At times, changes in the program were made as a result of journal input. Teachers working in groups of three or four developed, designed, and implemented a lesson plan of their choice. They selected concepts in conjunction with information learned from *Benchmarks for Science Literacy* and *National Standards*. They were expected to utilize their experiences from the Southern Science Center as well as experiences in the use of modern technology. Formal and written lesson plans were submitted and evaluated by the Curriculum and Instruction professor. These lesson plans were later compiled into a monograph. Grades were issued by the professor of record and three hours of graduate credit were conferred to each teacher.

The teachers provided feedback to their peers, the USL faculty and the SSC staff on their fall semester experiences. It was apparent that the teachers had incorporated into their curricula methodology and concepts learned. It was also apparent that real camaraderie had developed among the teachers. The graduate assistant assigned to the group was responsible to a large extent for this success as a result of campus visits and newsletter communication. Teachers continue to keep in touch with members of the biology department and the SSC and often visit the two facilities with groups of their students.