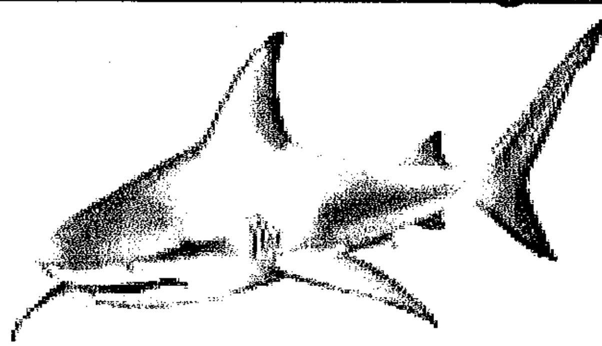
Icky Ichthyology -
Conservation Through Education



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Need for and Goals of the Program

"All children have a natural curiosity about the world around them."

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Nautilus Middle School Sharks'

Marine Conservation through Education: Icky Ichthyology

VISION:

The stakeholders of Nautilus Middle School endeavor to create a safe and effective learning environment that empowers students to become life-long learners, productive workers, responsible citizens, and thoughtful participants in a global society.

Comprehensive Middle School Science Blog
http://nautilusibsharks.spaces.live.com
Science is taught through inquiry and engaged learning laboratories through hands on activities and technology.

Program Summary:
Approaches to learning

Students will complete a scientific research based project on Ecosystems. Each Ecosystem will represent a Biome to research. Students will base their research on unit questions. They will create their Biome to represent an ecosystem. Student projects will be on display. Projects will include: maps, statistic charts, food, natural resources, brochures, timelines, natural and biological conservation data, weather/climate, natural resources, diseases, languages, art, and digital presentation through technology and distribution of information.

Students will become familiar with marine biology and the diversity of fishes working with salt water aquariums and live specimens. Ecology, the relationship of diverse life in the ocean, and differences between sport fishing and threatened species will be examined and researched. Students will apply science lessons and activities to real life situations, while interacting with protected species and conservation organizations online through computer technology.

Classroom lessons and activities include creating an aquarium with live specimens to understand relationships through observations. Students participate in online tracking of specimens and investigation with real life conservation organizations, comparing the methods and impact of local, national, and international programs.

Goals and Objectives:

Marine Conservation Through Education

This interaction with conservation is concerned with raising students' awareness of human interdependence with natural and man-made environments. It aims to help students develop an understanding of the concepts of conservation and sustainable development and how decisions and actions affect the delicate balance of the natural life support system. This area of interaction helps students develop attitudes and dispositions of concern and respect for context of environmental decision making everyday.

How Living Things Interact with Their Environment, demonstrates how a brief change in limited resources of an ecosystem may alter size of a population or average size of individual organisms and that long-term change may result in the elimination of animal populations. Students will understands that changes in the environment cause changes in populations and that humans are a part of an ecosystem and their activities may deliberately or inadvertently alter the equilibrium in ecosystems. Students will improve understanding and refine knowledge of ways that human activities may deliberately or inadvertently alter the equilibrium in the ecosystem.

The Nature of Science: Student uses the scientific processes and habits of mind to solve problems, understands that most natural events occur in comprehensible, consistent patterns and that science, technology, and society are interwoven and interdependent

Students will become familiar with:

Unifying concepts and processes in science:
Life science: Structure and function in living systems
Reproduction and behavior
Populations and ecosystems
Diversity and adaptations of organisms
Biological evolution Interdependence of organisms
Matter, energy, and organization in living systems

Students will:

- describe patterns of structure and function in living things
- know the structural basis and relationships of single and multicellular organisms
- understand the structures of cells, function and ways these mirror the structure and function of multicellular organisms
- understand diversity of cell structure permits diversity of functions for the organism.
- uses tools to identify or compare cells (i.e. microscope, hand lenses, bioscopes).
- understands the process and importance of genetic diversity.
- knows patterns of sexual and asexual reproduction in plants and animals
- knows organisms in populations live to reproduce due to survival characteristics.
- knows ways organisms are adapted to their environment.
- understands that species have characteristics that enable their populations to cycle within varying periods of time (minutes to hundreds of years).

Florida Sunshine State Standards Science Grades 6-8
FROM ASSESSMENT TO TEACHING AND LEARNING ACTIVITIES THROUGH INQUIRY

The Nature of Matter:
Standard 1: Student understands that all matter has observable measurable properties (SC.A.1.3.)
Standard 2: Student understands basic principles of atomic theory (SC.A.2.3).

Energy:
Standard 1: Students recognize that energy may be changed in for with varying efficiency (SC.B.1.3).
Standard 2: Student understands the interaction of matter and energy (SC.B.2.3).

Processes that Shape the Earth
Standard 1: Students recognize that processes in the lithosphere, atmosphere, hydrosphere, and biosphere interact to shape the Earth (AC.D.1.3)
Standard 2: Student understands the need for protection of the natural systems on Earth (SC.D.2.3.).

Earth and Space
Standard 1: Students recognize the interaction and organization in the Solar System and universe and how this affects life on Earth (SC.E.1.3).
Standard 2: Students recognize the vastness of the universe and the Earth's place in it (SC.E.2.3).

Processes of Life
Standard 1: Students describe patterns of structure and function in living things (SC.F.1.3).
Standard 2: Students understand that process and importance of genetic diversity (SC.F.2.3).

How Living Things Interact with Environment
Standard 1: Students understand competitive, interdependent, cyclic nature of living things in the environment (SC.G.1.3).
Standard 2: Students understand consequences of using limited natural resources (SC.G.2.3).

The Nature of Science:
Standard 1: Students use scientific processes and habits of mind to solve problems (SC.H.1.3).
Standard 2: Students understand that most natural events occur in comprehensible, consistent patterns (SC.H.2.3).
Standard 3: Students understand that science, technology, and society are interwoven and interdependent (SC.H.3.3).

Content What knowledge and/or skills are going to be used to enable the student to respond to the unit question? What state, district standards/skills are to be addressed? Sunshine State Standards? **SC.A.1.2.,.2.3,SC.B.1.3.,2.3, SC.D.1.3.2.3,SC.E.1.3.2.3,SC.F.1.3.2.3 SC.G.1.3,2.3, SC.H.1.3.2.3.3.3**
Skills and processes
Classifying- Ordering according to properties, characteristics or relationships
Communicating- Expressing information in a variety of forms—oral, written accounts, visual representations (graphs, diagrams, equations, tables, presentations using ICT applications, etc)
Defining= Giving the precise meaning of a word, phrase or physical quantity
Experimenting= Testing a hypothesis (at the core of scientific investigation)
Hypothesizing- Stating a problem in the form of a question, prediction, scientific explanation that can be verified by a process of experimentation
Predicting- Offering statements, suggestions or hypotheses based on observations, experience and knowledge to anticipate the outcome of a situation
Observing- Using the senses and instruments to focus the perception on some phenomenon, object or process
Measuring- Using appropriate instruments and techniques to collect and record data on weight, mass, temperature, time, volume etc
Recording- Collecting, showing and presenting data, findings and conclusions
Inferring- Making judgments based on observations and past experience
Inquiring= Formulating questions in order to clarify issues and understand meaning
Interpreting data- Observing information and offering explanations, organizing data, drawing conclusions and predictions
Analyzing- Examining and breaking information into parts, identifying patterns, relationships, causes, main ideas
Modeling- Describing and explaining relationships between ideas often using simplified mathematical or diagrammatical representation
Recognizing patterns- Articulating interrelationships between parts and components
Synthesizing- Combining information in a different way to construct meaning
Evaluating- Assessing the validity of information or quality of the work based on criteria

Course Outline/Overview

Narrative Description of the Program

Students will have the opportunity to study ocean life and the ecosystem through lessons and laboratory activities. Through outreach labs, students will have hands on experience in becoming familiar with ocean life of several classifications and their home environment. Classroom lessons and activities will include creating their own aquarium with live specimens and understanding their relationships on a daily living observation situation.

Student activities will integrate technology and studies of conservation organizations while understanding the impact of human population on ocean environment. Students will be performing activities in researching specific species and areas, diagramming life cycles, energy pyramids, and creating biomes and Power Point Presentations to understand the specialized needs of organisms and how balance is maintained in an aquatic ecosystem.

Students will create and observe a model natural habitat with live specimens and aquatic accessories. One research project will be conducted by setting up several small identical tanks and exposing them to different environmental conditions to observe how changes in one aspect of the environment can affect the other. Classroom aquarium ecosystem will make an effective display tank as well as providing opportunities for observation and inquiry.

Program Evaluation

Rubrics will be in place so students will know what is expected of them. KLW chart will be performed with each group. They will update, routinely, entries to monitor what they are learning versus what their preconceived ideas were. They will be assessed on participation as collaborative learning teams, completion of their finished products used in research, and presentation of their findings using technology and computer generated graphs illustrating their data analysis. Summaries of their research investigations and science project conclusions, with presentations will be presented on the class website.

To optimize learning, it helps to learn in a multi-sensory environment. Students become familiar with marine biology and diversity of fishes working with aquarium, biomes, and specimens. Ecology, the relationship of diverse life in the ocean, and differences between sport fishing and threatened species were topics of interest. Students apply science lessons and activities to real life situations, interacting with protected species and conservation organizations online through computer technology. Students want to learn about subjects they personally connect with or have prior knowledge. Active learning lessons, through inquiry, encourage integration into students' daily lives and focused interest. Computer interactive exploration activities are used as extension of the lessons for biological and scientific investigation through clinical laboratory procedures cultivating students for this professional field.

Hands on investigations of salt water and fresh water species are explained through form and function, classifying and organizing orders. Students will use the scientific processes and habits of mind to solve problems and understand that most natural events occur in comprehensible, consistent patterns.

Students will understand through studying ocean environments and living specimens, the need for protection of natural systems on Earth. Students will understand the process and importance of genetic diversity and be able to describe patterns of structure and function in living things. In studying life in ocean environments, students will understand how living things interact with their environment in competitive, interdependent, cyclic nature of living things in the environment, and the consequences of using limited natural resources.

In activities and related projects, students will use scientific processes and habits of mind to solve problems understanding that most natural events occur in comprehensible, consistent patterns. Through creating their own classroom salt water aquarium, students will experience and monitor the diversity and relationships of living ocean life, while collecting data and analyzing information to synthesize necessary criteria for conservation of endangered, threatened, and abundant species of life. Nautilus students will understand that science, technology, and society are interwoven and interdependent.

Students work in small cooperative learning groups participating in scientific inquiry activities. Laboratory activities encourage participation and achievements, developing a sense of relationship between evidence and explanation. Science methodology of organization, order, and classification of species through investigation of form and function of live and growing specimens provide evidence through first hand experiences in regular monitoring of field research through a classroom living habitat biome with live specimens.

Laboratory exercises provide direct observation, analysis, written explanations, and student presentations of findings based on observation, data collection, testing and conclusions of simulated filed studies. Activities using multiple intelligences include visual aids through interactive technology, hands on examinations of live specimens, and discussions of characteristics. Small learning groups communicate and explain their procedures and evidential findings.

Optimized Learning is demonstrated in student learning in a multi-sensory environment. Learning through inquiry consists of students learning:

10% of what they read
20% of what they hear
30% of what they see
50% of what they see and hear
70% of what they say
90% of what they say and do

This program fills a need, critical in concrete stages of development in science that broadens understanding and applied knowledge essential in ecology and biology. This program introduces species relationships, investigates organs and systems, physiology, and interdependence of the major organs in various species of the animal kingdom. Students acquire and retain an in-depth understanding of the diversity of life and relationships through basic anatomy and physiology analyzing comparative anatomy, function, evolution. Teachers give students opportunities to engage in and reflect on natural phenomena through inquiry by observing, organizing, experiment/ laboratory and communicating.

Learning Experiences

How will students know what is expected of them to practice and apply new knowledge?

With projects, they receive rubrics when project is assigned and explained. They will be shown examples and practice skills taught throughout unit in homework, individual/partner work, group activities, formal assessments and products. Students will present their model BIOME, with technology visual aids and data analysis through graphs to demonstrate the current dilemma of ecosystems and the impact human population can have on it for improvement. Examples, Rubrics, templates, class discussions, feedback from students and teachers will show expected outcome. Students acquire knowledge and practice skills.

Teaching Strategies

Formative assessments with teacher and student feedback while encourage differentiated teaching and learning for all.

Projects will be student and teacher-assessed corrected, with open discussions. Rubrics, tests, quizzes, class work and homework assignments graded by teacher, student or class, to give timely feedback. Students will complete corrections. Group activities, independent work, partner work, group literature circles, think/ pair/ share, reflections, researching, are teaching methods.

Vocabulary focus and student choice for research will be considered for ESE and ESOL students. Special accommodations used, such as extended time, separate settings, etc. for ESE students (see DATA notebooks). Expository research is done through video Pod casts, current event online and print publications in class discussions and individual research in basal reference books and computer activities (virtual labs or research). Labs with learning groups will engage students.

***LESSONS:* Assessments and Evidence of student understanding:**

Engaged Activities and Projects:

1. Icky Ichthyology: Research in oceanography biomes and creating and monitoring a water aquarium with live specimens for study of relationships.

2. Aquarium Ecosystem: Choice of Marine or Fresh Water Aquarium Ecosystem to monitor daily and research as a field study with live specimens

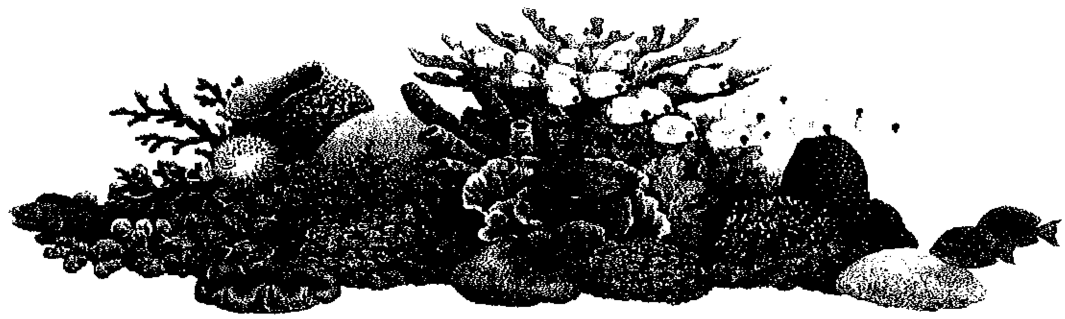
3. Adopting an endangered species or participation with wildlife conservation group-

4. BIOME Bizarre Ecosystems- Students build a 3 dimension biome and report conditions of global warming to minimize environmental problems.

5. Water Quality and Management

6. I am Puzzled" Ecology Crossword puzzles given to students / created by students to help ecology awareness.

7. Fun with Microscopes



LESSON 1: Icky Ichthyology:
Research in oceanography biomes to create an aquarium for study of live specimens.

Goal: Students make observations and direct measurements of a water ecosystem.
Objectives: Students will gain understanding of dynamics and relationships of human impact on water ecosystems. Students will conduct engaging, classroom-based "field studies" in biology and chemistry and create a habitat with aquarium and live specimens, as a versatile teaching tool for scientific methodology research and study

Lessons can be adapted to chosen teaching tools of fresh water or marine conservation activities as preferred by the teacher and class. Teaching with Ecosystem Aquariums (aquarium systems that also include a terrestrial, or land, component) allows students, especially those in urban areas, to observe elements of the natural world that they might not otherwise experience. This provides opportunities to conduct scientific inquiry in the classroom. A number of aquarium systems are suitable for modeling ecosystems such as brackish bogs and marshes, rivers, ponds, marine estuaries, and rainforests. They range from the elaborate Garden Aquariums to a simple Terra-Aqua Column made from a couple of 2 Liter soda bottles, which may be used to simulate a complex rainforest. Students care for the ecosystems, observe interactions among organisms, observe changes in the land and water environments, and conduct experiments using the scientific method. Aquarium ecosystems are excellent tools to help explore science content standards and teach science process skills while providing a unique learning experience.

Procedure for construction and function of a complete habitat:
Live rock reef aquariums
When people think of an aquarium, they think of fish swimming around a tank. This is not always the case. A live rock reef aquarium is a good alternative to a fish-only tank. Some enthusiasts think of a reef aquarium as a kind of Zen rock garden. It's not quite as lively as fish, but the steady pace of growth among the rocks is just what makes a live rock reef aquarium appealing. Classes may combine live rock, coral and animal life, or concentrate on reef-only aquariums. Live rock reef aquariums can be teeming with life, to be observed and analyzed by students. Those looking to combine a fish and reef aquarium have some work cut out for them because it can be difficult to maintain both reef life and fish life, partially because coral reefs and live rock need a fair amount of care to thrive. Live rock is much easier to maintain than coral, but it still needs a good environment to foster algae growth and other small invertebrates living in the rock. Reef

aquariums create a natural environment for live specimens of coral. Aquariums may be a combination of colored fish—but researched for compatibility and interdependence. Reef enthusiasts try to create a natural environment as close to the ocean as possible in a tank habitat. It is possible to combine coral with fish life, but it is a delicate balance to be approached with great care. Teachers can build up reef only aquarium to avoid worrying about jeopardizing the life span of fish. Coral is a living thing. Many find coral and live rock as lively and awe-inspiring as brightly colored fish.

Fresh Water or River Tank combines elements of an aquarium, a terrarium, and an animal exhibit to produce a dynamic habitat where plants, animals, and microorganisms interact in ecological balance. This can be exhibited in an aquarium tank with decorative and functional form in planting pockets and ledges to mimic a rock face such as might be found in a small mountain stream. A pump in the bottom of the tank sends water through a tube up the back of the form to flow through a channel before cascading down to return to the bottom of the tank. Some of the water also flows into the plant pockets, cascading from one pocket to the next. In this way water is recirculated throughout the system. The result is a series of mini-habitats, shallow and deep pools, slow and swift currents, rapids, eddies, and waterfalls, all connected by the flowing water.

This aquarium serves as a terrarium with cavities and ledges providing places to grow a variety of plants. These plants utilize fish waste and help keep the tank in balance by removing nutrients from the water. Reflecting the diversity of life in and around a stream, lizards and amphibians can use the banks and ledges as living areas.

The tank is designed to promote bacterial growth. Bacteria grow on practically every available submerged surface in the tank, and the plant pockets increase surface area available for the growth of bacteria. Water is well oxygenated and seeps slowly through the gravel, to promote an ideal, aerobic environment for beneficial bacteria. By supporting a large, healthy bacterial population, the river tank is well equipped for biological filtration without the need for expensive add-on filter units.

Students consider different types of organisms can live successfully in the tank and populate interdependently in tank environments. Leeches, crayfish, snails, worms, fish, salamanders, Anoles, newts, insects, bacteria, algae, higher plants, and many protistas all can be successfully raised, but need to be considered in coexisting with other species to learn a greater understanding of the concept of niches.

Establishing the fish collection poses a similar challenge for students.
The 20-gallon tank holds about 12 gallons of water and can support 12 to 16 fish. A class might consider the following questions when determining which fish to include:

1. Which species are considered community fish or aggressive?
2. Do all fish do well in a moving-water environment?
3. How many herbivores and scavengers does a tank this size require?
4. Do streams have bottom, mid-level, and surface feeders, as ponds do?

Once the fish colony is established, students can investigate additional questions:

1. Do fish orient themselves in predictable ways?
2. Does the water level (and waterfall size) affect fish migration between the pools?
3. Are certain species territorial?
4. Does crowding affect certain species more than others?
5. Since territorial fish often establish themselves near caves, does creating caves and overhangs change the behavior of certain fish?

Creating an Ecosystem Model

Students learn about ecology pyramids and relationships between producers, consumers, scavengers, and decomposers by determining how microorganisms, plants, and animals relate in a tank system. Students realize how dependent the biotic community is on abiotic components of the system (i.e., light, temperature, inorganic compounds, and oxygen and carbon dioxide levels) by studying its chemistry monitoring it daily.

Aquatic snails act as scavengers and window cleaners for the tank system
An aquarium ecosystem serves as an ideal introduction for a field trip to a local river or park, enabling a class to maximize the value of its visit. Students become aware to effects of human impact, destroying part of an ecosystem, or removing a particular organism. Information about organisms, habitats, niches, and ecosystems is available on Internet, podcasts, conservation groups, and science supply companies who also promote inquiry and activities through online, hard copy, and video. Viewing some of these images or using them to create a multimedia presentation gives students multi-sensory learning for opportunities to connect what they are learning in class to the world around them.

Microhabitats

If there are not too many herbivores in the tank, students will soon see several varieties of algae growing. Students can key out the specific types of algae, the entire class can have direct experience with the concepts of habitat and adaptation using a much less technical approach. By observing colors, growth patterns, and the location in the tank, all students can easily differentiate one type of algae from another. Where did the algae come from in the first place? Why does a particular alga grow in one place but not another? How does the distribution of algae change over time? Students will discover how minor changes in the environment give one species an advantage over another. Understanding ecosystems as comprised of well-defined habitats, students see that habitats can be divided into many microhabitats.

Identifying the characteristics of the microhabitats is a valuable exercise in problem solving. One challenge is to figure out how to observe differences in characteristics of the tank's waterfalls, pools, and rapids. This might be done by watching the movement of strings. Long, flexible plants can also serve as natural, qualitative flow indicators. Students create their own scale to describe the amount of turbulence.
Microhabitats are influenced by light intensity, moisture levels, and substrate differences. Once the microhabitats have been tentatively identified, students collect samples from each site to make direct observations and confirm whether the algae, microorganisms, and bacteria are indeed different at each site. Collecting samples can be done by scraping off small amounts of material, by examining growth microscopically. Students improve proficiency in lab skills by observing and describing the samples under the microscope.

Extension activities: Chemistry in the River Tank

Of the waste products fish excrete, ammonia, phosphorous, and undigested food impact an aquarium most significantly. Simple test kits are available for keeping track of the changing water chemistry of a river tank. Phosphorous occurs principally as dissolved phosphate and, since phosphate is often a limiting factor in plant growth, it is quickly removed by the plants directly. Undigested food and some by-products of digested food, namely amino acids and proteins, are a major source of dissolved organic compounds - a major component of the detritus that accumulates on the gravel bed and in the filters. This detritus is essentially harmless, but it clogs the filters and coats the gravel, limiting the ability of any carbonate particles in the gravel to dissolve and help buffer the water.

Ammonia (NH_3), is toxic to fish and must be removed or converted into benign substances before it builds up to lethal levels (levels above 0.1 ppm are considered dangerous). Some of the ammonia is taken up directly by certain plants (including most algae), but most is converted to mildly toxic nitrite (NO_2^-) by *Nitrosomonas* bacteria. *Nitrobacter* bacteria is converted to nitrite into nitrate (NO_3^-). Nitrate is quickly removed from the water by plants, which use it as a source of nitrogen to form proteins and nucleic acids. This processing of ammonia to nitrate is part of what is commonly referred to as the nitrogen cycle. Regular testing of the ammonia, nitrite, and nitrate levels gives a good sense of the robustness of the *Nitrosomonas* and *Nitrobacter* populations. Testing provides insight into well balanced the tank in the amount of waste generated and the ability of the bacteria to process that waste.

The pH of aquarium water is another important measure because fish are adapted to living within specific pH ranges; bacteria are sensitive to pH levels as well. African cichlids, for example, prosper in alkaline waters with a pH range of 7.4-8.0, while certain tetras thrive in acidic waters with a pH range of 6.0-6.2. If a fish is forced to live in a pH level outside its preferred range, its slime coat can suffer, making it susceptible to disease. Its fecundity drops and, ultimately, the gas exchange in the gill membranes will be so reduced that the fish may suffocate.

Nitrosomonas and *Nitrobacter* prefer an alkaline environment (pH 7-8), and pH levels much below 6 severely curtail their activity or kill them. Once the bacteria are gone, the toxic ammonia quickly builds up to levels that will kill all the fish.

In an aquarium, acids derive primarily from two sources. The first is when carbon dioxide (directly dissolved into aerated water or released as a respiration by-product) mixes with water to form carbonic acid.

$$H_2O + CO_2 <=> H_2CO_3 <=> H^+ + HCO_3^-$$

water + carbon dioxide <=> carbonic acid <=> hydrogen ion + bicarbonate

The other is when ammonia undergoes nitrification by *Nitrosomonas*.

$$2\,NH_3 + 3\,O_2 \text{ -> } 2\,NO_2^- + 2\,H^+ + 2\,H_2O$$

ammonia + oxygen -> nitrite + hydrogen ion + water

Should any part of the tank become anaerobic, the heterotrophic, bacteria producing, organic (e.g., lactic, acetic, and formic) acids will add to the acid load of the tank and lower its pH through fermentation. An underappreciated source of periodic pH swings is photosynthesis. During illumination, plants take in carbon dioxide, raising pH as the amount of carbonic acid (one source of carbon dioxide) in the tank is reduced. At night, respiring plants release carbon dioxide; so the amount of carbonic acid in the tank increases, lowering the pH.

Water hardness is an often overlooked though extremely important component of pH balance in an aquarium. Water hardness refers to total concentration of calcium and magnesium ions in the water, primarily from calcium carbonate ($CaCO_3$) and magnesium carbonate ($MgCO_3$). These ions, called buffers, are important because they slow the rate at which the pH changes.

The equation below shows that carbonic acid (H_2CO_3) dissociates into hydrogen (H^+) and bicarbonate (HCO_3^-) ions. The bicarbonate ions can further dissociate into hydrogen (H^+) and carbonate (CO_3^-) ions. When acid (H^+) is introduced into well-buffered water, carbonate ions react with the hydrogen ions to produce bicarbonate. Thus, even though acid is added, no change in the overall pH occurs. Furthermore, bicarbonate ions act as an additional reservoir for hydrogen ions. The reactions outlined in the equation below are pH sensitive and shift to the right as pH increases.

$H_2O + CO_2 <=> H_2CO_3 <=> H^+ HCO_3^- <=> 2H^+ + CO_3$
water + carbon dioxide <=> carbonic acid <=> hydrogen ion + bicarbonate <=> hydrogen + carbonate

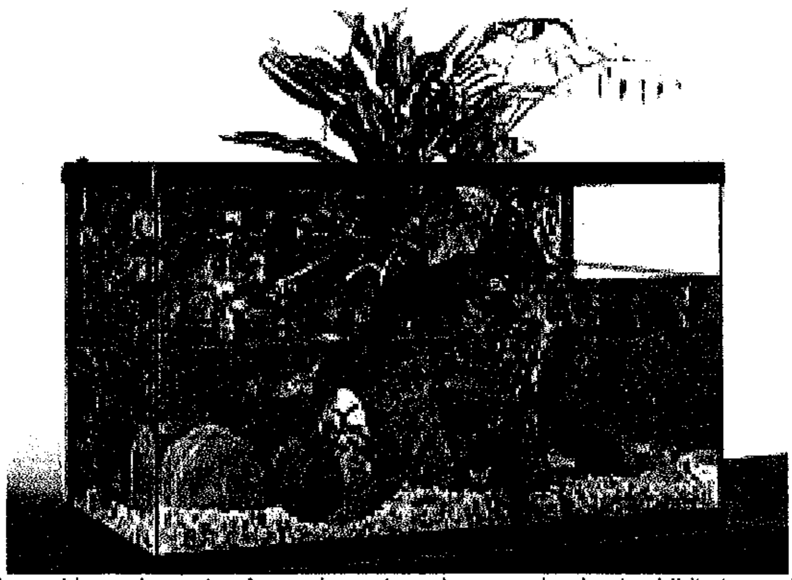
If the aquarium water is not well buffered (5.6-11.2 dKH or 100-200 ppm calcium carbonate in freshwater), any acid that is added serves to drive down the pH. The daily pH swings caused by photosynthesis can combine with longer-term acid accumulations and cause the tank to suddenly crash because of catastrophically low pH levels.

Oxygen is required to keep fish healthy and active and to maintain an aerobic environment that will support a robust, aerobic bacterial colony. The tank's small waterfalls and rapids aerate the water and keep it well oxygenated. A comparison of the oxygen levels between the tank and a container of standing water would demonstrate the role agitation and mixing play in maintaining oxygen levels. The agitation also helps dissipate any chlorine in the water which escapes at the surface as chlorine gas.


The comet goldfish

The aquarium ecosystem provides an effective way to present abstract ideas concretely. In discussing adaptation, students can see why animals with streamlined body shapes and plants with long, flexible stems live in streams. Concepts such as the water cycle, niches, ecosystems, changes over time, and the importance of the balance between the biotic and abiotic elements are powerfully reinforced by what students see in the tank and measure in their experiments. This serves as a visual-aid illustrating complex ideas for student comprehension.

Adaptation of the following teaching tool for marine conservation activities



The River Tank combines elements of aquariums, terrariums, and animal exhibits to produce a dynamic, ecologically balanced habitat. Shown here is a 45-gallon tank.

River Tank® is a registered trademark of Finn Strong Designs, Inc.
http://www.carolina.com/home

LESSON 2: Aquarium Ecosystems
Class Activity
Ecosystem Aquariums

Ecosystem aquariums (aquarium systems that also include a terrestrial, or land, component) allow students, especially those in urban areas, to observe elements of the natural world that they might not otherwise experience. They also provide opportunities to conduct scientific inquiry in the classroom. A number of aquarium systems are suitable for modeling ecosystems such as bogs and marshes, rivers, ponds, and rainforests. They can be as simple as the Terra-Aqua Column made from a couple of 2 Liter soda bottles, which may be used to simulate a complex rainforest. Students can care for the ecosystems, observe interactions among organisms, observe changes in the land and water environments, and conduct experiments using the scientific method.

For science content, students can study interrelationships and interdependence among organisms in the ecosystem. They can observe how changes in one aspect of the environment can affect the other. A classroom research project can be conducted by setting up several identical tanks and then exposing them to different environmental conditions.

For example, students can manipulate various abiotic (nonliving) variables such as temperature, light, pH, inorganic compounds, or oxygen and carbon dioxide levels and explore how simple changes may have a complex effect on ecosystems. By examining the interactions of the living and nonliving components of an ecosystem, students begin to understand how dependent the biotic community is on the abiotic components of the system.

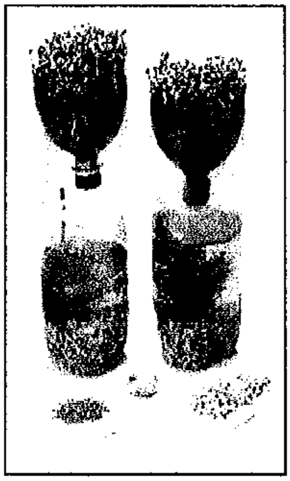


Figure 2 The TerrAqua Column (CT-15-9130) is a simple and inexpensive way to study the link between land and water.

Ecosystem aquariums provide abundant opportunities for learning basic and integrated science process skills, also. Conducting experiments like the ones suggested above allows students to apply the scientific method and learn appropriate experimental design. They also learn to observe and classify organisms, predict how a disturbed ecosystem will respond, measure the growth of organisms or the pH of the aquarium water, infer the reason for an observed result, and communicate their observations and results to the rest of the class.

TABLE 1

K–12 National Science Content Standards and Science Process Skills That Can Be Met Using Ecosystem Aquariums

Science Content Standards	
Unifying concepts and processes in science:	
K–12	Systems, order, and organization
	Evidence, models, and explanation
	Change, consistency, and measurement
	Evolution and equilibrium
Science as inquiry:	
K–12	Abilities necessary to do scientific inquiry
	Understanding about scientific inquiry
Life science:	
K–4	Characteristics of organisms
	Life cycles of organisms
	Organisms and environments
5–8	Structure and function in living systems
	Reproduction and heredity
	Regulation and behavior
	Populations and ecosystems
	Diversity and adaptations of organisms
9–12	Biological evolution
	Interdependence of organisms
	Matter, energy, and organization in living systems
	Behavior of organisms

Models of Natural Habitats

By creating and observing a model natural habitat, students learn about the interrelated ecological roles of the living (plants, animals, and microbes) and nonliving components of an ecosystem. This leads to an understanding of the relationships between producers, consumers, scavengers, and decomposers. While ecosystem aquariums are versatile, some are particularly suitable for modeling specific habitats.

Wetland Habitat

Bogs and marshes are considered wetland ecosystems. Concerns for diminishing wetland resources, and the important roles they play in our environment, make the study of these ecosystems relevant and important. In wetland areas the water table stays elevated at or above the ground level for extended periods of time. Floodwaters overflowing banks and rivers are taken up by wetlands and then slowly seep back, with the wetlands functioning as natural barriers to flooding. In areas where large expanses of wetlands have been drained, flooding has become a more severe problem than in the past.

Figure 3 The Living Machine (CT-16-2390) is ideal for modeling wetland habitats.

Wetlands are home to a wide variety of plants and animals, many unique to this ecosystem. Wetland plants are adapted to grow in water or soil with low levels of oxygen. Wetland plants and their root systems remove pollutants such as nitrogen and phosphates from the environment, allowing clean water to be fed back into streams. Some species of plants that preferentially take up heavy metals or other pollutants have even been used to clean contaminated sites or to treat sewage. (This use of plants to clean the environment is called phytoremediation.) The Living Machine (Fig. 3) is a model wetland ecosystem, ideal for studying the dynamics of natural wetland systems.

Stream Habitat

Streams or running water habitats generally support different organisms than standing water habitats (such as ponds, lakes, bogs, or swamps). Aquatic plants and animals are adapted so as to remain in place even against a strong current. Nutrient inputs and phytoplankton blooms do not generally occur because each would be washed away. Because currents mix water thoroughly, providing a high level of dissolved oxygen, animals of stream systems are not generally well adapted to low-oxygen environments.

River Tank™ Ecosystems (Fig. 4) may be used to model a stream or river and its banks. Students can collect local organisms to simulate a local habitat, or you may purchase tropical plants and animals to create a running water ecosystem. In fact, the requirements of low-light tropical land plants and tropical aquatic plants and animals may be more consistent with the classroom environment than temperate flora and fauna. For extensive ideas on use of River Tanks for teaching science, see "The River Tank™: A Versatile Tool for Teaching Science" in archived *Carolina Tips* at www.carolina.com (January, 1995).

Tropical Rainforest

Tropical rainforests cover almost a quarter of the total land area of the world, with about 20% of the world's population. These forests are generally found in tropical regions where the average rainfall is over 240 cm per year and the average temperature is over 17° C.

Lesson 3: Conservation Groups for Fish, Wildlife, and Sea Coral Biodiversity

Objective: Students will research coral reefs through books, magazines, and Internet to gain a greater understanding of the biodiversity of ocean life and living coral specimens in their natural ecosystem.

Focus Question: How does the biodiversity between tropical coral reefs and deep sea coral ecosystems relate to each other and are affected by human impact?

LEARNING OB JECTIVES
Students will research life forms found in tropical coral reefs and deep sea coral reefs to develop and understanding of biodiversity of the ecosystems
Students will compare the biodiversity and adaptations of coral reefs.

Materials for each collaborative learning group:
Colored pencils and markers
Drawing paper
Books, magazines, posters, with pictures and photos of coral reefs,

Activity 1: Research and Drawings

After the class is organized in small learning groups the teacher asks students to name sea life found in a coral reef. Students are directed in steps of researching through conservation organizations and other pertinent publications. Students use their research skills to learn about the ecosystem and locate photographs and drawing of tropical coral reefs. One following website for photos is: www.deepsea gallery.com

Each group presents there findings and drawings to the rest of the class. Class discussions include life specimens and criteria for surviving in their ecosystem of biodiversity.

Activity 2: Research and Drawing
The teacher directs students to research locations of an oceanic site on a World Map, asking the class, "Do you think the same life forms you drew on your tropical coral reefs will be found on these deep sea coral reefs?" Use their responses to guide a discussion of the demands of living in a deepwater ecosystem (no light, cold temperatures).
Students are recommended to research deep sea coral reefs at the following websites:
www.publicaffairs.noaa.gov/deepseacoral.html
www.gulfofmaine.org/times/winter99/deep_corals.html
www.cnn.com/2000/NATURE/08/10/coral.enn/

After an appropriate amount of time, life forms researched are discussed and drawn in their deep-sea coral ecosystems. Students may want to share the descriptions of the deep-sea coral reefs dwellers. The groups are directed to draw a picture of a deep-sea coral reef using their knowledge of this ecosystem.
4. Share group drawings with the class. The teacher should ask the students to compare the two coral reef ecosystems. How are they alike? How are they different?

FOR MORE INFORMATION
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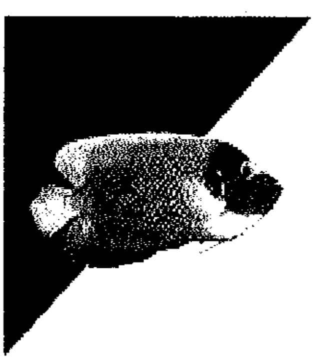
Internet sites for conservation organizations, discovery channel, and national geographic can be explored by students for choosing a location or a species to research the ecosystem and adaptation and life patterns of marine life in the five phyla of the animal kingdom.

Some recommended sites are:
www.coralreef.noaa.gov/outreach/resourcecd08/lessonplans.html
www.oceanservice.noaa.gov/education/classroom/lessons/01_data.pdf
www.thesciencejobs.com/jobs/biology/ecology/6448
www.unep-wcmc.org/latenews/index.cfm
weather.about.com/b/2009/08/09/say-goodbye-to-the-great-barrier-reef.htm
www.coralreefwatch.noaa.gov/satellite/education/reef_remote_sensing.html
www.oceanservice.noaa.gov/education/classroom/lessons/01_reef.pdf
www.symposium2006.conservation.org/
www.vims.edu/bridge/reef.html
ww.seaturtle.org
http://smithsonianeducation.org/educators/lesson_plans/ocean/main.html



LESSON 4: Biomes Bizarre Ecosystems- Students build a 3 dimension biome and report on conditions due to global warming and resolutions to minimize environmental problems.

Brief Description: A simulated field trip in which students visit various biomes and perform several sensory activities to learn about the world's ecological communities.

Objectives: Students will construct 3-D biomes. They will develop activities to help their peers experience the biomes. The ultimate goal of this activity is to allow students to be official tour guides and to teach one another about biomes, environmental responsibilities, habitats, and human roles in the various ecosystems.

Each student makes a passport with materials might include cardboard, construction paper, and glue. Students carry these passports from biome to biome. Additional material needs will be dictated by the general activities all students will participate in and activities students develop.

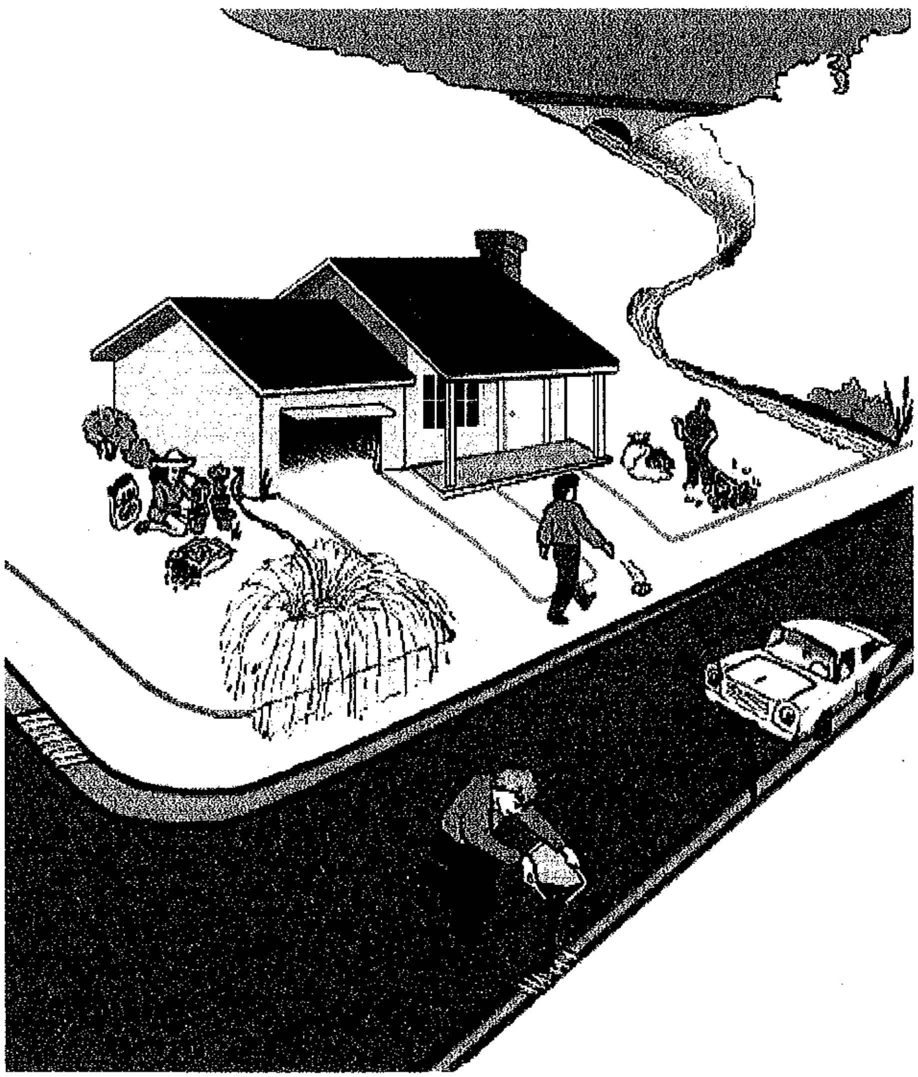
Lesson Plan
1. Assign each group to a different biome, as a savanna, desert, tundra, or rain forest.
2. Each group conducts research on the selected biome. The groups spend from five to seven days conducting research and planning activities for others to participate in when visiting the biome.
3. Students begin collecting materials for their classroom decorations. Each will decorate part of the room to resemble a selected biome.
4. Encourage all students to bring in materials to contribute to the group presentations. There must be at least five interactive activities in each biome exhibit so that as students visit a biome, they can engage in learning activities. For example, when students visit the rain forest, they might see a puppet show, listen to a native healer, and eat dishes prepared from bananas, or walk on logs to simulate the destruction of the rain forest.
5. On the day of the bazaar, every student will have an opportunity to visit all the biomes. At the end of a 30-minute tour, students get their passports stamped and move on to another activity. Prepare a schedule ahead of time so that students know exactly where they need to be every 30 minutes throughout the day. Students are rewarded with stamps for being at their own booths and leading the activities there.
Students can participate in activities that will challenge abilities to plot latitude and longitude, calculate population growth, and convert temperature from Fahrenheit to Celsius. They might contribute to a biome poem, illustrate environmental pictures using sand art, make thermometers from used plastic bottles, construct a life-sized model of an igloo, enjoy snow cones from the tundra, or categorize animals according to physical structures, adaptation abilities, and symmetry.

Assessment: Ask students to evaluate how the events are going and to offer suggestions and feedback. Rubrics are a basic assessment as the Collaborative Group Project.

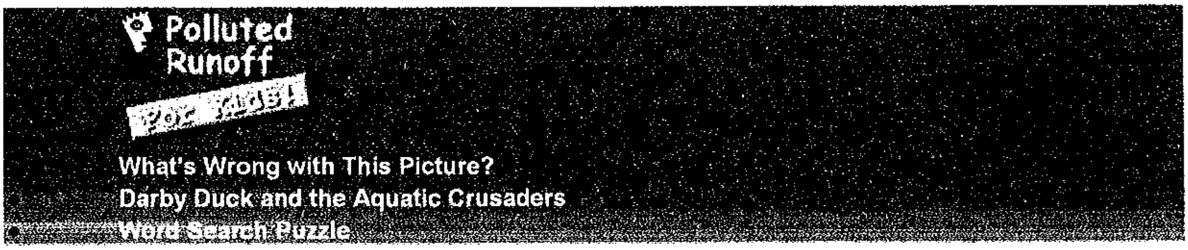
LESSON 5. Water Quality

Nonpoint Source Pollution Awareness
What's Wrong with This Picture?

The people below are taking care of their home and car, but they are doing many things that can damage the environment, especially our water. Click on the spots where you think someone is doing something wrong for a surprise.



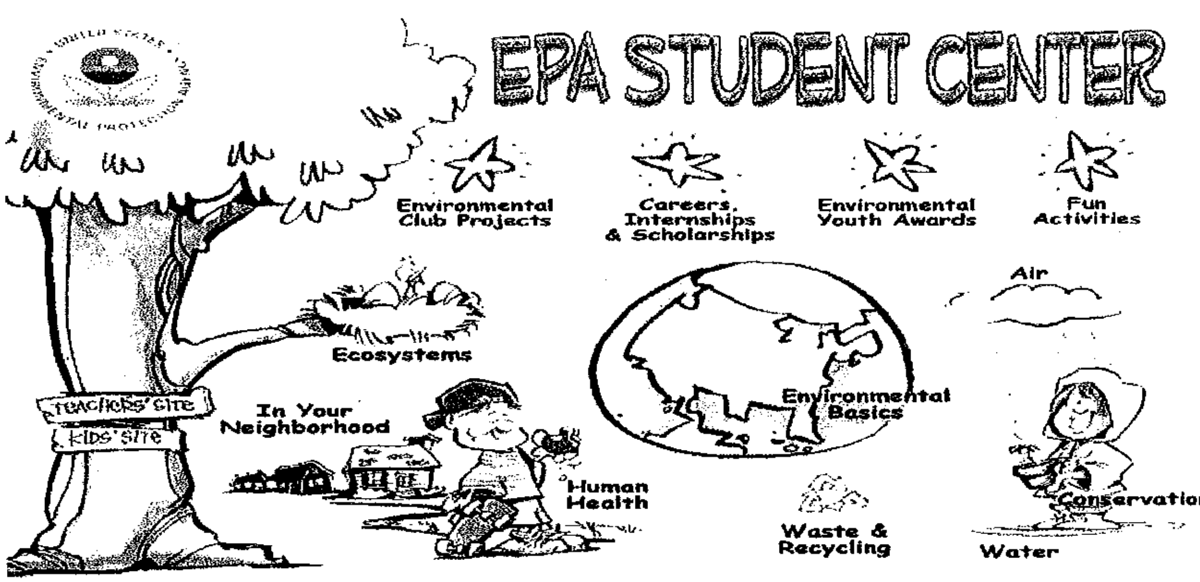
Water | Wetlands, Oceans & Watersheds | Watershed Protection



Water quality is designed to introduce students to the important chemical tests for water pollution. Lab activities, and test procedures for lessons regarding water quality that can be adapted to almost any grade level. Activities allow students to explore 10 water quality parameters.

Aquariums need to be tested for water quality and water testing kits are available from pet stores and science supply stores.
Packages include following materials:
Acidity Test Kit
Alkalinity Test Kit
Carbon Dioxide test Kit
Dissolved Oxygen Test Kit
Hardness Test Kit
Nitrate Test Kit
Phosphate Test Kit
pH/Temperature Meter

- Air Water Garbage & Recycling Plants & Animals Middle School High School Teachers EPA Home
- You & Your Environment Art Room Game Room Science Room Got a Question? A to Z Index



www.epa.gov/students/

Lesson 6: Learn to use your Microscope

Grade level(s): K-8 Subject: Life sciences Topic: Using a microscope in the classroom Estimated class time: 60 minutes Objective: To help students improve their skills in making slides and using a microscope.

Materials
Microscope slides
Glass or plastic cover slips
Fun with Your Microscope Book
Referenced: www.carolina.com

Review the fundamental parts of a microscope and basic microscope operation. Review slide making techniques by preparing slides for students to view and use as examples of proper technique.

Lesson outline

1. **Question and review**
    a. Ask students to identify the fundamental parts of a microscope.
    b. Explain how the compound microscope differs from the dissecting microscope
    c. Ask students how much they already know about microscope operation and slide preparation.
2. **Introduce background information**
    a. Explain proper microscope care and operation.
    b. Explain why compound microscopes and dissecting microscopes are used for different purposes.
    c. Explain the special techniques used to prepare specimens and create slides for microscopic study.
    d. Explain pertinent lab safety issues for slide preparation and microscopy.
3. **Guided practice**
    a. Guide students through hands-on preparation of different types of microscope slides.

b. Guide students as they view the slides they have prepared. Have them record their observations in writing and sketches.

4. **Independent practice/homework** Have students collect specimens at home, such as dust samples (from different areas of their houses), hair samples, or fingerprints, and bring them to school for study.

5. **Wrap-up** Ask your students what they learned and how the different techniques can have practical applications, e.g., in forensics or medical research.

Assessment Students will:

- Write about and sketch what they observed. (Note: If some students had difficulty viewing their specimens, ask them to explain what they think went wrong and how they can correct it the next time.)
- Describe procedures for preparing samples of other items they may wish to view under the microscope.

Cooperative learning ideas

- Have students compare and contrast their findings with those of their classmates.
- Have students work together to explain their findings and how they can improve their technique.

Cross-curriculum ideas

- Math: Young students count the number of specimens viewed on a slide, calculate magnification power, and learn about the metric system (e.g., the millimeter and micron). Older students can use the microscope's mechanical stage to estimate the area of the viewing field at different magnifications and estimate the size of organisms viewed.
- Language: Students write a paragraph describing what they observed with the microscope.
- Art: Students sketch what they observed with the microscope.

LESSON 7:"I am Puzzled" Ecology Crossword puzzles given to students / created by students to help ecology awareness. Ecology (#3527)

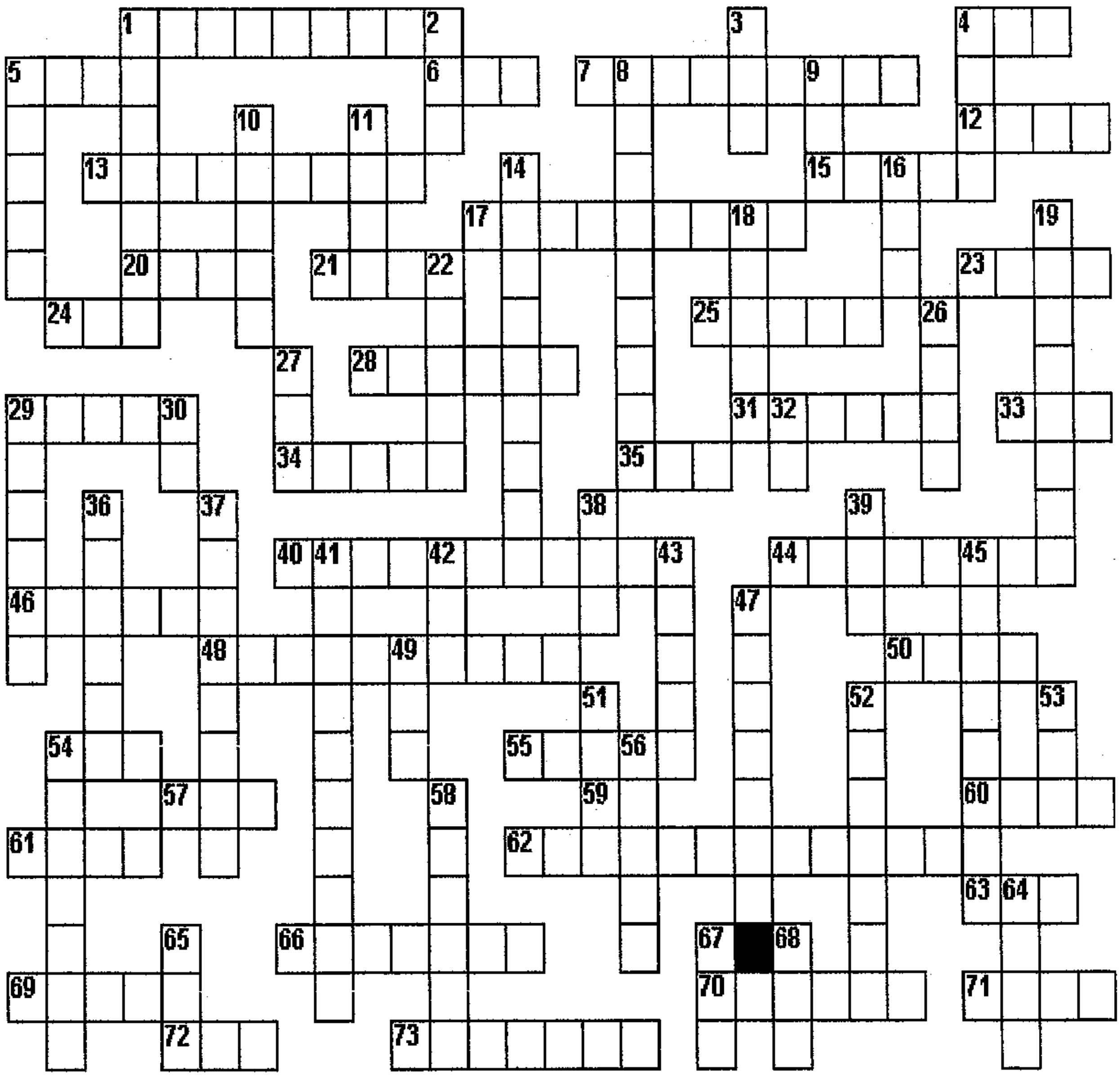
WORD BANK

Z	Y	W	V	G	V	D	U	M	B	D	D	P	V	M	H	P	T	K	O	N	V	Y	L	W	R	D	U	U	U
P	Q	E	A	O	F	N	H	Q	X	I	Q	A	A	T	K	E	R	D	C	F	X	O	S	O	S	Y	S	L	T
W	W	C	B	A	Q	W	K	R	G	X	O	P	X	N	F	V	V	J	V	B	T	H	H	T	J	P	B	T	Y
D	P	F	F	T	Q	Z	C	Z	O	F	N	S	N	V	X	W	B	K	B	M	F	H	T	B	J	Y	G	J	V
N	W	M	D	G	G	Z	R	L	V	Z	G	E	P	K	L	Z	B	S	Q	S	H	C	A	M	D	D	W	K	Y
Z	W	W	I	F	A	H	N	O	V	D	L	X	M	H	Y	V	V	B	E	B	G	A	J	B	I	D	S	T	I
T	Q	B	M	R	K	R	S	Z	R	I	L	I	E	A	E	B	E	G	B	S	I	P	E	M	I	A	P	N	E
D	M	E	E	I	P	S	V	E	R	K	P	F	M	V	Q	R	Q	Z	Y	O	U	Y	R	Y	R	T	Q	N	C
H	P	D	S	H	D	E	N	K	N	Y	A	D	W	I	H	E	E	M	R	J	C	K	Q	C	G	B	A	Y	O
C	T	X	B	B	P	R	T	M	O	U	R	T	H	J	T	L	B	G	H	F	W	E	V	F	Z	J	J	T	L
I	U	A	G	Q	F	R	E	X	J	Q	A	P	B	O	V	I	A	V	M	I	L	E	H	F	U	B	P	O	O
V	Y	C	D	S	O	R	E	T	Z	V	S	M	X	I	O	N	N	M	G	E	U	V	F	U	C	O	N	N	G
F	G	J	O	A	H	C	R	D	G	F	I	T	W	S	I	P	R	G	F	M	B	P	E	T	B	A	H	X	Y
U	Y	B	B	M	P	J	D	W	A	Y	T	O	I	S	P	T	V	Q	F	K	U	Z	P	I	B	F	U	A	F
E	P	Y	S	A	M	T	E	M	Z	T	E	S	M	K	C	R	G	P	P	A	O	U	O	I	J	K	U	E	H
G	V	L	D	F	L	E	A	Z	D	E	O	E	N	N	N	J	O	H	C	D	C	T	O	B	C	Y	T	J	H
Z	A	A	E	S	P	X	N	T	J	M	W	R	A	H	I	W	M	D	U	H	I	T	S	Q	B	Q	E	I	Q
W	C	O	P	L	B	O	Y	S	I	C	L	P	D	J	S	C	I	U	U	C	I	Q	O	M	J	I	Z	I	Y
N	D	C	Z	M	L	Y	P	E	U	O	C	X	X	Y	A	T	H	J	T	C	L	C	M	R	X	T	V	S	H
W	W	Z	Q	A	O	L	J	U	O	A	N	M	F	K	Z	E	E	E	I	U	E	U	Q	O	U	C	W	L	T
I	U	I	Z	F	L	K	K	M	L	M	L	S	Y	E	K	L	S	F	K	S	A	R	W	A	J	O	S	C	D
I	L	I	F	P	F	U	J	E	P	A	T	I	K	F	N	V	T	U	E	H	H	L	N	A	S	M	L	I	G
O	P	U	R	D	W	L	Z	N	J	H	T	Q	S	R	A	X	B	C	E	M	O	H	I	B	U	M	B	Q	I
F	J	E	E	Y	K	J	T	W	Q	P	J	I	N	M	I	M	Q	A	L	L	P	S	J	S	C	U	K	I	S
J	Y	U	C	F	Q	W	O	K	C	Q	V	D	O	P	J	Z	V	K	T	G	T	F	T	R	M	N	R	Q	C
X	A	X	K	R	C	F	U	O	N	A	D	L	K	N	M	E	D	T	D	I	K	H	Y	Y	V	I	Z	B	L
G	S	B	G	W	E	K	E	C	O	S	Y	S	T	E	M	U	V	X	L	P	Y	B	W	Q	M	T	B	F	C
H	E	W	Z	U	T	G	B	T	I	B	T	C	O	M	P	E	T	I	T	I	O	N	E	D	U	Y	V	Y	M
L	T	P	Q	R	D	C	T	T	J	U	S	C	F	F	Q	L	M	O	R	P	N	S	Q	F	T	R	M	M	D
X	K	C	M	Y	A	R	M	X	Z	H	T	L	U	I	T	F	D	M	L	E	O	H	O	C	G	S	L	N	U

HA

BITAT
NICHE
LIMITINGFACTOR
POPULATION
COMPETITION
PARASITE
MUTUALISM
COMMENSUALISM
ECOLOGY
ORGANISM
ECOSYSTEM
COMMUNITY
BIOSPHERE
HOST
PREY
PREDATOR
ADAPTATION
SYMBIOSIS
ABIOTIC
BIOTIC
PRODUCER

Ecology Exam Crossword



ACROSS CLUES:

cal = calories   kcal = kilocalories

1. Approximate doubling time in years for population with a 4% growth rate.
4. A common feline pet.
5. Percent growth rate for population with 60 births & 10 deaths per 1000.
6. Number of daughters per mother for zero population growth.
7. All the organisms in a natural community plus all the associated environmental factors.
12. More than half of the world's population depends on this plant for food.
13. Mathematical progression that increases exponentially.
15. Ecosystem that produces most of the earth's atmospheric oxygen.
17. The production of offspring.
20. Arborescent member of forest community.
21. Biotic communities have ____ energy available at each successive trophic level.
23. An endangered amphibian.
24. Condition of the desert ecosystem.
25. Law of Thermodynamics stating that energy can be converted from one form into another but it cannot be created nor destroyed.
28. Environmental factors that involve the presence of living organisms.
29. Primary energy source for members of the 1st trophic level.
31. A population increase by 100 percent.
33. The earth's primary source of energy.
34. Unlike oxygen, water, nitrogen & carbon, this resource isn't recycled.
35. A female sheep.
40. Reproduction in which each couple has one son & one daughter.
44. Occupies the first trophic level of a food chain.
46. Percent energy decrease at each link in the food chain.
48. An orderly sequence of different types of vegetation in a given region.
50. Population growth when carrying capacity = population size.
54. 100,000 lbs of phytoplankton makes ___ lbs of tuna in a 5-link tuna food chain.
55. Large geographical region supporting unique flora and fauna.
57. Not a natural significant population control factor in most animal populations.
59. Fecundity is proportional to survival rate of offspring (yes or no).
60. A Himalayan mountain goat.
61. Harvesting plankton from the ocean is like extracting ____.
62. Biological concentration of chemical residues increases along the food chain.
63. A large African antelope.
66. Starting with 10,000 cal of grass, the 3rd trophic level would contain one ____ cal.
69. The flora and fauna of a region.
70. A population increase by 200 percent.
71. Abbreviation for the California Native Plant Society.
72. An alkaloid beverage made from the leaves of an oriental shrub.
73. Graphical shape of energy, mass and numbers food chains.

DOWN CLUES:

1. Doubling time for U.S. population in years.
2. Prefix meaning not.
3. Marvelous organ providing us with vision.
4. Second most important food plant for people on planet Earth.
5. In Phytoplankton-Zooplankton-Herring-Mackerel-Tuna food chain, 50,000 lbs of phytoplankton supports ____ lbs of mackerel.
8. Occupies 3rd trophic level of a food chain.
9. In population that doubles every generation, how many female offspring are born to each fertile mother?
10. Doubling time in years for savings account earning 10% interest compounded annually.
11. Environmental factor affecting chaparral & coastal sage scrub communities.
14. Occupies 2nd trophic level of a food chain.
16. A haploid reproductive cell.
18. Baleen whales occupy this trophic level.
19. Occupies 2nd, 3rd and 4th trophic levels.
22. Style length of female fig flower that contains a wasp.
26. Food of a predator.
27. Marine animal generating electric current to protect itself.
29. Law of Thermodynamics stating that energy is dissipated as heat at each successive trophic level.
30. When the product of these two values = .695, the starting population will double.
32. A bovine mammal or castrated domesticated bull.
36. Behavioral population control in high level carnivore such as a lion.
37. Environmental factors such as climate, soil, fire, etc.
38. Interconnected food chains within an ecosystem.
39. Common canine pet.
41. Naturalized Australian tree that forever changed the southern Calif. landscape.
42. Another word for donkey or burro.
43. Number of links in food chain of baleen whale.
45. Maximum population size (capacity) for a given species that an ecosystem can support.
47. Food grown with natural fertilizers and without poisons.
49. In food chain starting with 100 kcal, how many links will result in carnivore with 0.001 kcal?
51. Style length of a female fig flower that bears a seed.
52. Reducing the population of troublesome pest animals without deadly poisons is called biological ____.
53. Insect that navigates by the position of the sun.
54. Level of nutrition or "link" in a food chain.
56. Used for currency by Homo sapiens sapiens.
58. With 20 year generation span, 80 people can be generated in 60 years. If only 26 people are generated in 60 years what is generation span?
64. Doubling time in years for population with growth rate of 7.72%?
65. Very successful rodent with high fecundity.
67. During aerobic respiration, 38 of these molecules are made.
68. Tree pollinated by symbiotic wasp.

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Supplemental materials (suppliers and informational resources)
Carolina Supplies
Ward Science Company
www.epa.gov/students
www.classhelper.org
www.4teachers.org
www.carolina.com/category/teacher+resources/classroom+activities.do?page=all
www.wardsci.com/category.asp_Q_c_E_807_A_Animals
www.tolweb.org/tree/ Tree of life Website
www.naturewatch.ca/english/wormwatch/index.html
www.iitc.tamu.edu/lessons/lesson23.htm
www.oceanconservancy.org

Videos: Pod casts and downloads for conservation issues from educational resources (Discovery, History Channel, National Geographic, etc.)

Instructional Resources: media center, computer lab, community guest speakers, newspapers, magazine articles, internet research articles, encyclopedias, dictionaries, Discovery, Science Channel. Going Green
For salt water living coral, fish, and other life specimens:
www.coralreeffarm.com

Appendices

Appendix A
Rubrics: Biome for Ecosystems

Building A Structure:

Biome for Ecosystem Study and Ecology Awareness

Teacher Name:

Student Name: ________________________________

CATEGORY	4	3	2	1
Function	Structure functions extraordinarily well, holding up under atypical stresses.	Structure functions well, holding up under typical stresses.	Structure functions pretty well, but deteriorates under typical stresses.	Fatal flaws in function with complete failure under typical stresses.
Information Gathering	Accurate information taken from several sources in a systematic manner.	Accurate information taken from a couple of sources in a systematic manner.	Accurate information taken from a couple of sources but not systematically.	Information taken from only one source and/or information not accurate.
Plan	Plan is neat with clear measurements and labeling for all components.	Plan is neat with clear measurements and labeling for most components.	Plan provides clear measurements and labeling for most components.	Plan does not show measurements clearly or is otherwise inadequately labeled.
Scientific Knowledge	Explanations by all group members indicate a clear and accurate understanding of scientific principles underlying the construction and modifications.	Explanations by all group members indicate a relatively accurate understanding of scientific principles underlying the construction and modifications.	Explanations by most group members indicate relatively accurate understanding of scientific principles underlying the construction and modifications.	Explanations by several members of the group do not illustrate much understanding of scientific principles underlying the construction and modifications.
Data Collection	Data taken several times in a careful, reliable manner.	Data taken twice in a careful, reliable manner.	Data taken once in a careful, reliable manner.	Data not taken carefully OR not taken in a reliable manner.
Construction - Materials	Appropriate materials were selected and creatively modified in ways that made them even better.	Appropriate materials were selected and there was an attempt at creative modification to make them even better.	Appropriate materials were selected.	Inappropriate materials were selected and contributed to a product that performed poorly.

Journal/Log - Content	Journal provides a complete record of planning, construction, testing, modifications, reasons for modifications, and some reflection about the strategies used and the results.	Journal provides a complete record of planning, construction, testing, modifications, and reasons for modifications.	Journal provides quite a bit of detail about planning, construction, testing, modifications, and reasons for modifications.	Journal provides very little detail about several aspects of the planning, construction, and testing process.
Journal/Log - Appearance	Several entries made and all are dated and neatly.	Several entries are made and most of the entries are dated and neatly entered.	Several entries are made and most of the entries are dated and legible.	Few entries are made AND/OR many entries are not dated or very difficult to read.
Construction - Care Taken	Great care taken in construction process so that the structure is neat, attractive and follows plans accurately.	Construction was careful and accurate for the most part, but 1-2 details could have been refined for a more attractive product.	Construction accurately followed the plans, but 3-4 details could have been refined for a more attractive product.	Construction appears careless or haphazard. Many details need refinement for a strong or attractive product.
Modification/Testing	Clear evidence of troubleshooting, testing, and refinements based on data or scientific principles.	Clear evidence of troubleshooting, testing and refinements.	Some evidence of troubleshooting, testing and refinements.	Little evidence of troubleshooting, testing or refinement.

TOTAL Score: ____

Appendix B
Rubrics: Collaborative Group Activities

Collaborative Work Skills : Laboratory Performance Assessment

Teacher Name:

Student Name: ____________________

CATEGORY	4	3	2	1
Contributions	Routinely provides useful ideas when participating in group and classroom discussion. A definite leader contributes effort.	Usually provides useful ideas when participating in the group and in classroom discussion. A strong group member who tries hard!	Sometimes provides useful ideas when participating in the group & in discussion. A satisfactory group member who does what is required.	Rarely provides useful ideas when participating in the group and in classroom discussion. May refuse to participate.
Quality of Work	Provides work of the highest quality.	Provides high quality work.	Provides work that occasionally needs to be checked/redone by other group members to ensure quality.	Provides work that usually needs to be checked/redone by others to ensure quality.
Time-management	Routinely uses time well throughout the project to ensure things get done on time. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Usually uses time well throughout the project, but may have procrastinated on one thing. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Tends to procrastinate, but always gets things done by the deadlines. Group does not have to adjust deadlines or work responsibilities because of this person's procrastination.	Rarely gets things done by the deadlines AND group has to adjust deadlines or work responsibilities because of this person's inadequate time management.
Problem-solving	Actively looks for and suggests solutions to problems.	Refines solutions suggested by others.	Does not suggest or refine solutions, but is willing to try out solutions suggested by others.	Does not try to solve problems or help others solve problems. Lets others do the work.
Attitude	Never is publicly critical of the project or work of others. Always has positive attitude about task(s).	Rarely is publicly critical of the project or the work of others. Often has a positive attitude about the task(s).	Occasionally is publicly critical of the project or the work of other members of the group. Usually has a positive attitude about the task(s).	Often is publicly critical of the project or the work of other members of the group. Often has a negative attitude about the task(s).
Focus on the task	Consistently stays focused on the task and what needs to be done. Very self-directed.	Focuses on task and what needs to be done most of the time. Other members can count on this person.	Focuses on the task and what needs to be done some of the time. Other group members must sometimes nag, prod, and remind to keep this person on-task.	Rarely focuses on the task and what needs to be done. Lets others do the work.
Preparedness	Brings needed materials to class and is always ready to work.	Almost always brings needed materials to class and is ready to work.	Almost always brings needed materials but sometimes needs to settle down to work	Often forgets needed materials or is rarely ready to get to work.
Monitors Group Effectiveness	Routinely monitors effectiveness of group, and makes suggestions to make it more effective.	Routinely monitors the effectiveness of the group and works to make the group more effective.	Occasionally monitors the effectiveness of the group and works to make the group more effective.	Rarely monitors the effectiveness of the group and does not work to make it more effective.
Working with Others	Almost always listens to, shares, and supports efforts of others. Tries to keep people working well together.	Usually listens to, shares, with, and supports the efforts of others. Does not cause "waves" in the group.	Often listens to, shares with, and supports the efforts of others, but sometimes is not a good team member.	Rarely listens to, shares with, and supports the efforts of others. Often is not a good team player.

TOTAL Score: ____________________

Appendix C
Rubrics: Self Assessment for Teacher

Teacher: Self Assessment

I................	WHERE AM I?					I................
Assess students' full contextual understanding	5	4	3	2	1	Assess only students' knowledge of specific facts and isolated skills
Compare students' performance with established criteria	5	4	3	2	1	Compare students' performance with that of other students
Make the assessment process public, participatory, and dynamic	5	4	3	2	1	Make the assessment process secret, exclusive, and fixed
Give students multiple opportunities to demonstrate their full range of knowledge	5	4	3	2	1	Allow students a single opportunity or provide a single way of demonstrating their knowledge
Develop a shared vision of what to assess and how to do it	5	4	3	2	1	Develop assessments by myself
Use assessment results to ensure that all students have the opportunity to achieve their potential	5	4	3	2	1	Use assessment results to filter and select students
Align assessment with curriculum and instruction	5	4	3	2	1	Treat assessment as independent oi curriculum and instruction
Base grading judgments on multiple sources of evidence	5	4	3	2	1	Base grading judgments on single sources of evidence
View students as active participants in the assessment process	5	4	3	2	1	View students as the objects of assessment
Regard assessment as a continual process	5	4	3	2	1	Regard assessment as sporadic and conclusive
Hold all concerned with learning accountable for assessment results	5	4	3	2	1	Hold only a few accountable for assessment results

1. A score ranging between 48-55 means that your assessment practices reflect the current shifts.
2. A score ranging between 19-43 means that your assessment practices represent a combination of the old and new shifts.
3. A score ranging between 11-18 means assessment practices have not changed to reflect current practices in education.

THE EDUCATION FUND
FOR EXCELLENCE IN MIAMI-DADE PUBLIC SCHOOLS

IMPACT II
ADAPTER APPLICATION

Use this form to get seed funding to ADAPT an idea

APPLYING FOR AN IMPACT II ADAPTER GRANT

A teacher seeking to become part of the IMPACT II network as an ADAPTER chooses one of the curriculum ideas profiled in past or this year's *IDEAS with Impact* catalogs and creatively modifies it to their own classroom. (For a list of past years' ideas, contact Lorna Valle, 305-892-5099, x18 or visit www.eductionfund.org).

Adapter Grant awards average $200. *To apply, you must contact the teacher who developed the idea before submitting your application.* Contact can be made by attending a workshop given by the disseminator, communicating via e-mail or telephone, by visiting the disseminator in their classroom, or by having the disseminator visit your classroom. Project funds must be spent within the current school year or an extension must be requested. A final report and expense form with receipts are required. Periodic site visits may be conducted.

Deadline: December 1

1. GENERAL INFORMATION (Please TYPE. All information must be completed for consideration.)

A. Name: ______________________ **B.** School: ______________________

School Address: ______________________ City/State: ______________ Zip Code: ________

School Phone: ______________________ School Fax: ______________________

C. Home Address: ______________________ City/State: ______________ Zip Code: ________

Home Phone: ______________________ E-mail: ______________________

2. PROJECT INFORMATION

A. Title of Project (as it appears in the Idea catalog): ______________________ Catalog Year: ________

B. Name of Project disseminator(s): ______________________

C. You are REQUIRED to make direct contact with the disseminator(s) of the project you are interested in adapting BEFORE a grant can be approved.

I made contact via: ☐ Workshop/EXPO ☐ Telephone ☐ Visit ☐ Letter/E-mail

☐ Other (Please specify): ______________________

If no contact was made, please state why: ______________________

3. IMPLEMENTATION INFORMATION

A. Who are the students involved in your adaptation? How many? ________ Grade level(s)? ________

Ethnic distribution? ______________________ Achievement levels? ______________________

B. How will it help low-performing students in your classroom? ______________________

____

C. What is the educational need for this project in your class? (Use one additional page if necessary.)

____

D. How will you implement the project with your students and integrate it with your curriculum? What changes will be made from the original project ideas? Will you be adapting the project to fit with a current theme or event? (Use ONE additional page if necessary.)

____

____

____

E. May IMPACT II staff and teachers visit your class with prior approval? ☐ Yes ☐ No

F. Are you willing to help the disseminator network this idea? ☐ Yes ☐ No

4. BUDGET INFORMATION

A. What materials are needed to adapt this project to your class? *Be specific.* (Use ONE additional page if necessary.)

Item and Description	Cost	Source of funds (this grant, school funds, other)

TOTAL REQUESTED $ ____________________

5. COMMUNITY AND SCHOOL RESOURCES

A. What other persons, if any, will be involved in implementing this project? (e.g. teachers, specialists, library media specialists, para-professionals, parents, other volunteers)____________________

____

B. What other resources does your school have to assist in adapting this project? (e.g. library materials, equipment, instructional materials, community agencies)____________________

____

6. ADMINISTRATIVE SUPPORT (TO BE COMPLETED BY SCHOOL PRINCIPAL)

I support implementation of this project during this school year. ☐ Yes ☐ No

Principal's Comments:____________________

____

____________________ ____________________ ____________

Applicant's Signature Principal's Signature Date

Deadline for application is **December 1** Send an original, typed application and **four** copies with **four** self-addressed mailing labels to:

The Education Fund, 900 NE 125th St., Suite 110, North Miami, FL 33161

*****This application may be photocopied to distribute to other educators.***

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