Miami-Dade County Public Schools
Division of Mathematics and Science Education

Biscayne Nature Center for Environmental Education

Curriculum Materials for Senior High Program

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Miami-Dade County Public Schools
Division of Mathematics and Science Education

Biscayne Nature Center for Environmental Education

6767 Crandon Boulevard
Key Biscayne, Florida 33149
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Curriculum Materials for Senior High Program: A Population-Density Survey of a Seagrass Community

(Revised August 2008)

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INTRODUCTION TO THE BISCAYNE NATURE CENTER FOR ENVIRONMENTAL EDUCATION

http://science.dadeschools.net/bncee

The **Biscayne Nature Center for Environmental Education (BNCEE)** was established by Miami-Dade County Public Schools (M-DCPS) in 1971 to provide instructional programs that foster an awareness and appreciation of the natural world and promote an understanding of ecological concepts. Units of study emphasize the special geological features, natural resources, and habitats of South Florida while encouraging the students to develop a sense of stewardship and to live harmoniously with our vital native communities.

In addition to classroom curriculum materials and activities, the BNCEE programs feature one and two days of field investigations in our **National Environmental Study Area*** located within Miami-Dade County's Crandon Park on Key Biscayne. Daily, six M-DCPS environmental science Educational Specialists instruct approximately 120 students, their accompanying classroom teachers, and parent chaperones in hands-on ecological studies and multisensory observations within our varied ecosystems. Each year, more than 10,000 students visit the coastal strand hammock (native woods), intertidal zone, mangrove swamps, vegetated sand dunes, unique fossil mangrove rock reef, and extensive seagrass beds associated with this sand barrier island.

ADDITIONAL ACTIVITIES

All BNCEE programs are designed to promote student FCAT achievement with activities modeled after the M-DCPS' Competency-Based Curricula (CBC). These student- or teacher-directed, inquiry-based learning programs include the following:

Designation as Member of Homeland Security WeatherNet Network (2003)
Professional Development for Teachers
South Florida Regional Science & Engineering Fair
Miami-Dade County Public Schools Elementary Science Fair
Online Curriculum Development
Ask an Environmental Educator Online
Curriculum writing, design, and evaluation
Conference and symposium presentations
Dade County Science Teachers Association
GLOBE Program

***1976 U.S. Department of the Interior, National Park Service designation.**

INTRODUCTION (continued)

AWARDS

Florida Department of Education: Statewide Program of Distinction

Florida Department of Education: Statewide Program of Quality

Miami-Dade County Public Schools: Award of Outstanding Achievement

COMMUNITY SERVICE

With the assistance of student groups, teachers, parents, and governmental agencies, the BNCEE has been or is actively involved in meeting the following special community needs:

- Mangrove mitigation
- Dune restoration
- Science-fair organization
- Park personnel training
- Teacher mentoring
- Environmental education workshops
- Protection of native habitats
- Establishing nature trails
- Expanding environmental education

STAFF

Quinton Nealy, Chairperson
Judy Prickitt
Don Deresz

Science Education Supervisor:

Dr. Gladys Barrio
Executive Director
305-995-2932

Mailing Address: Biscayne Nature Center for Environmental Education
6767 Crandon Boulevard, Key Biscayne, FL. 33149

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Phone: 305-361-6767 ext.130
Fax: 305-361-7061

School Mail Code: 9771

TEACHER OVERVIEW AND PRE-VISIT ACTIVITY SUGGESTIONS: ECOLOGY / MARINE BIOLOGY / OCEANOGRAPHY PROGRAM

During their visit to the Biscayne Nature Center for Environmental Education (BNCEE), students will participate in a field investigation where marine organisms are collected, sorted, classified, counted, and recorded. Upon return to school, the data is used to determine the **population density** of organisms in the study area. This field-research activity involves waist-deep wading and is designed for groups of thirty-six (36) students. The activity focuses on an ecological system, the **seagrass community**, in the Atlantic Ocean along the shores of Key Biscayne/Virginia Key.***** Prior to the trip to the Center, classroom teachers are expected to guide students through the suggested activities regarding the seagrass community.

Upon arrival at the Center, the BNCEE staff will discuss certain ecological aspects of the South Florida environment and inform students of protective adaptations of selected marine organisms they may encounter. An explanation of the technique and equipment used in the population-density survey will be given prior to dividing the students into three teams for the seagrass study.

Each student should be given a copy of the **Student Guidelines** (pages 23-28) prior to the trip. The student should submit a completed **Parental Permission/Health Statement** signed in **TWO** places by a parent or guardian.

It is recommended that you conduct the **Population-Density Simulation Lab** (pages 17-20) as a whole-class, pre-visit activity, even though all students may not attend the field trip. The Lab is designed to stand alone as a lesson, although the ideal culminating activity is using the actual field data brought back to the school from the field trip to complete calculations and make real-world inferences.

Teachers need to discuss the program activities and safety procedures with their students. The **Teacher Preparation List** (page 13) should be used so that the students are equipped to do as much on their own as possible. During the activities at the Center, the teacher is expected to actively participate while BNCEE staff serves as facilitators.

The classroom teacher's contribution to the learning experience at the Center is important. Teachers will be relied upon to:

- provide educational support while moving from team to team.
- assist students when they are identifying and classifying organisms.
- supervise students at all times, especially during the lunch and restroom periods.

*** In the event of inclement weather, land-based activities may be conducted.**

The program activities focus on:

1. Using the quadrat method to conduct a population-density survey of the animals living in a seagrass community.

2. Identifying the physical and biological characteristics of a seagrass community.

3. Classifying the collected animals according to their respective phyla.

4. Determining the number of individuals of each species and mathematically expressing, interpreting, and applying the data.

5. Drawing some conclusions based on the information collected.

THE CBC/SSS/BNCEE INTERFACE

The students attending the BNCEE will engage in activities designed to apply learning to an increased emphasis on higher thinking skills. The BNCEE program will assist the teacher in leading students toward the performance of the following competencies. Not all the Components, Competencies and/or Objectives may be addressed by all the teachers at the BNCEE during the students' field experiences.

BIOLOGY

COMPONENT I: Science Skills and Attitudes, Applications, and Contexts of Biology

Competency A: Apply science investigation skills to design and carry out appropriate types of experiments and to analyze the data collected to form conclusions on biological topics using established laboratory safety procedures.

Objectives:

1. Use careful observations and exploratory activities to identify variables and develop problem statements. **(SC.H.1.4.1)**

3. Write hypotheses leading to different types of experimental designs for selected problem statements using variables identified as manipulated (independent) and responding (dependent). **(SC.H.1.4.0)**

6. Interpret experimental data by reordering and/or plotting graphs and then describing the central tendency of the data by the appropriate use of the mean, median, and/or mode and the variation of the data by the appropriate use of the range and/or the frequency distribution. **(SC.H.1.4.0)**

7. Write conclusions that cover the following seven points: state what was investigated; describe whether the hypothesis was supported by the results; include sample results; compare the results with other investigations; provide possible explanations about the results; recommend additional studies; discuss possible applications. **(SC.H.1.4.3)**

CBC/CEE INTERFACE (continued)

Competency B: Apply biological knowledge, principles, and skills to clarify and make decisions involving critical social issues.

Objective:

2. Identify current problems caused by applied technology and economic pressures that might be solved by the application of biological knowledge, e.g., pesticides in the environment, genetic engineering, management of public lands and resources, and deforestation.
   (SC.H.3.4.2, SC.H.3.4.3)

COMPONENT II: Cellular Structures and Functions

Competency C: Connect the structure of the cell to the production of energy.

Objectives:

1. Describe the basic processes of photosynthesis and its importance in energy and chemical cycles, including the following: raw materials, forms of energy used and produced, chemical products, the role of chlorophyll, and the location of the process.
   (SC.F.1.4.1, SC.F.1.4.4)

2. Describe the basic processes of anaerobic (fermentation) and aerobic respiration and their importance in energy and chemical cycles, including the following: raw materials, form and amount of energy produced, chemical products, and the location of the process.
   (SC.F.1.4.1, SC.F.1.4.4)

COMPONENT IV: Mendelian Genetics

Competency A: Relate the inheritance of traits to the genetic information contained in the DNA molecules and how this information is conveyed through chromosomes from one generation to the next.

Objective:

1. Identify Mendel's laws and relate them to inheritance of traits.
   (SC.F.2.4.1)

CBC/CEE INTERFACE (continued)

COMPONENT VII: The Evolution of Organisms

Competency A: Describe the purpose of the theory of evolution and use the mechanism of natural selection to explain how the theory accounts for the diversity of living and extinct species and yet produces the similarities within that diversity.

Objectives:

1. Describe the processes of adaptation and evolution using the tenants of Darwin (natural selection). **(SC.F.2.4.3)**

4. Identify factors that could influence natural selection and explain an example such as climate, overpopulation, mutations, recombination of genes and pollution. **(SC.G.2.4.3)**

COMPONENT VIII: Ecology

Competency A: Describe characteristics of abiotic and biotic components of a South Florida community and relate them to patterns of matter and energy cycling within the community using several types of food webs or food chains.

Objectives:

1. Identify the biotic and abiotic components of an ecosystem and the importance of each in determining the organisms found in South Florida or other regions (biomes). **(SC.G.2.4.3)**

2. Describe how the interdependence of organisms in an ecosystem results in a relatively stable system that cycles around a state of equilibrium. **(SC.G.2.4.2)**

3. Describe the carbon, nitrogen, and water cycles and their relationship to the maintenance of life. **(SC.G.2.4.0)**

4. Construct and compare food chains and food webs. **(SC.G.1.4.1, SC.G.1.4.2)**

5. Explain the ecological interactions demonstrated by symbiosis (mutualism, commensalisms, parasitism, competition, and predation). **(SC.G.1.4.1)**

CBC/CEE INTERFACE (continued)

Competency B: Describe how population growth and limiting environmental factors interact to produce a stable ecosystem and then how individual organisms and populations (including human technology) can upset the balance.

Objectives:

1. Explain the role of limiting factors with respect to carrying capacity using human population growth and quality of life as examples.
   (SC.G.2.4.3)

2. Describe and differentiate between primary and secondary succession, e.g., in a mangrove community.
   (SC.G.2.4.4)

3. Describe environmental problems such as pollution and biological magnification of toxic substances facing South Florida, and generate possible solutions.

4. List ways in which certain types of pollution affect health and life span, the extinction of other animal and plant species, and the accelerated change to the environment leading to habitat loss or the creation of new habitats.
   (SC.G.2.4.6 for objectives 3, and 4)

COMPONENT IX: Diversity of Monerans, Protists, Fungi, Plants, and Animals.

Competency A: Correlate the diversity of representative monerans, protests, and fungi, to how their identifying characteristics help them to survive in different environments.

Objective:

6. Contrast certain microbial processes as being helpful to humans or other organisms (disease, soil fertility, variety of food, decay, fermentation, toxin production, antibiotic production, and the genetically engineered chemicals).
   (SC.F.1.4.8)

Competency B: Correlate the diversity of representative plants, to how their identifying characteristics help them to survive in different environments.

Objectives:

1. Describe the structural characteristics of vascular and non-vascular plants, including their adaptations to life on land.
   (SC.F.2.4.3)

CBC/CEE INTERFACE (continued)

2. Describe the structures and functions or roots, stems, flowers, leaves, fruits, seeds.
   (SC.F.1.4.2)

4. Compare methods of reproduction in higher plants (gymnosperms and angiosperms) with lower plants (algae, mosses, liverworts, and ferns).
   (SC.F.2.4.1)

5. Identify various tropisms in plants and explain the role of plant hormones.
   (SC.F.1.4.6, SC.F.1.4.7)

6. Investigate and describe the biological and economic importance of some plants.
   (SC.G.1.4.1)

Competency C: Correlate the diversity of invertebrate organisms to how their identifying characteristics help their survival in different environments.

Objectives:

1. Describe the division of labor among cells and explain how it permits a higher degree of specialization among multicellular organisms.
   (SC.F.1.4.2)

2. Describe, then compare and contrast, the development of systems among the major invertebrates including Porifera, Cnidaria, Platyhelminthes, Nematoda, Annelida, Mollusca, Arthropoda, and Echinoderms.
   (SC.F.2.4.3)

Competency D: Correlate the diversity of vertebrate organisms to how their identifying characteristics help their survival in different environments.

Objectives:

2. Identify and differentiate the major characteristics of invertebrates and vertebrates including types of symmetry.

3. Describe the characteristics of endotherms and ectotherms and list some adaptations of vertebrates and invertebrates which facilitate survival, including behavior.
   (SC.F.1.4.2 for objectives 2 and 3)

EARTH/SPACE SCIENCE

COMPONENT I: Nature of Science

Competency A: Apply science investigation skills to design and carry out appropriate types of experiments and to analyze and interpret the data collected to form and report conclusions on earth/space science topics using established laboratory and safety procedures and equipment.

Objectives:

1. Describe how investigations are conducted to explore new phenomena, to check on previous results, to test how well a theory predicts, and to compare different theories.
   (SC.H.1.4.1)

2. Explain that from time to time, major shifts occur in the scientific view of how the world works, but that more often, the changes that take place in the body of scientific knowledge are small modifications of prior knowledge.
   (SC.H.1.4.2)

3. Justify that no matter how well theory fits observations, a new theory might fit them as well or better or might fit a wider range of observations, because in science, the testing, revising, and occasional discarding of theories, new and old, never ends and leads to an increasingly better understanding of how things work in the world, but not the absolute truth.
   (SC.H.1.4.3)

6. Relate the importance of a sense of responsibility, a commitment of peer review, truthful reporting of the methods and outcomes of investigations, and making the public aware of the findings.
   (SC.H.2.4.2)

7. Explain that scientists control conditions in order to obtain evidence, but when that is not possible for practical or ethical reasons, then try to observe a wide range of natural occurrences to discern patterns.
   (SC.H.2.4.2)

CBC/CEE INTERFACE (continued)

COMPONENT II: Earth and Space

Competency A: Describe the interaction and organization in the Solar System and the universe and how this affects life on Earth.

Objective:

1. Describe and delineate the relationships between events on Earth, and the movements of the Earth, its moon, the other planets, and the Sun.
   (SC.E.1.4.1)

COMPONENT III: Processes that Shape the Earth

Competency C: Describe and interpret types of erosion with emphasis on soil types, glaciation, ocean currents, resulting land forms, and weather patterns.

Objective:

1. Relate how knowledge of energy is fundamental to all the scientific disciplines (e.g., the energy required for biological processes in living organisms and the energy required for the building, erosion, and rebuilding the Earth).
   (SC.B.1.4.1)

Competency D: Assess renewable and nonrenewable earth resources.

Objective:

2. Conclude the changes in a component of an ecosystem will have unpredictable effects on the entire system but that the components of the system tend to react in a way that will restore the ecosystem to a state of equilibrium that is equal to the new conditions that the changed components create.
   (SC.G.2.4.2)

Competency E: Describe and explain how climatic patterns on Earth result from an interplay of many factors.

Objective:

3. Knows the ways in which humans today are placing their environmental support systems at risk (e.g., rapid human population growth, environmental degradation, and resource depletion).
   (SC.G.2.4.6)

CBC/CEE INTERFACE (continued)

4. Describe the composition and layers of the atmosphere and explain how weather patterns form and occur with respect to high- and low-pressure air masses (cyclones), solar-radiation absorption and reflection, jet streams, winds, conduction and convection, the Coriolis effect, water in the atmosphere, and weather fronts.

Competency F: Describe how the earth/space sciences interact with technology and society.

Objectives:

1. Explain the interconnectedness of the systems on Earth and the quality of life.
   (SC.D.2.4.1)

2. Describe how the world ecosystems are shaped by physical factors that limit their productivity.
   (SC.G.2.4.4)

4. Relate how technological problems often create a demand of new scientific knowledge and that new technologies make it possible for scientists to extend their research in a way that advances science.
   (SC.H.3.4.2)

5. Interpret how scientists can bring information, insights, and analytical skills to matters of public concern and help people understand the possible causes and effects of events.
   (SC.H.3.4.3)

CHEMISTRY

COMPONENT I: Science Skills and Attitudes, Applications, and Contexts of Chemistry

Competency A: Apply science investigation skills to design and carry out appropriate types of experiments and to analyze the data collected to form conclusions on chemistry topics using established laboratory and safety procedures.

Objectives:

1. Use careful observations and exploratory activities to identify variables and to develop problem statements.
   (SC.H.1.4.1)

CBC/CEE INTERFACE
CHEMISTRY/COMPONENT I
Competency A, continued:

2. Distinguish among descriptive (laboratory and field observations), comparative (comparing two experiments with one common manipulated variable), and experimental (controlled experiment) investigation designs commonly used in chemistry.
   (SC.H.1.4.1, SC.H.3.4.1)

3. Write hypotheses leading to different types of experimental designs for selected problem statements using variables identified as independent (manipulated) and responding (dependent).
   (SC.H.1.4.0)

4. Routinely analyze experiments in terms of problem statement, hypothesis, manipulated and responding variables, quantification of variables, identification of variables held constant, the number of tests and trials, and the use of an experimental control.
   (SC.H.2.4.2)

5. Based upon an appropriate number of experimental trials and samples, systematically collect and organize data into tables or charts and properly distinguish among types of qualitative (nominal and ordinal) and quantitative (interval and ratio) data analyzed.
   (SC.H.1.4.0)

6. Interpret experimental data by reordering and/or plotting graphs and then describing the central tendency of the data by the appropriate use of the mean, median and/or mode, and the variation of the data by the appropriate use of the range and/or frequency distribution.
   (SC.H.1.4.0)

7. Write conclusions that cover the following seven points: state what was investigated; describe whether the hypothesis was supported by the results; include sample results; compare the results with other investigations; provide possible explanations about the results; recommend additional studies; discuss possible applications.
   (SC.H.1.4.3)

CBC/CEE INTERFACE
CHEMISTRY/COMPONENT I
Competency A, continued:

8. Analyze conclusions by classifying each sentence as a statement based upon one of the following: an observation (the result of information gathered throughout the senses), an inference (the explanation or interpretation of observations), a fact (the activities performed during the investigation), or an opinion (inferences not directly supported by observations). **(SC.H.1.4.7)**

9. Identify the parts, functions, proper care, and use of appropriate scientific equipment, e.g., balances, and demonstrate accurate metric measurement by reading common laboratory apparatus to the nearest one-half unit of measure and describing the uncertainty of these measures.

10. Select attire (aprons, eye protection, containment of hair, clothes)to ensure personal protection, and practice accepted safety procedures using appropriate science equipment for all science activities. **(SC.H.1.4.0 for objectives 9 and 10)**

Competency B: Apply chemistry knowledge, principles, and skills to clarify and make decisions involving critical social issues such as environmental pollution, nuclear medicine, and pharmaceuticals, using fundamental chemical principles as a common thread.

Objectives:

4. Determine that results are tentative, are subject to different interpretations, and should be replicable by other scientists. **(SC.H.1.4.4, SC.H.1.4.5, SC.H.1.4.6, SC.H.1.4.7)**

5. Explore research and career opportunities in chemistry. **(SC.H.3.4.6)**

TEACHER PREPARATION LIST

1. **ENTER** appropriate information on the **Parental Permission and Health Statement** (M-DCPS form MIS-10566, page 14) such as school name, date, BNCEE trip date, teacher name, and school phone number.

2. **DUPLICATE AND DISTRIBUTE** the Student Guidelines (pages 23-28), including the **Parental Permission and Health Statement**. When returned, be sure the parent has signed in **two (2) places**. Cut the form in half – **THE TOP PORTION IS TO BE RETAINED AT YOUR SCHOOL BY THE PRINCIPAL'S SECRETARY. THE BOTTOM HALF SHOULD BE GIVEN TO A BNCEE INSTRUCTOR UPON ARRIVAL AT THE CENTER. NOTE:** To participate, each student must have a completed form. The school principal will be called and asked to pick up any student who arrives at the Center without a completed and signed **Parental Permission and Health Statement.**

3. **REVIEW** the **Student Safety Procedures** and **Student Preparation Checklist** with the students.

4. **ARRANGE** for lunches: Instruct students to bring lunches that do **NOT** require refrigeration, as they will be stored on a picnic table in the shade. Plan to pack cold drinks in ice chests.

5. **BUS BOARDING:** The bus will be at the school site at 7:30 a.m. Be prepared to board soon after.

6. **NOTIFY** all participants about clothing: Other teachers, chaperones, and students need to bring a towel and change of clothes, including underclothes and shoes. ***WEAR APPROPRIATE CLOTHING IN COLD WEATHER:*** long pants and a long-sleeved sweatshirt over a T-shirt.

7. **ASSIST** students in conducting the **Population-Density Simulation Lab** (pages 17-20) and selected **Additional Student Pre-Visit Activity Suggestions** (page 16).

MIAMI-DADE COUNTY PUBLIC SCHOOLS (MDCPS Form: MIS-10566)

PARENTAL PERMISSION - CENTER FOR ENVIRONMENTAL EDUCATION

School Name:_____ Teacher:_____
Student's Last Name:_____ First Name:_____
Field-Trip Date:_____ School Phone Number:_____

Dear Parents: Your child is invited to participate in an environmental education experience at the Biscayne Nature Center for Environmental Education (BNCEE) on Key Biscayne, a National Environmental Study Area (6767 Crandon Boulevard) near Parking Lot 1-2, Crandon Park, and at various sites on Virginia Key. This is a special program offered by the Miami-Dade County Public Schools.

The program is physically demanding and may involve three or more miles of hiking. There **will be wading** in shallow water (weather and other conditions permitting). There is **NO SWIMMING**. In order for your child to have the safest and best educational experience, you should go over the safety rules and complete the checklist with your child.

Please complete the **PERMISSION AND HEALTH STATEMENT** form at the bottom of this page. If you are able to accompany the group as a chaperone, please contact me.

My child _____ has my permission to attend the Biscayne Nature Center for Environmental Education program at Key Biscayne and Virginia Key.

X_____
(Parent Signature)

TEACHER, TEAR BELOW THE LINE AND GIVE TO BNCEE STAFF MEMBER WHEN REQUESTED.

PERMISSION AND HEALTH STATEMENT:

My child _____ has my permission to attend the environmental education program on Key Biscayne and Virginia Key on_____, 20___. I have instructed him/her to abide by all rules of the program.

X_____
(Parent Signature)

Please describe any allergies, or special health problems affecting your child and any medications currently required.

_____
_____
_____

Note: A parent should accompany a child who has a serious health problem.

EMERGENCY INFORMATION:

Student Name:_____
Emergency Contact Person's Name:_____
Emergency Phone Number:_____

Teacher's Name:_____**School Name:**_____

EMERGENCY CONTACT INFORMATION SHEET (M-DCPS Form: MIS-13583)

School Name: _____Teacher's Name: _____ School Phone: _____

Emergency Contact Information			
Student Last Name	First Name	Emergency Contact Name	Phone #
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SUGGESTED PRE-VISIT ACTIVITY

TEACHER PREPARATION AND TIPS: Have the students work in teams. One member should be equipment manager. All members will record the data collected and do the calculations. Hold all team members accountable for all data, etc.

After this activity is completed, review with the students the ***Description of the Quadrat Sampling Method Used in a Population Density Survey*** (page 26). Those are the activities the students will complete during the field trip. Not all students will be able to go, but the data they bring back will be more meaningful to the entire class if all students have completed this simulation.

PROCEDURE:

1. Discuss the background information.
2. Review lab procedures.
3. Hand out and discuss student worksheets.
4. Distribute materials.
5. Allow the students to complete the simulation.
6. Collect materials.
7. Reconvene the teams to discuss results, complete the calculations, and complete the worksheets.
8. Create charts and/or graphs to illustrate data.

ASSESSMENT: Successful completion of activities and student worksheets

STUDENT WORKSHEETS:

1. Population-Density Simulation Lab (page 17)
2. Population-Density Lab Student Data Sheet (pages 18-20)

ADDITIONAL STUDENT PRE-VISIT ACTIVITY SUGGESTIONS:

1. Construct a food web using the "species" found in the simulated quadrat.
2. Describe the factors that affect the existence of grass beds.
3. Describe the importance of grass beds to organisms.
4. Practice the population-density survey in your own backyard by marking off a one-meter-by-one-meter quadrat of grass. Identify as many different plants and/or animals as you can and count the number of each. Record your observation.
5. Use your textbook to review the characteristics of each major phylum within the animal kingdom, and practice classifying common marine animals according to their respective phyla.
6. **SAMPLE PROBLEM:** A scientific team collected 200 edible shrimp in a quadrat. The length of each side of the quadrat was 10 meters. What is the population density of edible shrimp? (Answer on page 28).

POPULATION-DENSITY SIMULATION LAB

TEACHER INFORMATION

LESSON TITLE: Simulated Seagrass Population-Density Survey

PURPOSE OF LESSON: This simulation introduces field techniques used at the Biscayne Nature Center for Environmental Education during the Population Density Survey. The computations and questions that follow are designed to help determine the significance of the student data.

BACKGROUND: South Florida seagrass beds are primarily composed of three plants: turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), and shoal grass (*Halodule wrightii*). These plants grow on a substrate that is generally composed of calcium carbonate ($CaCO_3$) and a minute amount of silica sand (silicon dioxide - SiO_2).

The oceanic water temperature range in Florida is 17°- 32°C. The water salinity is about 35°/oo (35 parts per thousand). The tidal range at Government Cut is typically about 0.75 meters. Extensive seagrass beds are not found deeper than 10 meters.

Seagrass beds serve as nursery and spawning grounds for a variety of marine tropical animals by providing protection, a food source, and a surface for attachment of sessile larval stages. A barrier sandbar protects the seagrass from severe wave action.

Scientists have determined that a large variety of species and/or phyla in the seagrass community indicate the existence of a healthy natural environment. Scientists can use a population-density survey to evaluate the productivity or yield of a community.

TIME: 1-2 hours

MATERIALS / STUDENT TEAM: (NC = non-consumable, C = consumable)

(NC)	artificial turf (12 cm. X 12 cm.)	(NC) sand (bucketfull)
(C)	paper towels	(NC) string (15 cm.)
(NC)	petri dishes (6-8 per team)	(NC) metric ruler
(NC)	4 dissection pins	(NC) dissection pan
(NC)	forceps for each student	
(NC)	species mix of small shells, fish scales, etc. (up to 8 “species” in the mix)	

POPULATION-DENSITY SIMULATION LAB (continued)

STUDENT DATA SHEET

PROBLEM STATEMENT: Scientists have determined that a large variety of species and/or phyla in the seagrass community indicates the existence of a healthy natural environment. Scientists can use a population-density survey to evaluate the productivity or yield of a community. How "healthy" is your simulated seagrass community? How many different species does it contain?

HYPOTHESIS: My seagrass community contains _____ different species.

MATERIALS: Each team

artificial turf (12 cm. X 12 cm.)	sand	paper towels
string (15 cm.)	petri dishes	metric ruler
dissection pins	dissection pan	species mix
forceps for each member		

PROCEDURE:

STEP 1: Place a paper towel in the dissecting pan. On top of the towel, place the piece of turf; sprinkle in the "species mix."

STEP 2: Get ready to identify the area of study (quadrat). Measure and mark two points on the string that are 10 cm. apart.

STEP 3: Now lay out the quadrat in the dissection pan by creating a square with the dissection pins. Use the marked string to ensure the square is 10 cm. on each side.

STEP 4: It is time to collect the organisms that inhabit your quadrat. In an actual field setting, seine nets and landing nets are used to collect. In this simulation, you will use the forceps to collect the organisms represented by the shells, fish scales, etc. As you collect organisms, sort them into petri dishes according to "species." When all visible organisms have been collected, count them, and record on the data table.

STEP 5: In an actual field setting, the next step would be to return the organisms to their natural environment, but for this simulation, remove the pins and string from the quadrat, transfer the remaining organisms and sand onto a second paper towel. Use the forceps and remove any organisms you missed during the first count.

STEP 6: Record the names of the organisms on the data sheet.

STEP 7: Put all lab materials away. Complete the calculations and questions on the data sheet.

POPULATION-DENSITY SIMULATION LAB (continued)

STUDENT DATA SHEET

1. Record the "species" collected from the quadrat. List them ranging from most prevalent to least prevalent.

DATA TABLE		
Name of "Species"	*Number Collected*	*Density (/cm2)*
		/cm^2
		/cm^2
		/cm^2
		/cm^2
		/cm^2
		/cm^2
		/cm^2
		/cm^2
		/cm^2
		/cm^2

2. Study the definition of population density below. This is the formula you will use with the data collected in order to determine population density in the simulated habitat.

Population density is a ratio which expresses the number of individuals of a species in a sampling area divided by the size of the sampling area.

D = Number of Individuals/Area or D = N/A

NOTE: Area of a square = (length of a side)^2. Density is often expressed as individuals per m^2. In this simulation, it will be expressed as individuals per cm^2.

Use this formula to calculate the density for each "species" and record the results in the data table above.

POPULATION-DENSITY SIMULATION LAB

STUDENT DATA SHEET (continued)

3. List the names of organisms missed during the quadrat collection:

_____
_____
_____

4. During the quadrat collection, you failed to collect all of the organisms present. What were the reasons for this?

_____
_____
_____

CONCLUSION: Describe in a single paragraph what you learned.

_____
_____
_____
_____
_____
_____

APPLICATIONS: Now you have an idea of how a scientist actually collects field data. Think about and answer the following questions:

1. In the field, why might a collector miss some of the organisms present in a quadrat?

_____
_____

2. What factors may affect which species of organisms are found in a given grass flat?

_____
_____

3. Why do scientists repeatedly survey the same area?

_____
_____

4. How do scientists use the data collected?

_____
_____

TEACHER POST-VISIT ACTIVITY SUGGESTIONS

Students who participate in the field studies at the BNCEE may be able to independently complete the **Student Pre- and Post-Visit Activities**. The following activities are meant as an addendum. Some of these suggested activities could be conducted, discussed, and/or completed with entire classes, even though some of the students did not participate in the field trip.

Seagrass Community: General Activities

1. Have students explain how the seagrass supports many food webs.
2. Have students postulate a typical food chain/web in the seagrass habitat.
3. Have students discuss the trophic levels in which selected organisms belong and their placement in food-chain/food-web/food-pyramid schema.
4. Have students postulate why there are fewer seagrass beds in Biscayne Bay now than in 1900.

Plants of the Seagrass Community

5. Have students research how the structure of the seagrass plants affects wave action, beach erosion, and turbidity.

Animals of the Seagrass Community

6. Have students list the adaptive features that illustrate survival capacities of four animals found in the seagrass.

7. Have students who attended the field trip teach the class about particular phyla observed during the seagrass investigation.

8. Have students act out the behavior of selected seagrass organisms (charades). The class, using data sheets, attempts to identify the acted-out organism.

Physical Characteristics

9. Have students discuss the **physical conditions** as variables affecting the seagrass community. Examples of these variables are water temperature, tide range, depth of water, sunlight, current speed, water clarity, amount of dissolved oxygen, and salinity. Then discuss the correlation of a physical variable to the population density of a particular animal.

10. Have students research the source of the $CaCO_3$ and silica sand in the substrate.

TEACHER POST-VISIT ACTIVITY SUGGESTIONS (continued)

11. Divide the students into groups. Have the student groups identify and discuss environmental problems caused by human impact that were observed during the trip. Have the students hypothesize as to the effects such problems have on the seagrass community and consider solutions to these environmental concerns.

12. The total area of Biscayne Bay is 573 km^2. Approximately 63% or 361 km^2 of the Bay bottom is covered with seagrass. Based on the results of the population-density survey, have the students choose an arthropod and calculate the total number that might be found in Biscayne Bay. Do the same for a selected chordate.

13. Relative density is a calculation of the percentage of the total animal/plant count for a certain species. Have the students determine the relative density of each species by using the formula.

Relative Density = Density of a species/density of all species x 100 = _____%

14. Have the students compare and contrast the value of the team- or group-research approach to scientific data collection as opposed to working independently.

15. Have the students discuss some major advantages of actively participating in scientific fieldwork as opposed to merely reading about it.

16. Have the students compare data collected by your school to that collected by other schools or data collected by your school over several years. Graph the comparisons and hypothesize or develop inferences accounting for the observed variations.

BISCAYNE NATURE CENTER
for ENVIRONMENTAL EDUCATION

STUDENT SECTION

A Population-Density Survey of a Seagrass Community

MIAMI-DADE COUNTY PUBLIC SCHOOLS

BISCAYNE NATURE CENTER
FOR ENVIRONMENTAL EDUCATION,
KEY BISCAYNE, FLORIDA

STUDENT OVERVIEW AND OBJECTIVES

At the Biscayne Nature Center for Environmental Education (BNCEE), you will participate in a field investigation where marine organisms are collected, sorted, classified, counted, and recorded. Upon return to school, you will use the data to determine the **Population Density** of organisms in the study area. This field-research activity focuses on a marine biological system, the **Seagrass Community**, in the Atlantic Ocean along the shores of Key Biscayne/Virginia Key**.***

Prior to your trip to the Center, your teacher will guide you through certain procedures and activities regarding the Seagrass Community. You will be required to submit a completed **Parental Permission/Health Statement** (page 7), signed in **TWO** places by a parent or guardian. Please review the **Safety Procedures** and use the **Student Preparation Checklist** while preparing for your visit.

Upon your arrival at the Center, the BNCEE staff will discuss certain ecological aspects of the South Florida environment and inform you of protective adaptations of selected marine organisms you may encounter. An explanation of the technique and equipment used in the population-density survey will be given prior to dividing your group into three teams for the seagrass study.

The program activities focus on:

1. Using the **quadrat method** (page 19) to conduct a population density survey of the animals living in a seagrass community.

2. Identifying the physical and biological characteristics of a seagrass community.

3. Classifying the collected organisms according to their respective phyla.

4. Determining the number of individuals of each species and mathematically expressing, interpreting, and applying the data.

5. Drawing some significant conclusions based on the information collected.

**** In the event of inclement weather, land-based activities may be conducted.***

STUDENT SAFETY PROCEDURES

The program at the Center for Environmental Education is designed so that you can learn about the environment and have fun at the same time. For a safe visit, please observe the following rules:

1. **REMAIN IN YOUR GROUP AT ALL TIMES**.

2. **NO SWIMMING AT ANY TIME**. UP TO WAIST-DEEP WADING WILL BE INCLUDED IN THE SEAGRASS AND/OR MANGROVE INVESTIGATIONS WHEN WEATHER AND OTHER CONDITIONS PERMIT. THIS WADING INVOLVES WALKING IN SHALLOW WATER.

3. **TENNIS SHOES ARE TO BE WORN AT ALL TIMES**. Shoes must be worn in the water, because there may be bottle tops and broken glass on the bay floor which can injure you. Many plants and animals are harmful when stepped on. No open-toe shoes or sandals will be permitted **(old tennis shoes that can tie are recommended over water shoes/booties)**.

4. **REPORT ALL INJURIES OR ILLNESS**. First-aid supplies are available.

5. **IN CASE OF STORMS**, be quiet and alert. Listen to instructions. Seek shelter in a building or bus. Do not stay in the open or stand under a lone tree, especially during an electrical storm.

6. **NO GUM CHEWING IN THE WATER.**

NOTE: Staff at the BNCEE are full-time science teachers of Miami-Dade County Public Schools. The CODE OF STUDENT CONDUCT applies at all times.

	STUDENT PREPARATION CHECKLIST
	1. I HAVE THE PERMISSION AND HEALTH STATEMENT completed and signed (in two places) by one of my parents. The *EMERGENCY CONTACT NAME AND PHONE NUMBER* have been filled in. I gave the completed form to my teacher.
	2. I HAVE PACKED a towel and a complete change of clothes including underwear and shoes. I have included a plastic bag for wet clothes.
	3. I HAVE PACKED a raincoat, sweater or jacket, sun hat, sunscreen, and insect repellent (NO SPRAYS, PLEASE), as appropriate.
	4. I HAVE PACKED a lunch in a strong bag with 1 or 2 drinks in cans - NO BOTTLES OR THERMOS JUGS. Lunches and drinks are clearly identified with my name. I have a packed a lunch that does not require refrigeration.
	5. I WILL WEAR shoes that can get wet. I will wear shoes, shorts, and shirts for wading. I WILL NOT WEAR A BATHING SUIT, SANDALS, OR OPEN-TOE SHOES. For cold weather wading, I will be prepared to wear shoes, long pants, and a long-sleeved shirt over a T-shirt IN THE WATER. **(old tennis shoes that can tie are recommended over water shoes/booties)**
	6. I am aware of all the safety procedures on this page.
	7. I HAVE COMPLETED AND TURNED IN the *Pre-Visit Activities*.

STUDENT BACKGROUND INFORMATION

A SEAGRASS COMMUNITY POPULATION-DENSITY SURVEY

South Florida seagrass beds are primarily composed of three plants: turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), and shoal grass (*Halodule wrightii*). These plants grow on a substrate that is generally composed of calcium carbonate ($CaCO_3$) and a minute amount of silica sand (silicon dioxide - SiO_2).

The oceanic water temperature range in Florida is 17°- 32°C. The water salinity is about 35°/oo (35 parts per thousand). The tidal range at Government Cut is typically about 0.75 meters. Extensive seagrass beds are not found deeper than 10 meters.

Seagrass beds serve as nursery and spawning grounds for a variety of marine tropical animals by providing protection, a food source, and a surface for attachment of sessile larval stages. A barrier sandbar protects the seagrass from severe wave action.

Scientists have determined that a large variety of species and/or phyla in the seagrass community indicates the existence of a healthy natural environment. Scientists can use a population-density survey to evaluate the productivity or yield of a community.

DESCRIPTION OF THE QUADRAT SAMPLING METHOD USED IN A POPULATION-DENSITY SURVEY

Population-density surveys are often used "to determine the number of individuals of a species present in a sampling area." For this study, the sampling area (quadrat) will be defined as an area having four sides of equal length.

Materials: (to be supplied by the BNCEE)

seine net	hand nets	quadrat poles
landing nets	10-meter tape	life jackets
trays	buckets	phyla signs
data recording sheets	first-aid kit	clipboards
meter stick	thermometer	pencils

STUDENT BACKGROUND INFORMATION
DESCRIPTION OF THE QUADRAT SAMPLING METHOD USED IN A POPULATION-DENSITY SURVEY (continued)

Method

Each team will mark off a quadrat, ten meters on each side, in a bed of seagrass. In this one-hundred-square-meter (100 m^2) area, pelagic organisms will be collected by making three pulls across the quadrat using a seine net. Benthic and additional pelagic organisms will be collected using the landing nets. A systematic method of collection will be employed to ensure a thorough sampling of the area. All organisms collected from the sampling area will be temporarily stored in buckets.

On shore, the organisms will be transferred from the buckets into several large water-filled trays. Then organisms will be sorted and classified according to appropriate phyla, with each phylum assigned to one or more small trays. Within each phylum, individual species will be identified, counted, and recorded. Organisms will then be returned to their habitat.

STUDENT POST-FIELD TRIP ACTIVITIES

1. Determine the population density of the three most prevalent (common) and the three least prevalent animal species using the formula:

Density = N/A

(Where N represents the number of a species caught and A is the area of the quadrat)

MOST PREVALENT SPECIES

Name of Species	Number Collected	Density
		/m^2
		/m^2
		/m^2

LEAST PREVALENT SPECIES

Name of Species	Number Collected	Density
		/m^2
		/m^2
		/m^2

2. What is the function and value of the seagrass beds as a shallow-water marine habitat?

3. What contribution do you think the existence of seagrass makes to commercial and sport fishing?

4. List possible sources of error in the population-density survey conducted in the seagrass.

5. Suggest changes or improvements in the equipment and/or methods used in this study.

6. How can this type of study be useful to the scientist?

ANSWER TO THE SAMPLE PROBLEM ON PAGE 9

Density = N/A = 200 shrimp/10m x 10m = 200 shrimp/100m^2 = 2 shrimp/m^2

MIAMI-DADE COUNTY PUBLIC SCHOOLS
NON-DISCRIMINATION POLICY

The School Board of Miami-Dade County, Florida, adheres to a policy of nondiscrimination in employment and educational programs/activities and programs/activities receiving Federal financial assistance from the Department of Education and strives affirmatively to provide equal opportunity for all as required by:

Title VI of the Civil Rights Act of 1964 - prohibits discrimination on the basis of race, color, religion, or national origin.

Title VII of the Civil Rights Act of 1964, as amended - prohibits discrimination in employment on the basis of race, color, religion, gender, or national origin.

Title IX of the Education Amendments of 1972 – prohibits discrimination on the basis of gender.

Age Discrimination in Employment Act of 1967 (ADEA), as amended - prohibits discrimination on the basis of age with respect to individuals who are at least 40.

The Equal Pay Act of 1963, as amended – prohibits sex discrimination in payment of wages to women and men performing substantially equal work in the same establishment.

Section 504 of the Rehabilitation Act of 1973 - prohibits discrimination against the disabled.

Americans with Disabilities Act of 1990 (ADA) - prohibits discrimination against individuals with disabilities in employment, public service, public accommodations and telecommunications.

The Family and Medical Leave Act of 1993 (FMLA) – requires covered employers to provide up to 12 weeks of unpaid, job-protected leave to "eligible" employees for certain family and medical reasons.

The Pregnancy Discrimination Act of 1978 – prohibits discrimination in employment on the basis of pregnancy, childbirth, or related medical conditions.

Florida Educational Equity Act (FEEA) - prohibits discrimination on the basis of race, gender, national origin, marital status, or handicap against a student or employee.

Florida Civil Rights Act of 1992 – secures for all individuals within the state freedom from discrimination because of race, color, religion, sex, national origin, age, handicap, or marital status.

School Board Rules, 6Gx13- 4A-1.01, 6Gx13- 4A-1.32, and 6Gx13- 5D-1.10 - prohibit harassment and/or discrimination against a student or employee on the basis of gender, race, color, religion, ethnic or national origin, political beliefs, marital status, age, sexual orientation, social and family background, linguistic preference, pregnancy, or disability.

Veterans are provided re-employment rights in accordance with P.L. 93-508 (Federal Law) and Section 295.07 (Florida Statutes), which stipulate categorical preferences for employment.

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