GUYANA MARINE TURTLE CONSERVATION SOCIETY (GMTCS)

CONSERVATION IN CLASSROOMS

A Guide for Teachers in Guyana

Michelle Kalamandeen, Marie-Louise Felix,
Waldyke Prince and Phillip DaSilva

GUYANA MARINE TURTLE CONSERVATION SOCIETY (GMTCS)
c/o Le Meridian Pegasus, Kingston, Georgetown.
Guyana, South America
Tel: (592) 225-4483/4
Website: http://www.gmtcs.org.gy/

Dear Teachers,

The primary purpose of education is to nourish the inherent possibilities of human development. Each of us, whether we realise it or not, is part of the global environment. An eleven year old today will be an adult in ten years, making decisions that impacts his/her home, community, country, future and children's future.

As teachers, you influence and sculpt the lives of many students each year, motivating them to seek knowledge, develop new areas of interest and become active and responsible citizens. Your classrooms are the ecosystems that facilitate the holistic development of students, fostering a sense of caring for the environment and connecting them to their community and country.

The Guyana Marine Turtle Conservation Society (GMTCS) in partnership with the Environmental Protection Agency (EPA) and German Development Bank (KfW) strongly believe that it is important to nurture an appreciation and understanding of the natural world around us. Such learning experiences can provide an awareness of who we are and how we relate to the world. When people become aware of their environment and the wonders it holds, many experience a sense of inspiration and appreciation.

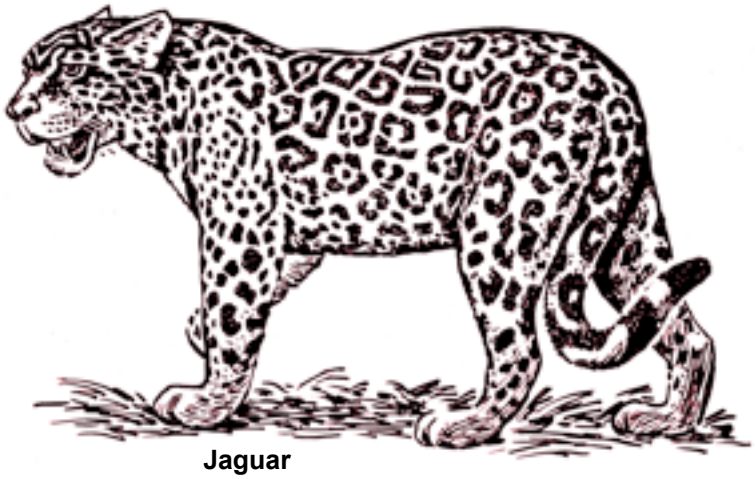
This teacher's guide was created to help you bring the concepts of conservation of our natural resources to life in your classroom. With information on teaching strategies and hands-on activities for students, we hope this guide will make it easy to integrate conservation messages into your classrooms and teaching in all subject areas.

GMTCS, EPA and KfW are dedicated to the conservation of Guyana's natural resources for our children - present and future. We invite you to join us in this effort by motivating your students to learn about, appreciate and care for the biodiversity that surrounds us all in Guyana.

Sincerely,

Dr. Raquel Thomas, Chair
Maj. Gen. (ret'd) Joseph Singh, Senior Member
Guyana Marine Turtle Conservation Society

Mr. Doorga Persaud,Executive Director
Environmental Protection Agency



Jaguar

TABLE OF CONTENTS

WELCOME TEACHERS!

The Guyana Marine Turtle Conservation Society (GMTCS) in partnership with the Environmental Protection Agency and the German Development Bank (KfW) had developed *Conservation In Classrooms* as a resource for teachers and non-formal educators working in the Northwestern region of Guyana.

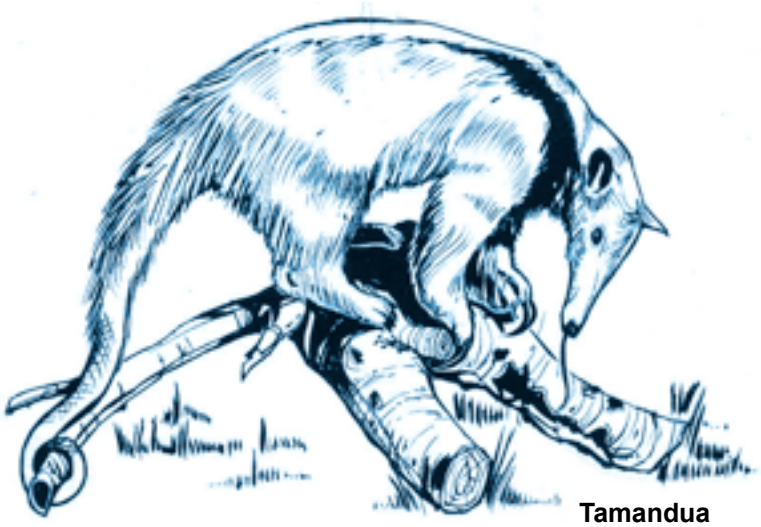
As a teacher, you have an enormous effect on the way your students learn and develop into the next generation of leaders and decision makers. By helping students develop a sense of caring and responsibility towards their local environment, they will be able to act locally while understanding the global effects of their decisions, both now and in the future.

Conservation In Classrooms is packed with information on strategies and approaches designed to help you convey important conservation messages in your classrooms. It also provides ideas and hands-on activities that help you explore both the ecological and social dimensions of conservation with your students. This guide was designed for use with students aged 11-17 but we've found that many of the activities and methodologies work well with older age groups too. Most of the activities in this guide can be integrated into many subject areas and not just science.

In *Conservation In Classrooms* we provide many helpful tips and opportunities for teachers to arouse curiosity and motivate students. Researchers have found that teachers do not transmit knowledge to students, but rather students construct their own understanding of new information and experiences acquired. For this reason, it is important to understand and learn new strategies and approaches to teaching that enable students to better understand biodiversity conservation and its application.

Environmental Education has 5 objectives:

* **Participation**. Opportunities to be actively involved in exercising environmental citizenship and working towards sustainable development
* **Knowledge**. Gain experiences and understanding of how the environment functions
* **Values**. Acquire feelings of concern for environmental issues and set values upon which appropriate judgements and actions can promote sustainable development.
* **Skills**. Acquire the skills to identify, investigate and resolve environmental problems
* **Awareness**. Understand the impacts and effects of behaviours and lifestyles on the environment



Tamandua

The strategies and activities found in this guide emphasize group learning, and the development of problem-solving, analytical, critical thinking, and creativity skills, among others.

The guide is divided into five sections based on the different teaching strategies. You will find a comprehensive overview of these strategies and approaches to incorporate conservation messages into the classroom. Under each strategy are 3 - 5 different activities that you can use in your teaching. Additionally, each activity includes some background information about the specific topic being covered. We highly recommend reading the strategies and activities before teaching commences.

Also included in the Guide is Appendix A: Branching Out that offers a number of suggestions of how you can involve students in learning about the environment through fun and creative activities.

The goal of this programme is not to teach your students what to think about conservation but rather to introduce you to the various strategies that you can utilise to help them to explore, analyse, evaluate and discuss environmental issues. We're aware that biodiversity issues are both controversial and complicated. Your students may bring many diverse perspectives to the conservation of natural resource issues. However, with your guidance, these different views can contribute to a dynamic learning environment in which students can clarify their own thinking and listening skills, and gain new insights about the conservation of their natural and cultural heritage.

Green Iguana

ACTIVE LEARNING

WHAT IS ACTIVE LEARNING?

Active Learning refers to a range of teaching and learning activities that are 'hands-on' and require students to participate in class in ways other than the usual 'chalk and talk method'. Activities that contain the active learning method can include brief question-and-answer sessions, discussions, and hands-on activities. By engaging in active learning methods, students are able to develop skills in different subject areas such as analyzing, synthesizing and evaluating. The types of active learning vary, depending on the teaching goals, the students' abilities, class size and the subject area.

Objectives:

- To introduce teachers to the subject of active learning
- To give teachers the skills to incorporate active learning in their classrooms
- To understand the concept behind active learning
- To provide activities that engage students in active learning in and out of the classroom

Subject: Art, English, Maths, Science, Social Studies, History

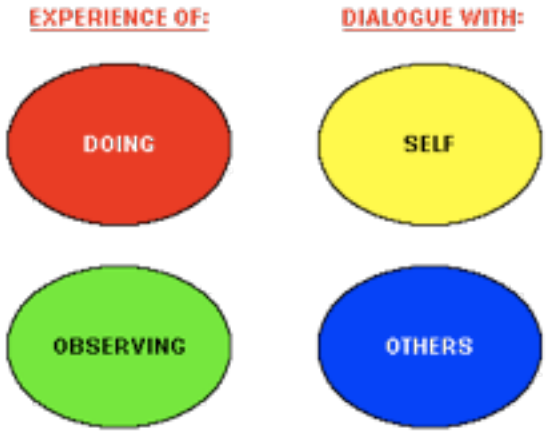
WHY IS ACTIVE LEARNING IMPORTANT?

Use of this technique in the classroom is important because of its powerful impact on students' learning. For example, several studies have shown that students prefer methods using active learning to the traditional 'chalk and talk' method. Many strategies promoting active learning are better than lectures/talks (chalk and talk method) as they promote the development of students' skills in thinking and writing. Students are also better able to understand concepts and topics when explanatory techniques are used.

UNDERSTANDING ACTIVE LEARNING

Active Learning Model

[adapted by L. Dee Fink, University of Oklahoma, 1999]



Every learning activity involves different kinds of experience or dialogue. The two main kinds of dialogues are 'Dialogue with Self' and 'Dialogue with Others' while the two main kinds of experiences are 'Observing' and 'Doing'.

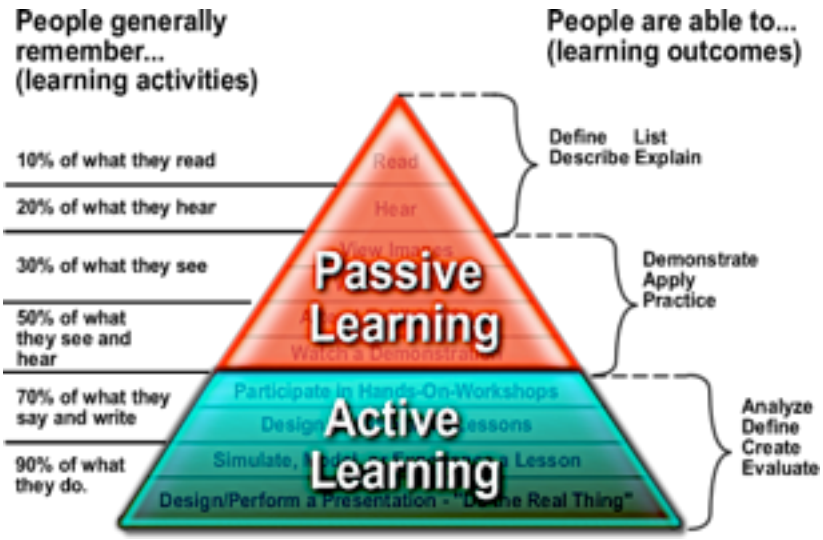
Dialogue with Self: This occurs when a student thinks reflectively about a topic, i.e., she/he ask herself/himself what is it that I think or should think about the topic? and what do I feel about the topic? A teacher can promote the dialogue with self by asking students to keep a journal about what they are learning, how they are learning, what role does the information given play in their own life, how this makes them feel, etc.

Dialogue with Others: This comes in many forms. In traditional teaching, some dialogue occurs when students read a textbook or listen to a lesson as they are "listening to" another person (teacher). But this is limiting as there is no exchange of information from student to teacher or author. A much more active form of dialogue occurs when a teacher creates an intense group discussion on a topic. Sometimes teachers can also find creative ways to involve students in dialogue with professionals other than students, either in class or outside of class.

Observing: This occurs whenever a student watches or listens to *someone else "Doing" something* that is related to what they are learning about. The act of observing may be "direct" or "indirect". For example,

a direct observation of cassava bread-making might be for the student to actually go to where cassava bread is being made, spending time and watching the process of how cassava bread is made by the indigenous women. An indirect observation of the same topic might be to watch a documentary or reading about how cassava bread is made.

Doing: This refers to any learning activity where the student actually does something such as conducting a school band, design and/or conduct a scientific experiment, assess an argument or piece of writing, investigate local natural or historical information and resources, make an oral presentation. "Doing" may be direct or indirect. Case studies, role-playing and simulation (fake) activities offer ways of indirectly engaging students in the "Doing" process.



Active Learning: adapted from http://www.edutechie.ws/2007/10/09/

IMPLEMENTING ACTIVE LEARNING IN CLASSROOMS

1. ***Expand the Kinds of Learning Experiences You Create.*** The most traditional teaching consists mainly of students reading a text and listening to a talk, which is a very limited form of 'Dialogue with Others'. So consider using more lively forms of 'Dialogue with Others' and the other three kinds of learning. For example:

- **Questions:** Questions are the simplest form of interaction and can occur at any time during the lesson. By asking questions, you turn students into active participants while getting a sense of their interest and comprehension. You might try asking questions at particular points in a lesson or asking for comments or opinions about the subject. Vary the timing of your questions though, to avoid creating a known pattern for students which can make learning passive.

- **Pro and Con Grid:** The Pro and Con Grid lists advantages and disadvantages of any issue and helps students develop analytical and evaluative skills. It also forces students to search for at least two sides to the issue. Let students know how many pros and cons you expect and whether they should use point form or full sentences.

- **Brainstorming:** Students generate ideas which you record on the chalkboard. When teaching a new topic, you might begin by saying "Tell me everything you know about…" The main rules of brainstorming are to acknowledge every offering by writing it down and save any comments until after the idea generation time is over.

- **Quizzes:** This technique involves writing quiz questions on the chalkboard, or a handout and giving students an appropriate time to respond. A quiz at the beginning of a lesson allows you to determine how familiar students are with important terms, facts or concepts prior to the lesson, while a quiz that follows a lesson can reveal how well students understood the material.

- **Think-pair-sharing:** Students think about a particular question or scenario then they pair up to discuss their ideas. They then share their results in a large class discussion. Think-pair-sharing forces all students to attempt an initial response to the question, which they can then clarify and expand as they collaborate. This process should take 5-10 minutes, depending on the questions.

Teaching Tips

When you deliver a set of information to students, the students should return a set of information to you. This creates a back and forth pattern that enables you to garner feedback on how they understand the material.

- **One-Minute Paper or Short Writes:** Punctuating your lesson with short writing assignments is a powerful way to assess the degree to which students understand presented material. You might ask, "What was the most important thing you learned during this lesson?" "What questions remained unanswered?" or "Summarize the main point of today's session in one sentence."

- **Problem Solving: Demonstrations, Proofs and Stories:** Begin a lesson with a question, a paradox, a puzzle, or a compelling, unfinished human story. Solving the problem, depending on what it is or in what field, may require a scientific demonstration, a mathematical proof, an economic model, the outcome of a novel's plot, or a historical narrative. Examples of questions include: "What do you think will happen?" "Which solution, outcome, or explanation makes the most sense to you?"

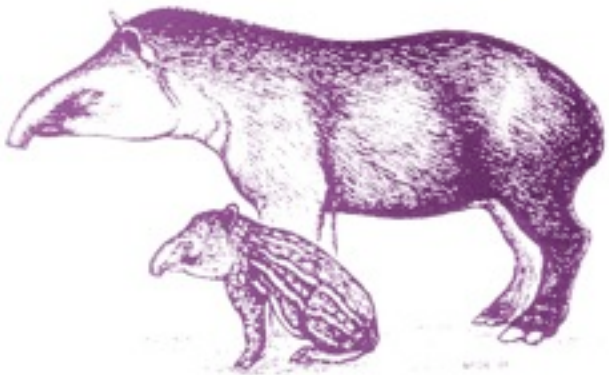
- **Modeling Analytical Skills:** This involves viewing and analyzing passages of text, paintings, sonatas, graphs, charts, artifacts, etc. together with your students. You should make sure students have a copy of the document in front of them and then follow three steps: model the analysis, let the students practice it, and then give them feedback.

- **Debates:** Debates allow you to add a participatory dimension to your lessons without compromising your control of the class. One strategy is to divide students according to where they happen to sit. Another approach is to ask them in advance to seat themselves in the section representing a particular side of the debate.

- **Role Playing:** The first step in this session is to give a talk to establish the situation and setting for the role playing. Then divide the class into a number of groups of varying sizes. Each group is assigned a clear role and given a task – usually to propose a position and course of action. To bring closure to the topic, ask students to summarize what they have learned.

2. ***Take Advantage of the "Power of Interaction."*** Each of the four kinds of learning has its own value. However, if used together, it can multiply the educational impact. For example, if students write their own thoughts on a topic (Dialogue with Self) before they engage in small group discussion (Dialogue with Others), the group discussion should be richer and more engaging. If they can do both of these and then observe the action (Observation), they can understand the topic better. If this is followed by having the students do in the action itself (Doing), they will have a better sense of the subject/topic. Finally if, after 'Doing', the students write about their experience (Dialogue with Self) and/or discuss it with others (Dialogue with Others), this will add further insight.

3. ***Create a Dialectic Between Experience and Dialogue.*** You can refine the student's learning by discussing what they experienced after each process (Doing, Observing, Dialogue with self and Dialogue with Others). A teacher who can creatively set up a discussion of learning activities in which students move back and forth between having rich new experiences and engaging in deep, meaningful dialogue, can maximize the likelihood that the students will experience significant and meaningful learning.



Adult and Baby Tapirs

Activity 1: The Web of Life

INTRODUCTION

An **ecosystem** is a community of plants, animals, and micro-organisms that interact with each other and their physical environment. Forests, streams, lakes, savannahs, and rotting logs are all examples of ecosystems. Animals and plants in an ecosystem connect to and depend on each other for food, shelter, pollination and many other things. What happens to one member of an ecosystem can have an impact on the whole system. Although all species are important, some species, called **keystone species**, play critical roles in ecosystems. If a keystone species is removed from or added to an ecosystem, it is likely to cause major disruption to that ecosystem.

Objectives:

- To demonstrate an understanding of how different parts of an ecosystem are interconnected

Subject: Science, Language, Art

Materials: ball of rope, twine or heavy duty string (at least 20m)

Time: 45 minutes

Ecosystem change can be caused by humans or natural processes, such as floods, fires, or drought. Humans can have a negative effect on ecosystems, for example through clearing forests, over-hunting or over-harvesting plants, or polluting the air, soil and water. Sometimes disruptions like floods or fires that are part of an ecosystem's natural process can be made more severe or more frequent because of the way humans use the environment. For example, humans use fire to clear land for agriculture, but sometimes if the right precautions aren't taken, fires can get out of control and burn larger areas than were originally planned. Depending on the severity of the disruption and the species affected, ecosystems may adjust to a crisis quickly or may sometimes take a long time to recover, or even be changed forever. It is often hard to know exactly how each species is connected to all the rest and how harming that species may affect the whole ecosystem.

GETTING READY

1. Choose a local ecosystem (such as a forest, wetland or marine/beach) and with your students create a list of the various living and non-living things in that ecosystem. Remember to not only think of common animals, but also to include insects, marine turtles, fish, mangrove, microorganisms and other living things.

Sample Marine / Beach Ecosystem Members

sun	water	air
mangroves	labaria	driftwood
frog	leatherback turtle	dragonflies
monkey	howler monkey	noni tree
butterfly	green iguana	agouti
beetle	shell / sand	shark
scarlet ibis	mud	catfish
jaguar	vines	hatchlings

(Be sure to include humans in the web!)

2.Assign each student the name of a plant, animal, microorganism, or non-living thing in the ecosystem. If you have time, students can write the name of their ecosystem member and draw it on a piece of paper and tape it to the front of their shirts. Having these signs on their shirts will help the students remember who's who throughout the activity.

WHAT TO DO

1.***Create an ecosystem.*** Ask students to stand in a circle and explain that together they represent an ecosystem and each student represents a part of the ecosystem. Have students look around the circle and think about how plants, animals, microorganisms, and non-living things in their ecosystems are connected.

2. ***Weave the Web.*** Ask one student to hold onto the end of the string and toss the rest of the ball of string to another student, explaining his or her ecological connection to that other student. For example, the "tree" student might say that she is connected to the "bird" student because she provides shelter for the bird. The bird then might say that he is connected to the snake because snakes eat birds. As such students make a connection, help wrap the rope around the back of each student's waist, forming a big complicated star-shaped web among the students. It works best if students are connected to others across the circle from themselves, rather than next to each other.

3. ***Talk about the connections.*** When all the students are connected to the web, explain that harming any part of the web can hurt the entire web, sometimes in ways that we don't foresee, because everyone is connected to everyone else in the ecosystem. Have the students imagine what would happen, for example, if the trees were cut down (the tree student can start to shake or tug on the rope), or if the birds went extinct (have the bird student fall to the ground). Ask the other students if they can feel the changes through their string.

ECO-CONNECTIONS

Encourage students to think creatively about the connections and similarities among the different members of an ecosystem. Remember to use some of the following connections:

1. a small animal that a bigger animal depends on in some way
2. a big animal that a smaller animal depends on in some way
3. a plant that grows on other plants (e.g. bromeliads, mosses, orchids)
4. an introduced species that has caused problems for native species (e.g. tilapias)
5. a wild animal that can thrive in or around people's home (e.g. cockroaches, flies, rats)
6. an animal that eats dead things (e.g. termites, vultures)
7. an animal home that is in or on a plant (e.g. bird's nest)
8. a plant that benefits humans in some way (e.g. medicinal plants, food, shade trees, etc)
9. a plant that harms humans in some way (e.g. aromatas)
10. an animal that benefits humans because of the role it plays in its habitats (e.g. bees and butterflies pollinates plants)
11. an animal that harms humans in some way (e.g. mosquitoes, labarias, etc)
12. an animal that looks like a plant (e.g. stick insects, praying mantis)
13. two species that are useful to each other in some way (e.g. egrets and cows)
14. an animal that spends its life in two different habitats (e.g. frogs spend part of their life in water and part on land)
15. an animal that eats seeds or fruits and then spreads the seeds by passing them as waste (e.g. agoutis and tapirs eats crabwood seed)
16. something that turns into soil (e.g. rotting logs, dead leaves)
17. a plant that depends on animals in some way (e.g. trees may depend on birds to pollinate them).

BRANCHING OUT

After students have played for a short time, have them stop and discuss which members of the ecosystems have the most connections to others and why this might be the case (trees provide food and shelter for many species, for example). What might happen if one of the big animals that eats other animals disappear? With fewer key predators, the animals the predators eat become more numerous, which can affect many other interactions in the system. Animals such as large predators that are important to the way the whole ecosystem works are examples of keystone species. What might be a keystone species in your local ecosystem? Discuss the status of ecosystems in your area - are they healthy or has there been some sort of disturbance to the system (pollution, deforestation, over-hunting)?

Have your students choose from one of the following concluding exercises:

- Write a paragraph that describes a connection that they noticed for the first time.
- Write a paragraph that describes one connection they observed during the game. Then have them write a second paragraph that speculates on what the effects might be if one of the 'connectors' were to suddenly disappear.
- Write one or more paragraphs either supporting or refuting the following statement: *People are a part of nature*. Have them express their agreements or disagreement with the statement, along with examples that support their views.

Students can also go on an expedition to a natural area near to your school. Ask students to see how many kinds of ecological connections they can observe from their lists.

Adapted with permission from Exploring Biodiversity, a joint publication of CI and WWF, 1999

Youths from Three Brothers' Village, along the Waini River in Guyana, conducted an inventory of crabwood tree (Carapa guiananesis). The crabwood tree has medicinal properties and is traditionally significant; but is also exploited as a timber species. The information gathered from the inventory is being incorporated into the community's management plan.

Butterflies feeding on flowers

Activity 2: Spaces for Species

INTRODUCTION

When people build a new farm, home and roads, they are trying to help improve their lives. However, development can also destroy natural ecosystems and habitats or homes where animals and plants live. **Habitat loss** is one of the most serious threat to biodiversity. As forests are broken up into smaller areas, 'habitat islands' are created, with portions of what used to be part of a large area becoming separated from each other by buildings or farms for human use. Scientists call this breaking up of habitats into smaller pieces **fragmentation**. The problem with these habitat islands is that small habitat areas cannot hold as many plants, animals and micro-organisms (**species**) as large ones.

In this activity, students will imagine they are species trying to get to different sized 'islands' at different distances from the 'mainland'. Then they'll apply the concepts they have learned to habitat islands and explore some of the threats facing species in habitat islands and ways to reduce those threats by planning development with biodiversity conservation in mind.

Objectives:

- To describe factors that affect the relationship between habitat fragmentation and biodiversity loss.
- To describe strategies for designing protected areas that could help lessen the effects of fragmentation

Subject: Science, Maths, Physical Education

Materials: two pieces of 12m rope and two pieces of 8m rope, leaves and small stones, a watch

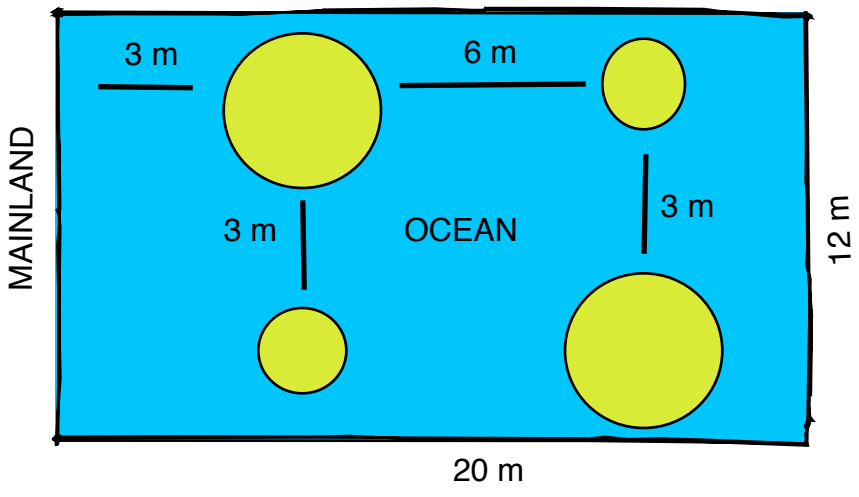
Time: 1 hour 30 minutes

GETTING READY

1. Read 'What's the Problem with Patches?' and familiarise yourself with the rules of the game.

2. You'll need an open playing area about 20 metres by 12 metres. Doing this activity outdoors is best. Use four visible markers such as large rocks or articles of clothing to mark the boundaries. Use two 8m ropes to make two small islands. Use two 12m ropes to make two large islands.

3. Arrange the islands in the playing area as they are arranged in the diagram below.



4. Collect plenty of small rocks and leaves for the second round of the game. Count out enough stones and leaves so that there is one for every student in the habitat islands.

5. Next, draw the 'Protected Area Design Choices' on the chalkboard. Make sure you do not include the answers on the chalkboard until you go over the design choices with the students.

What's the Problem with Patches?

Habitat fragmentation is one of the most serious threats to biodiversity. Small, fragmented habitats, called habitat islands, usually cannot hold as many species as larger, more continuous ones.

Luck of the draw: When a piece of habitat is destroyed, some species could be wiped out by chance alone. If a species uses only a small part of a larger area, and that part happens to be destroyed, that species and its habitat (home) are lost. Species that are very rare or that are found only in small populations are especially at risk when their habitats are broken up into smaller and smaller pieces.

Less area, less species: To continue, species need to live in populations of a certain size. If habitat areas are reduced to small fragments, there may not be enough room for a large enough population of the species, making it more prone to **extinctio**n (meaning they are lost forever). Space is a particular problem for large animals that need large areas in which to find food.

Road blocks: Some species can live in habitat fragments if they can move from one area to another to get everything they need such as food, shelter and mates. Unfortunately, many fragments are surrounded by barriers that prevent species from moving between different areas. Roads are a common barrier that many species can't cross, but buildings, farms and fences can also keep species from getting where they need to go. When a species is isolated from others of its kind, individuals may breed with relatives, causing a loss of genetic diversity. Offspring of this breeding is oftentimes infertile.

On the edge: When we develop a habitat and break it into small areas, we create more boundaries between the habitat and the outside world. Conditions at these boundaries, called 'edges', are very different from the conditions in the habitat's interior. There may be more sunlight and wind at the edge, and because there's no canopy overhead to keep the moisture in, the edge is often much brighter and drier than the interior. These different conditions can change the plant and animal species living in the area. There can be different predators and prey, making it harder for animals to find food and to avoid being eaten. In small fragments, edge conditions can take up most of the habitat. Scientists call this problem the 'edge effect', and species that can't adapt to the edge often becomes threatened.

Fragmentation doesn't affect all species in the same way. Some species are more sensitive than others. Some can even benefit from fragmentation and the edge effect, because they thrive in the kinds of habitats found on the edge.

WHAT TO DO

1. ***Introduce the Activity.*** Explain to the students that they will be doing an outdoor activity to study species that travel between islands and the mainland.

2. ***Explain the rules***. Familiarise students with the playing area. Show them the islands and their sizes and distances from the mainland. Select three-quarters of the class to be species immigrating to the islands and the rest of the class to represent threats that can cause immigrating species to become extinct. Students should select a species or threat they'd like to represent e.g giant otter, diseases. They may wish to act like the species or threats they are representing.

Explain that immigrating species will have one minute to run from the mainland to an island, but when they are between islands they will have to avoid being tagged by the students in the playing area. If they are tagged they will become **extinct** and be eliminated from the game.

Explain that once you give the signal (Immigrate!), species on the mainland should begin running to the islands. The other students should run after them and try to catch them. Species can be tagged out of the game only when they are out in the open ocean. They cannot be tagged if they are on the mainland or island. Tell students that at the end of the game, you will count the species that successfully made it to the islands.

Tell taggers to spread out and make sure they keep moving all the time that students are immigrating. Explain that in nature threats to species are spread all around the landscape, so taggers should also be spread out.

THE HIPPO DILEMMA

To understand the role people are playing in biodiversity loss, it helps to think of the HIPPO dilemma. HIPPO is an acronym for the main threats to biodiversity:

Habitat loss
Introduced species
Population growth
Pollution
Over-consumption

Other causes of extinction include diseases and climate change.

3. ***Play Round 1: Immigrate!***. Yell 'Immigrate!' to let students know the game has begun. Keep time and tell the students to stop after one minute. Ask students who become extinct to help monitor the game.

4. **Evaluate the Results:** Have the students count the number of animal species on each island. Keep track of the results on a piece of paper. Have the students gather around you to go over the results of Round 1 and to talk about what they'll do in Round 2. Having them near to you will help them focus on you and not on the many distractions outside.

   (a) Tell students that the large island close to the mainland should have the most species. Ask students why this is true. (Those who tried to run to the farthest islands faced many more threats on their journey than those who travelled only to a nearby island.) Regardless of how many students made it to islands at different distances, more students should be on the large islands than on the small islands. Ask students why this is true and why the same is true with different species in nature. (Small islands don't have the space or variety of different habitat types to support many different species, just as the small islands in the game were not big enough to hold many students.)

   (b) Ask the students who didn't survive why they think they were tagged. Were the extinction taggers faster than they were? Did they have to go to several islands, leaving themselves open to taggers each time? Were they forced out of a small island that was too crowded? Ask them if the same things also affect real species. Species are sometimes forced to travel between many habitat islands to find all the resources they need and are thereby open to threats when they leave their habitat, and many species can be pushed out of overcrowded habitat islands and forced to move to other areas.

   (c) Ask students why animals need to move between habitat islands. Explain that many islands are too small for all species living in them, and they can become crowded. Competition for food, water, and living space may force animals to move to find more food or shelter. Some animals need to migrate. Others may be looking for mates.

5. ***Play Round 2: Habitat Island Hopping.*** Round 2 will demonstrate what it's like for species trying to move between habitat islands. Tell students that the playing area now represents habitat islands in a sea of development rather than an ocean. Have the students think about how the extinction factors might be different in habitat islands and oceanic islands e.g. many animals become easy targets for predators when they leave their habitat as there might not be enough food in the space between habitat islands. Animals are often killed trying to cross roads or rivers where speed boats are found.

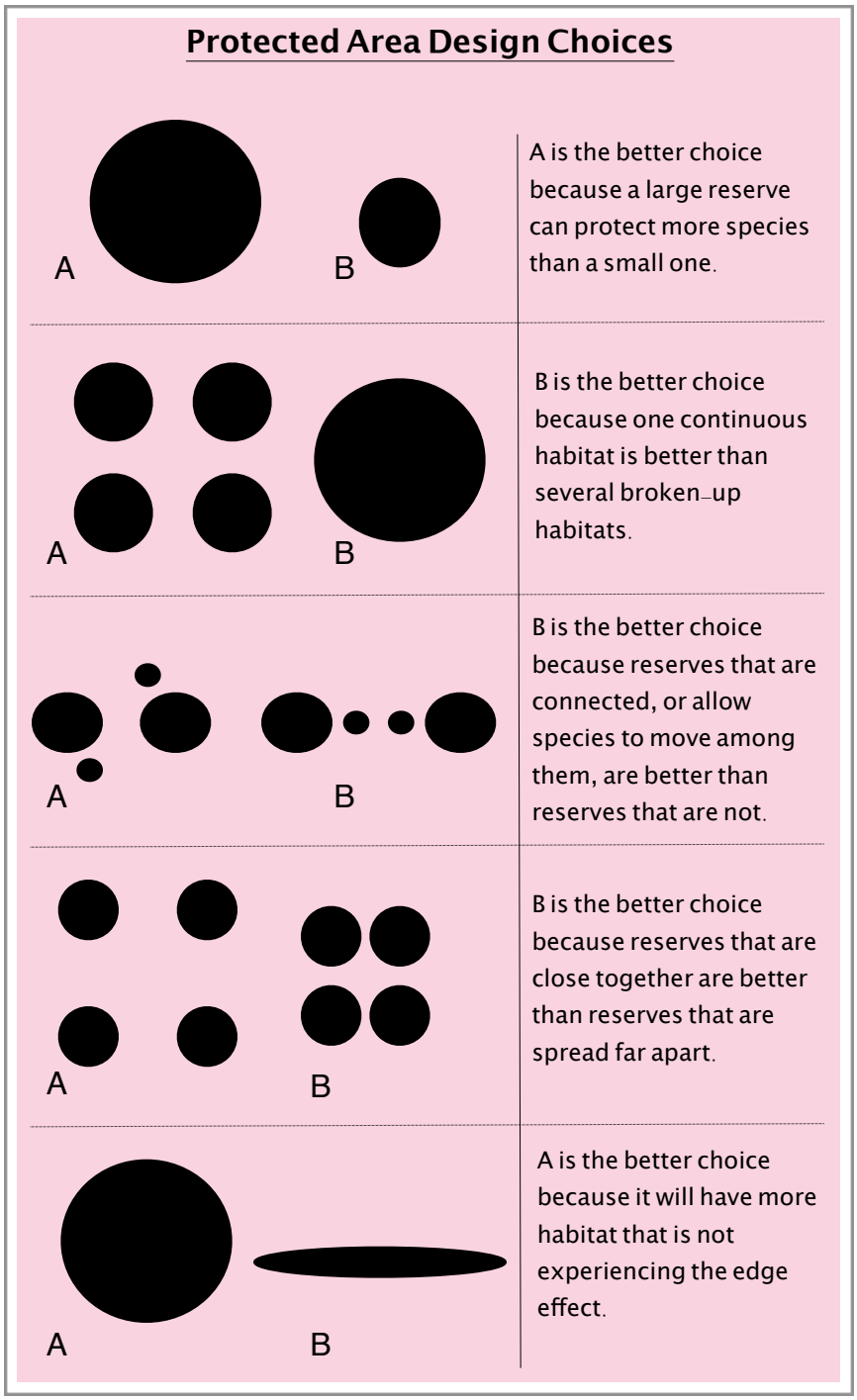
Tell students that the stones and leaves represent some of the things species need. The leaves may be food and water, and the stones may be space, shelter and mate. Tell the students that they'll be competing for these resources in the habitat islands. Scatter the stones and leaves throughout the four islands so that the larger islands has more stones and leaves as larger habitats contain more resources.

Tell students that they must collect at least one stone and one leaf to survive, but they can collect more if they like. Students can pick up only one stone or leaf at a time from any island. If a student picks up a stone or leaf on the island she starts from, then she must run to another island for another stone or leaf. Students can return to their first island for additional stones and leaves if they need to.

Shout 'Immigrate!' to start the game again. This time give students as much time as they need to move between islands. Stop the game when every student either has been tagged or has collected at least one stone or leaf. After Round 2, count the number of students who survived and record it.

6. ***Discuss the Results.*** Have the students gather together to figure out the percent of species that survived. Most likely, a large percent became extinct. Ask students why they think so many species didn't make it. Were the taggers faster than they were? Did they have to go to several islands, leaving themselves open to taggers? Were they forced out of a small island that was too crowded? Ask them if real species face similar threats? What are they? (Species that have to travel to several habitat areas to get resources face many threats, such as lack of food, shelter and nowhere to hide from predators and humans.)

   Ask the students who survived why they think they were never tagged. Ask the students if real species can survive in the same way that they did. (Some species can avoid many threats that other species face, for example, birds can



fly to escape predators, they can also search for food over large areas. Some species need only a very small amount of space to get what they need, so they might not ever need to leave their habitat island, or they might not have to look far outside their habitat. Still other species might not be affected by the main threats in an area e.g. if there was a predator killing many small animals in an area, a larger species might be too big to be eaten by that predator.)

7. ***Discuss protected area design: Making a good plan***. Go inside to discuss this activity. Ask the students to think about how we can help wildlife in fragmented areas. One way to make sure that there's enough habitat for species is to set aside land in protected areas. Ask the students if they can think of any potential problems with protected areas. (If they have trouble thinking about problems, lead them back to the concepts they learned in the game. Many protected areas are like habitat islands - they are surrounded by human communities and can become isolated. Some protected areas might be too small to support many species. Wildlife moving between protected areas can face many threats. Your students may come up with other problems not related to the concepts of the game, but be sure that the ones listed here are covered.)

   Refer to the diagram 'Protected Area Design Choices'. Each diagram represents a possible protected area design, but in each set one is a better choice than the other. Ask the students which design in each pair they think is best, based on what they learned in the game. Ask them to explain their choices, and then give them the answer and explanation provided. If the students can justify their answer with an explanation that demonstrates that they understand the material, they're right. Let them know that there are many ways of looking at the problem.

8. ***Talk about how people can help species in developed area.*** Most animals probably don't live their whole lives in protected areas. Even if they use the protected area most of the time, chances are they'll need to leave them to find food, mates or other things at some point. Do your students think wildlife has a good chance of surviving outside protected areas? Are there things we can do to increase the animals' chances of survival and help preserve biodiversity? Many people are working to create conservation corridors that link protected areas by involving all of the people who live and work in the areas between and around legal parks and reserves. In a corridor, everyone plays a role. Private landowners and communities collaborate to maintain or create safe habitat for species, while still earning a living through sustainable use of the land. Some ideas to help reduce threats to wildlife may be:

   (a) Plant native plants and trees so that the land is more like the animal's habitat.
   (b) Reduce the use of pesticides so that birds, insects and other species can use habitats without the threat of being poisoned.
   (c) Make boxes that birds can use for nesting.
   (d) Do not pollute the animals' habitat by dumping garbage there. Pick up all plastics and put them in a bin.
   (e) Do not eat products that can harm the animal, for example, if you eat sea turtle eggs or meat, there will be less sea turtles in the ocean.

BRANCHING OUT

Have students write an interview between a journalist from Stabroek News and an animal or plant whose habitat has gotten smaller because of human development. The interview could include questions such as: Why are you leaving home? Where do you think your travels will take you? What are your special habitat needs? How could people have reduced the damage this development caused? Afterwards, students can share their interviews by taking turns playing the roles of journalists and species being interviewed.

Adapted with permission from Exploring Biodiversity, a joint publication of CI and WWF, 1999

Activity 3: Levels of Life

INTRODUCTION

Guyana's rainforest is filled from top to bottom with life. The rainforest is layered with the thickest layer being the highest. At the floor is the herb layer that contains small grasses and other plants up to several metres high. The shrub layer rises above the herbs to a height of about 6 metres. This is composed of short trees and bushes. Far above is the understory, an area of medium height trees. At the top is the canopy, a wide and unbroken expanse of leaves at a height of 30 metres or more. The floor of the rainforest is often dark with less than 5% of the available sunlight filtering to the ground.

Most of the animals in the rainforest live in only one of the vegetation zones, for example in the canopy. The canopy is the most populated area. Due to the difficulties in reaching and moving through the canopy, much of the life in this region is unknown. Even more difficult to reach is the understory layer. Trees in this area are relatively far apart, will not support much weight and hard to climb. Some contain nests of biting ants. Since the canopy prevents studies from being done from above and the weak trees prevent researchers from climbing, a lot of life in the rainforest is virtually unknown. Most of the exploration of the rainforest has occurred in the herb and shrub layers.

Objectives:

- To research a plant or animal from the rainforest and identify its physical location within the rainforest (e.g., canopy, etc.).
- To understand that different organisms live in different layers of the rainforest.

Subject: Science, English literature

Materials: World Map, Construction paper in various colors, newspaper, Coloured art paper (especially browns and greens), Markers, colored pencils, crayons, Chalkboard or bulletin board, scissors, rulers, glue, string, reference materials such as encyclopedias, science books, coloured thread.

Time: 60 minutes

In this activity, students will research the characteristics of a variety of rainforest organisms and present their research findings to the group. As a class, they will construct a bulletin board that places the animals by their position in the environment, gives information about each animal, and shows their interrelationships.

Examples of Plants and Animals in Guyana

Animals: Howler Monkey, Hawksbill sea turtle, Anaconda, Jaguar, Ocelot, Tapir, Agouti, Labba, Anteater, Giant River Otter, Manatee, Scarlet Macaw, Deer.

Plants: Crabwood tree, Bulletwood, Balata, Greenheart, Purpleheart, Ite Palm, Mora, Kabukalli, Aromata, Red/Black mangrove.

WHAT TO DO

1.Teachers should begin with a review of the rainforests of the Earth using the Rainforests Fact Sheet below and either a wall map or smaller printed maps. On the maps, identify the areas of rainforest around the world.

2. After reviewing the Rainforest Fact Sheets, ask students to name the different animals and plants that they know living in the rainforest of Guyana. As they call out the names, make a list of the animals and plants on the chalkboard.

3. Ask each student to research one of the named animal and plant that live in the Guyana rainforest

RAINFOREST FACT SHEET

A tropical rainforest is one of the earth's most spectacular natural wonders! Tropical rainforests are located around the equator – from the Tropic of Cancer in the north, to the Tropic of Capricorn in the south. The largest rainforests are in Brazil (South America), Democratic Republic of Congo (Africa), and Indonesia (islands found near the Indian Ocean). Other tropical rainforests lie in Southeast Asia, Hawaii, and the Caribbean Islands. The Amazon rainforest, which Guyana is part of, in South America is the world's largest rainforest in the World.

Rainforest are called so, because they're wet! Tropical rainforests are defined by their wet and dry seasons. Tropical rainforests receive 160 to 300 inches (400–760 cm) of rain each year. Also because rainforests lie near the equator, temperatures stay near 75–80 degrees Fahrenheit all year round, which is nice and warm.

A tropical rainforest consists of four layers: the emergent trees, canopy, the understory, and the forest floor. The emergent and canopy layers make up the very top of the rainforest, where a few trees, called emergents, poke out above the green growth to reach the sun. Most of the plant growth in rainforests is here, close to the sun. Most rainforest animals, including monkeys, birds, and tree frogs, live in the canopy. Below the canopy are the young trees and shrubs that make up the understory. The plants in this layer rarely grow to large sizes because the canopy blocks most of the sunlight. The forest floor is almost bare because very little sunlight can get through the canopy and understory to reach the ground. This is where fallen leaves and branches rot quickly to release nutrients for other plants to grow. Large mammals such as tapirs who are too heavy to climb up into the canopy layer live in the dim light of the understory and forest floor.

In all of nature, and especially in rainforests, plants and animals depend on each other for survival. This is called interdependence. For example, some insects can only survive in one type of tree, while some birds only eat one type of insect. If this tree is destroyed, the insects will have no home. If the insects die, the birds who rely on them for food will starve to death. Because of this interdependence, if one type of plant or animal becomes extinct, several others could be in danger of extinction as well.

One secret to this lush environment is that the rainforest reuses almost everything that falls to the ground and decays. When leaves fall from the trees, when flowers wilt and die, and when any animal dies on the forest floor, it decays and all of the nutrients in the decayed species are recycled back into the roots of the trees and plants. Only the top few inches of rainforest soil have any nutrients. Most of the nutrients are in the biomass, the bulk of animal and plant life above the ground. The roots of rainforest trees are not very deep;that way they can collect all of the nutrients in the top few inches of the soil. Rainforests even recycle their own rain! As water evaporates in the forest it forms clouds above the canopy that later fall as rain.

Rainforests are essential – not just to those who live in or near them, but to everyone on the whole planet. They help control the world's climate. However, when the rainforests are burned and cleared, carbon is released that causes the weather to be much hotter. This is called the greenhouse effect. People also use many rainforest materials. Many of our medicines come from plants that grow in rainforests. Perhaps someday the cure for cancer or AIDS will be found in a tropical rainforest. Some of the medicines we now use come from tropical rainforest plants, such as aspirin, heart disease treatment, and painkillers. Many products, such as crabwood oil, nibbi and tibisiri, can be taken from rainforests without destroying them;but other products—such as timber, gold, and diamond—require a more destructive method of extraction. Logging for tropical timber and gold mining has contributed to much of the destruction of tropical rainforests.

A rainforest cannot be replaced. Once it is destroyed it is gone forever. Once the web of interdependence has been broken, plants and animals have no way to rebuild their complex communities.

and the layer of the rainforest it inhabits. Students should collect information on index cards that are labeled with general topics on the top, factual information on the lines and bibliographic details on the back. A collection of between 10 and 30 cards should prove sufficient information. The cards should then be condensed so that each organism is represented by one index card on the bulletin board display.

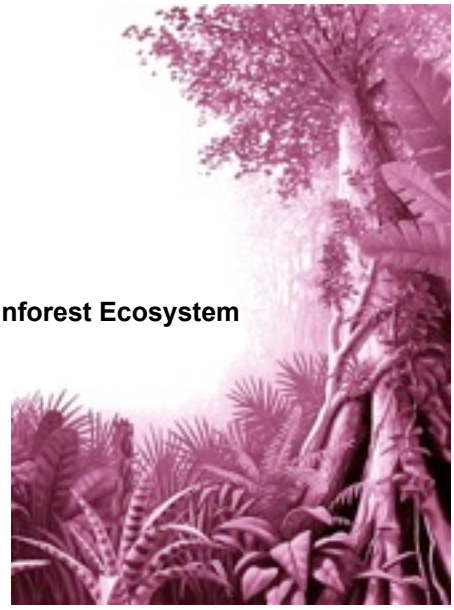
4. The chalkboard/bulletin board should be cleaned for preparation of the forest ecosystem. Tree trunks are made from rolled newspaper covered with brown paper. Rolled paper bags resemble vines. Construction paper backed with wire with tissue paper fronds represent ferns. Bromeliads may be made from toilet paper rolls with layers of construction paper and tissue. Flowers are constructed from tissue. Students will prepare a colour drawing and/or model of their animals and plants for display on the board.

5. After completion of the display, students should make a 2 to 5 minutes presentation to the class about the organism they researched. The presentation should provide general characteristics, the position they live in the rainforest and identify the organism's diet.

6. Students will post the name or picture of the researched/studied organism in the proper position on the chalkboard or bulletin board. The plant materials should be attached to the board first and the animals last. The information card will be placed on the perimeter of the board with a string connecting the information to the organism model/drawing.

7. Colored thread may be used to connect organisms to one another to illustrate the concepts of a food web, commensalism, symbiosis, competition for resources, or predator-prey relationships. Different colors can be used to represent different relationships.

In Guyana, the Iwokrama International Centre is setting up a model for sustainable forestry, the aim of which is to demonstrate how tropical rainforest can be conserved and equally utilized to yield ecological, economic and social benefits. FairView Village, the only community within the Iwokrama Protected Area is a key shareholder in the sustainable forest harvesting.



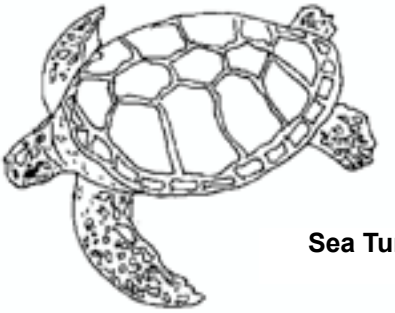
Rainforest Ecosystem

INFORMATION ACQUISITION, DISSEMINATION AND TESTING KNOWLEDGE USING SEA TURTLES

WHAT ARE MARINE TURTLES?

Marine turtles are long-living marine reptiles. They are found along the Northwestern coasts of Guyana, primarily at Shell Beach where the females come ashore to nest during the months of January to August each year. There are 4 species that nest in Guyana: the largest turtle, the Leatherback (*Dermochelys coriacea*); the world's largest hard-shelled turtle, the Green turtle (*Chelonia mydas*); the world's most valuable turtle (historically traded for its beautiful shell), the Hawksbill turtle (*Eretmochelys imbricata*); and the smallest and least abundant turtle in Guyana, the Olive Ridley (*Lepidochelys olivacea*).

Marine turtles reproduce by laying eggs in nest cavities dug in sandy beaches. The eggs take about 60 days to incubate before hatching. Small turtles, called hatchlings then emerge, and immediately battle their way to the water as they encounter several predators such as crabs, wild dogs, raccoons, jaguars, vultures, sea birds and ants along the way. Once in the water, the hatchlings must swim rapidly to avoid the many fish that await them along the shore.



Sea Turtle

Objectives:

- To introduce teachers to the subject of marine turtle biology and threats to survival.
- To demonstrate how teachers can impart this information to students of different age groups through interactive methods that reinforce learning.
- To ensure teachers understand the actions that must be taken to reduce human–based threats and actions that support turtle population protection and recovery.
- To understand the development of games that utilize models of recovery.

Subject: Art, English, Physical Education, Science

Duration: varies – depends on activity

Once at sea, not much is known about the turtles. They are rarely seen or encountered for several years. The males may never be seen again, but the females eventually return to their nesting location to lay their own eggs.

SURVIVAL THREATS

Marine turtles face numerous threats to survival. The threats exist both on land and at sea and all stages of growth. At the first stage, eggs are vulnerable to beach erosion, beach alterations, predation by man and animals, and climate change. The hatchlings must avoid a host of predators both on land and in the water. As the turtles grow, carnivorous fish, sharks and killer whales feed on them. Marine pollution leads to tumours and dietary problems in turtles. As they reach adult size, turtles have few predators as their hard shells and speed in the water make them almost unbeatable! However, fisheries pose a serious threat as many adult turtles, and also small turtles, are frequently caught in fishing nets. As turtles are not

fish, they drown once in these nets as they are unable to surface to breathe. Currently, deliberate and accidental capture by fisheries is believed to be the greatest cause of death in marine turtles.

As a consequence of threats, populations of all 7 species of marine turtles around the world have declined significantly over decades. There is now a concerted effort being made to protect the remaining populations and to facilitate their recovery. It is realized by biologists that if action is not taken now, and at a global level, marine turtles face the real possibility of extinction.

WHAT CAN YOU DO TO REDUCE TURTLE MORTALITY?

Reduction in human-based threats must occur. Disturbances to nesting beaches, predation of eggs, pollution of the marine environment, turtle fisheries and other forms of fisheries that incidentally catch marine turtles must all be addressed.

WHAT TO DO

SESSION 1: Information acquisition
Conduct information research using all available media (e.g. books, websites, interviews). Teachers will present information data on marine turtles using one or more chosen media.

There are many ways that information can be acquired. Request assistance from the Guyana Marine Turtle Conservation Society at Le Meridien Pegasus, Kingston, Georgetown or the World Wildlife Fund office to acquire information on marine turtles. Detailed information on Caribbean sea turtles can also be found on the Wider Caribbean Sea Turtle Conservation Network (WIDECAST) at www.widecast.org.

You must obtain information on marine turtles in order to impart important facts to your class. The information that you want to impart should:

- Expand the student's knowledge on marine turtles;
- Promote an understanding as to the need for conservation of the various species;
- Encourage marine turtle conservation;
- Provide guidance to the students so that they understand how they may contribute to turtle conservation within his particular environment or circumstance;
- Stimulate the students to want to learn more and thus encourage further investigation into the subject.

SESSIONS

Session 1

Information acquisition

Internet, Books, Films, PPT presentations, Posters, Stickers

Session 2

Information dissemination

- Creating dissemination tools
- Identifying the key conservation message
- Use of posters, drama, flash cards, lecture, art and poetry

Session 3

Testing Knowledge

- Building marine turtles
- Game: Bowling out conservation threats
- Marine Turtle Trivia Pursuit

Marine Turtles: Information Points
The following represents the basic information that you will need to present to your students. Note: repetition is always good. It reinforces a point:

- Marine and Sea turtles are the same thing.
- Marine turtles differ from land turtles by having flippers and not legs. They are relatively flat so that they can move faster through water.
- Marine turtles are large, long-living reptiles. This means that they mature and age slowly.
- Marine turtles reproduce by laying soft-shelled eggs in nest cavities dug in sandy beaches.
- With the exception of the Leatherback, all marine turtles have a bony shell on their back (called a carapace) and their belly (called a plastron). The carapace of the Leatherback is leathery and flexible.
- Marine Turtles have scales.

- There are several types (or species) of turtles. These include the giant leatherback turtle *Dermochelys coriacea*; green turtle *Chelonia mydas*; hawksbill turtle *Eretmochelys imbricata*; the olive ridley *Lepidochelys olivacea*.
- Marine turtle eggs and meat are often eaten by humans, jaguars, stray dogs, raccoons, mongoose, crabs and vultures; and hundreds of adult turtles are caught and drown in fish nets every year.
- As a consequence of predation and fisheries, marine turtle populations all around the world have declined.
- Marine turtles may therefore disappear from the planet if care is not taken to protect them. Marine turtles are thus described as being endangered.
- Marine turtles eat different things: leatherback turtles eat jelly-fish; green turtles eat sea grass, hawksbill turtles specialize on sponges.
- Beach and sea pollution also help harm marine turtles. One of the biggest threats to sea turtles worldwide is the loss of habitat to human settlement, often associated with tourism.
- When fishermen place nets close to the shore during nesting season, this leads to sea or marine turtles getting entangled in nets and drowning.

Teaching Tips

Encourage participation and attendance by building information into activities that students cannot source in other ways e.g. debates, mock interviews, mock trails, etc

SESSION 2: Information dissemination

In preparing your lesson, identify the key conservation message you would like to convey. Information can be detailed but use simple, easy to follow text. You should avoid long, complicated sentences and terms. If a complex word or term is used, ensure that you define it beforehand. Create and/or identify the best dissemination tools to convey this message, depending on available resources and culture of the community. The use of TV and videos, computer presentations, posters and flash cards are some dissemination tools you can use. When making your presentation, limit your talk to 5 points for students 5 – 9 years; 6 points for students 9 – 12 years, and 7 – 8 points for students 12 – 16-years. Repeat each point at least 3 times.

The use of imagery and story-telling can be very effective at communicating ideas and new information to young persons. The attention span of most children is relatively short. Thus it is best to present information in a way that stimulates as many of the primary senses as possible: sight, hearing, small, touch.

Sharing Information with your class

As a teacher, a major part of your job is to share information. Follow these simple steps for a successful lecture/talk.

Step 1: Conduct your research. Use books, newspapers or the internet. Prepare your points in short sentences.

Step 2a: Present your information in an easy–to-follow manner, using the resources that are readily available to you. Everyone enjoys television and computer presentations. However, if you have no access to electricity or computers or projectors, use flip charts or work with a local drama group to present a puppet show.

Step 2b: If you have access to television, try to borrow or purchase movies that can assist you in transferring information.

Step 2c: A field trip with a video camera is a great way to acquire information that can be later shared with a larger group.

Step 3: Present one point at a time. If you can draw, use artwork to emphasize your point. Alternatively, you can cut items from old magazines! If you are teaching about nature, visit the schoolyard and bring back, where possible, samples of the subject: a leaf, an insect, soil and seeds.

ASSIGNMENT FOR TEACHERS

Objective: To demonstrate your understanding of the information provided

Materials Needed: poster paper, pencil, eraser, crayons, ruler, tape, glue, old magazines, photographs, stencil, paint and brush.

Activity:

1. Determine your key message.
2. Do a layout design with a pencil for your poster. Try to use large text and many images. Children can be placed into groups and given the task to make their own posters. The teacher may choose to make her own poster for use in the classroom.
3. Do a layout design for your flash card. Flash cards are useful to provide information on different themes. You can do a card for each species of turtle, for each threat that turtles face, for the different places that turtles live, or the different stages of growth of the turtle. For large groups, flash cards are fun and useful as each child can be given the task to make one or more flash cards.
4. For flash cards, cut your thick poster paper into squares about 6.35 x 7.62 centimetres
5. Your design should have an image to the front with a title. The back of the card can have two or three important facts pertaining to the theme of the card.

Step 4: Making Posters and or Flash Cards

SESSION 3: Testing Knowledge

Teachers must test the students' understanding of the information provided in the lecture/presentation. This can be done in several interactive ways. The following are only a few examples:

1.Building marine turtles

Things you need: poster board, paint, scissors and crayons.

•Students should be invited to select their poster board and colour pencils or crayons. They may also be provided with other art supplies such as glitter, glue, sequins, crepe paper and other items such as old buttons, bottle caps, pencil sharpenings, leaves, sand.

•Children are assisted in making their marine turtles. Children can be guided to display specific characteristics of the species selected. They can then "dress-up" for later activities or for a parade, photograph or be part of a drama production. Turtles can also be used to decorate the classroom.

2.Use of Drama to describe stages in the life of marine turtles

Things you need: Poster paper, twine, scissors, paper puncher.

•Make your presentation on the life of the marine turtle. Break this down into the various stages: egg, hatchling, juvenile and adult. Discuss the threats faced by the turtle, the food eaten, the interactions with other animals and plants on the beach and in the sea. Include interactions with humans.

- Place children in groups.
- Give each group the task to dramatize a life stage of the marine turtle. To increase the level of fun, have children "dress up". Using poster paper ask groups to draw, colour and cut out 15 - 22 cm shapes of sharks, turtles, crabs, jelly-fish, corals, reef fish, killer whales, vultures, fish nets, fishermen, jaguars, eggs, hatchlings, … etc. Children must then punch holes at each end of their cut-outs and connect them with a length of 30 cm twine. They can now place these around their necks. Each child should have one cut-out to indicate his role in the play.
- Each group can now present its play. An advanced activity would be to let the children mime the drama, and allow the other groups to later describe what was dramatized.

3. Use of Art and Poetry

Things you need: pen, pencil, writing paper, art supplies.

- Present your lecture.
- Present a theme or topic or scenario and ask students to write a poem, short story and artwork on the theme. The level of difficulty can change depending on the age group of the students.

4. Use of Games: Bowling out Conservation Threats

Things you need: used plastic soda bottles, all of the same size.

- Children will be assisted to construct 10 bowling pins representing threats to turtles.
- Remove labels from the soda bottles. Identify the threats marine turtles face. Create “threat” labels. (Examples include “sand crabs”; “sharks”, wild dogs”, “poachers” etc.) You need 10 threats.
- Stick labels on the bottles. Each label will receive a number. Grade pins according to threat severity. (Examples “Red ants 1”, “ Jaguar 2”, “catfish 3”, “Killer whale 5”, “Fisheries 7”
- Fill the bottles with sand.
- Place as you would bowling pins. Put the bottles in a random order according to the threats.
- Make a ball: fill a plastic bag with some sand so that it is about 7 cm in diameter. Place in a used sock and tie the end securely.
- Each child gets 2 turns to knock down as many bottles as possible. Points are awarded according to the bottles that are knocked down.

5. Marine Turtle Trivia Pursuit

This game is more advanced and will require the teacher to develop the board and cards.

- Determine information to be tested.
- Draft questions, categorize them and grade according to the level of difficulty.
- Teacher must demonstrate the game to the class. The game should be played in groups of 3 – 4 students.

Shell Beach, a 140km stretch of beach and mudflat along the Northwestern coast of Guyana, is known as the annual nesting ground for four species of endangered sea turtles in Guyana. They are the Leatherback, Hawksbill, Olive Ridley and Green sea turtles. The Guyana Marine Turtle Conservation Society (GMTCS) hires rangers from the main sea turtle using communities of Almond Beach, Santa Rosa and Waramuri to help monitor and protect the nesting female turtles that come ashore from January to August every year.

Activity 1: Let's Be A Sea Turtle

INTRODUCTION

Students will learn about adaptations that enable sea turtles to survive in the marine environment.

Objectives:

- Name 3 differences between land turtles and sea turtles.
- Name 3 adaptations of sea turtles.
- Create imaginary creatures with adaptations similar to those of sea turtles.

Subject: Art, Science, Vocabulary

Materials Needed: Nose clip, 2 pairs of swim fins (1 large, 1 small pair), cardboard "carapace" and "plastron", goggles, scissors, tongs, mortar and pestle, paintbrush, drawing paper, crayons, markers

Duration: 60 minutes

GETTING READY

1. Create the cardboard carapace (top shell) and plastron (bottom shell) by cutting two 1 m ovals out of thick paper or cardboard.

WHAT TO DO

1. Introduce the subject. Animals live in all kinds of habitats. To survive, these animals have developed physical adaptations: changes in the structure or function of an animal that allows it to better adjust to and survive in its environment.

2. Explain to the students that they will be considering these adaptations as they "transform" a class member into a Sea Turtle. Ask for a volunteer from the group. The volunteer will wear items that represent a variety of sea turtle adaptations. See Sea Turtle transformation below.

3. Now the students will have the opportunity to create their own creature. Divide the students into groups of 2-4. Each group will create an imaginary creature and its habitat, based on the information given. They can not use an actual known animal, they must come up with their own creation using crayons and markers! Adaptations should include - but are not limited to - how it moves, eats, breathes and protects itself. Students must also develop a unique name for their animal.

Abilities of the animal must include:

1. Lives in water.
2. Swims well under water.
3. Eats _____. (Students may use an imaginary food. They should describe the food and the adaptations needed to catch and eat it).
4. Needs protection from predators. (Students should choose a predator and describe how their creature avoids the predator).

4. Have each group present their imaginary animals to the rest of the class, and explain their adaptations.

BRANCHING OUT

1. Have the students draw animals close to home and explain their adaptations.

2. Discuss how adaptations might change with different climates and/or different food availability.

Adapted with permission from Marin, Alicia B. 2008. Sun, Sand and Sea Turtles: Inspiring Caribbean Youth through Nonformal Education (Karen L. Eckert, Editor). Wider Caribbean Sea Turtle Conservation Network (WIDECAST), 2008

Sea Turtle Transformation

A. **Goggles** – These represent a sea turtle's eyes (clear eye-lid) and how they are able to see underwater.

B. **Nose clip** – This represents how the sea turtle can hold its breath under water. Remember, sea turtles are air breathing reptiles and must surface in order to breathe.

C. **Large fins (worn on the hands)** – These represent the sea turtle's front flippers. The fore flippers are long and paddle- like. They are powerful structures that help propel the animal through the water and assist the nesting female in pulling herself up the beach.

D. **Small fins (worn on the feet)** – These represent the sea turtles' back flippers. They are shorter than the front because they have a different function. The hind flippers act as rudders, stabilizing and directing the animal as it swims. The back flippers are also used to help push a nesting female up the beach, in addition to helping her to dig her nest. Discuss how the flippers differ from a land turtle, which has stumpy legs. What would happen if you put a land turtle in water?

E. **Cardboard carapace and plastron (worn on the back and chest, respectively)** – These represent the carapace and plastron. They protect the inner organs of the sea turtle, much like a Knight's armor. The carapace and plastron are part of the skeleton of the sea turtle. The backbone and rib cage are fused to form the carapace. A sea turtle is born with its shell and grows with it all its life. A turtle does not switch shells like a hermit crab. The hard shell protects the animal from predators. As a sea turtle grows larger, the carapace and plastron get stronger and there are fewer animals that can penetrate the shell and hurt the turtle.

Notice the streamlined, or hydrodynamic, shell allows the sea turtle to move quickly and easily through the water. This flattened shell also prevents the sea turtle from retracting its head and limbs. Beside the hard carapace, sea turtles rely on other adaptations – such as their flippers – to help them escape quickly from predators.

F. **Paintbrush** – This represents the different coloration pattern that sea turtles have. Color can be a form of camouflage. Hawksbills have a color pattern that helps them to blend into the coral reef environment, while Green turtles have a slightly different pattern that blends into a sea grass meadow. (Remember, Green turtles are vegetarians!)

G. **Scissors, tongs, mortar and pestle** (demonstration only, have the student hold each item as you describe them) – These represent the different oral adaptations of sea turtles. Jaw shape varies among species, and each species has a jaw shape adapted for its diet. Loggerheads have strong jaws lined with flat crushing plates for eating hard-shelled prey like conch and crabs (mortar and pestle). Leatherbacks have 3 interlocking cusps used to grab their soft bodied prey, jellyfish (tongs). The serrated jaw or rhamphotheca of a Green sea turtle allows for efficient grazing of sea grasses like scissors.

Activity 2: Create Your Own Sea Turtle

INTRODUCTION

Students will assemble and decorate their own sea turtle and be able to identify the "parts" of a sea turtle.

Objectives:

- Name at least 3 different anatomical structures of a sea turtle
- Create a sea turtle to take home

Subject: Art, Science

Materials Needed: Provided Sea Turtle Pattern, Cardstock, Googley eyes, Tongue depressors, Crayons, Markers, Glue, Scissors

Duration: 40 minutes – 60 minutes

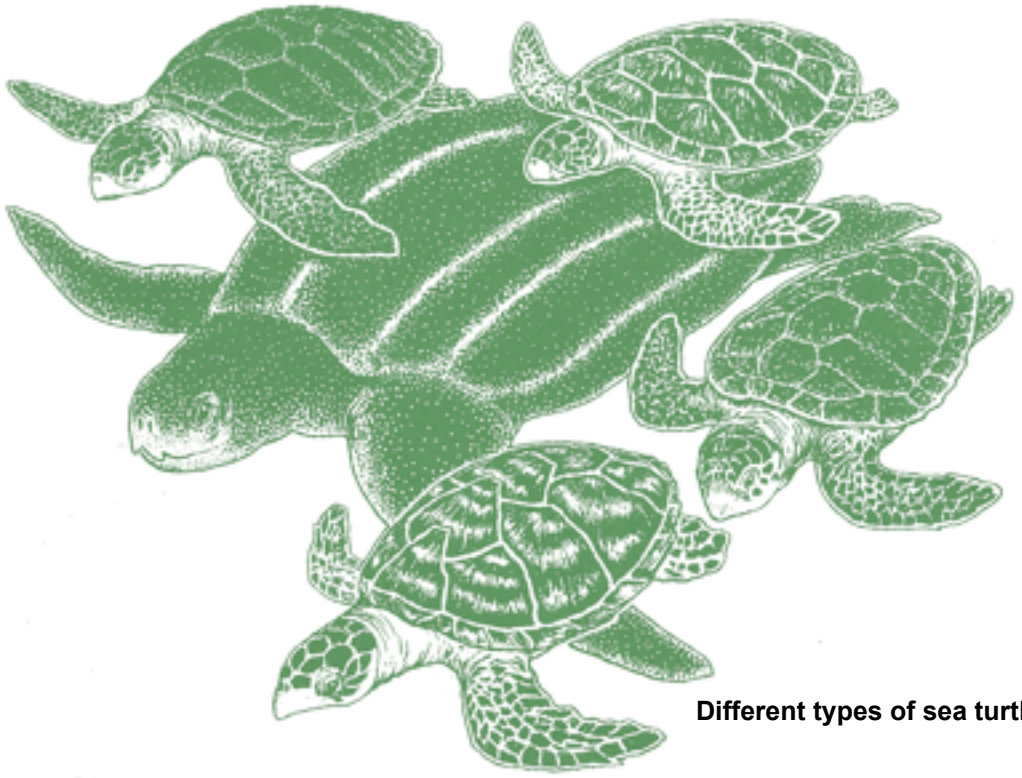
GETTING READY

Teachers can copy the provided Sea Turtle Pattern, one per student. Students can draw the eyes and use the flippers provided on the pattern instead of using googley eyes and tongue depressors.

WHAT TO DO

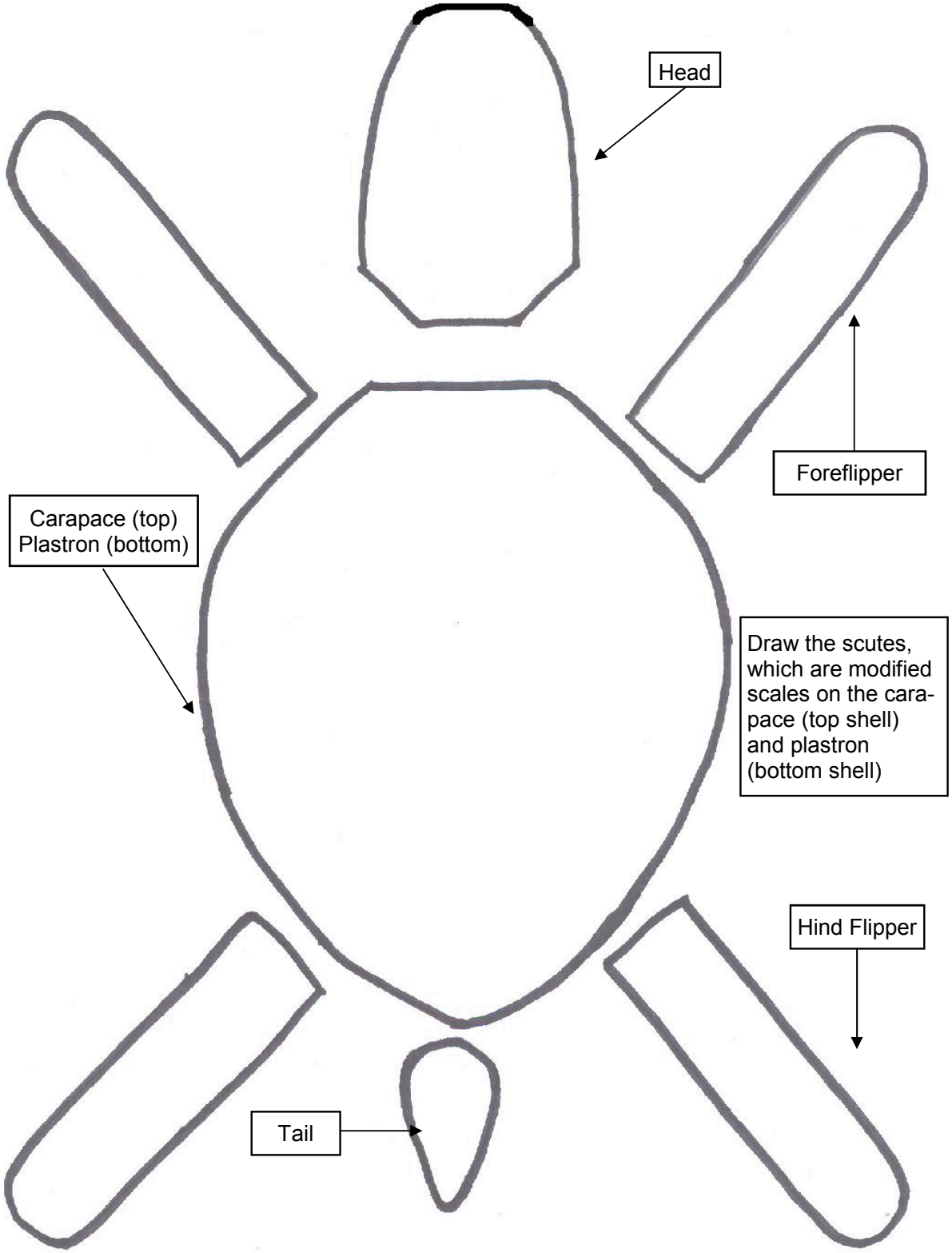
1. Each student will cut out, assemble and decorate their own sea turtle. As you instruct them how to assemble it, review the names of each anatomical structure (head, carapace, plastron, fore flipper, hind flipper, tail and scutes). Have the student list each structure on the back of their turtle.

2. Have the student write 3 facts about their sea turtle on the back of their craft and then share these facts with the class.



Different types of sea turtles

Sea Turtle Pattern



Adapted with permission from Marin, Alicia B. 2008. Sun, Sand and Sea Turtles: Inspiring Caribbean Youth through Nonformal Education (Karen L. Eckert, Editor). Wider Caribbean Sea Turtle Conservation Network (WIDECAST), 2008

Activity 3: Ready, Set, NEST!

INTRODUCTION

Students will simulate the egg laying process by participating in a relay race: swimming to shore, crawling up the beach, clearing the nest area of debris, digging the nest cavity, laying eggs, covering, and finally returning to the sea.

Objectives:

- Name 2 adaptations that contribute to successful nesting
- Identify 3 steps of the egg laying process
- Learn how many eggs a sea turtle lays

Subject: Physical Education, Science

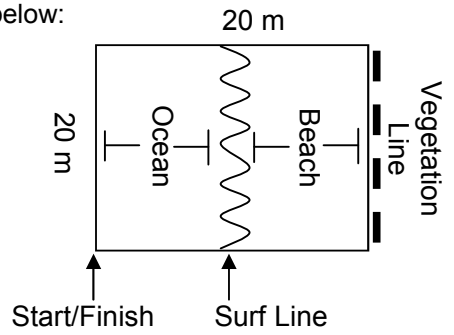
Materials Needed: Sandy area preferably a beach

Duration: 70 minutes

NOTE: If a Lifeguard is present, there is an aquatic adaptation to this game. In that case, the REAL ocean will be used and only the vegetation line should be marked.

GETTING READY

1. Set up the playing area as shown in the picture below:



WHAT TO DO

1. Review the steps of the nesting process with the students. First the female swims to her nesting beach and crawls toward the vegetation line, generally at night. After finding a suitable nesting spot, she clears the areas of dry sand and debris, such as leaves and sticks. Next she digs a nest cavity and deposits her eggs. Then she covers the eggs and disturbs the area by throwing sand over it. Finally she crawls back down the beach and returns to the ocean.

2. Divide the class into teams of 4 to 5 students. Ask each team to stand together. Each team represents ONE nesting female. Explain to the students that each individual will have a role in this Nest Relay Race and give them a few minutes to decide amongst themselves who will play each of the following roles (nesting order): the Swimmer, the Crawler/Clearer, the Digger/Egg Layer, the Coverer/Returner to the sea.

NOTE: If the class is large, each role can be further broken up so each student has a part to play. If it is smaller, certain roles can be combined or students can play more than one role.

3. Have the students stay with their teams and ask them to spread out horizontally across the Start Line. Then instruct the students to get in their respective places; the Swimmer at the Start Line, the Crawler/ Clearer at the Surf Line, the Digger/Egg layer and the Coverer/ Returner at the Vegetation Line. Make sure all members of the team are in the same vertical line - each student should see their teammate in front of them.

NOTE: If resources allow, have a staff member stand at each divide: the Surf Line, and the Vegetation Line. Aquatic extension: a staff member MUST stand in the water, to mark start/finish line.

4. Once given the signal, the Swimmer will swim (using their arms as flippers) from the Start Line toward the Beach (Aquatic Extension: students will start in the water and swim to the beach). When the Swimmer reaches the nesting beach (Surf Line), they tag their awaiting team member (the Crawler/ Clearer) who then crawls toward the Vegetation Line.

5. When the Crawler/Clearer reaches the Vegetation Line, he/she must use his/ her front flippers (arms) to clear the area. Once that is complete, the Crawler/Clearer tags the Digger/Egg Layer.

6. The Digger/Egg Layer can only use his/her hind flippers (feet) to dig the nest. The Beach/Vegetation Line Monitor (staff member) will let each Turtle know when they have completed digging their nest. After they finish digging, they begin to lay their eggs, by counting out loud in increments of 10 until they reach 100. When they reach 100, they tag the Coverer/Returner.

7. In the final stage of this Nesting Relay Race, the Coverer/Returner first fills in the nest with his/her hind flippers and then uses his/her front flippers to camouflage it by tossing sand. Then he or she crawls back toward the sea and tags the Swimmer.

8. The first team whose Swimmer crosses the Finish Line is the winning Nesting Female!

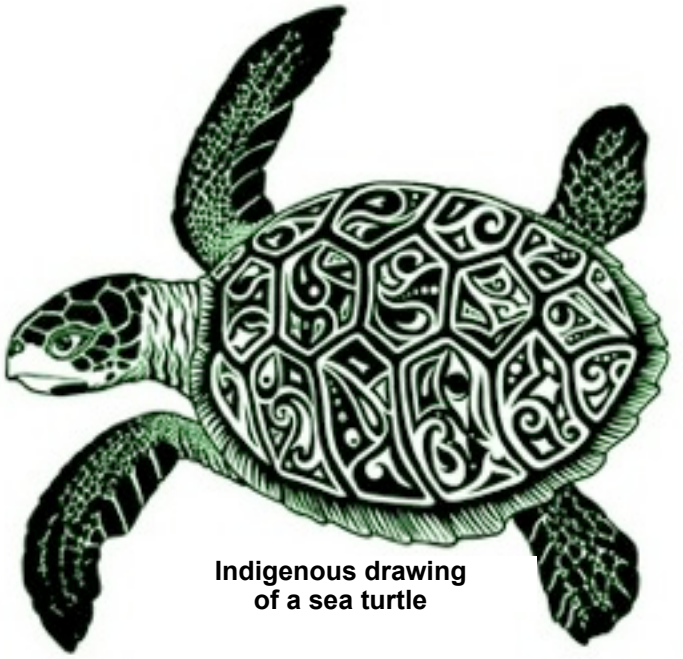
BRANCHING OUT

1. Repeat the entire game, only this time have the students switch their roles within their teams.

2. Another option is to give certain turtles disabilities, such as missing a front or rear flipper, the sand being too hard to dig into, lights on the beach (which disorients or frightens the female), etc. Have the students play the entire game again with these disabilities. Once they have finished, ask the Turtles with disabilities to discuss their experience. Was it easier or harder to nest?

Adapted with permission from Marin, Alicia B. 2008. Sun, Sand and Sea Turtles: Inspiring Caribbean Youth through Nonformal Education (Karen L. Eckert, Editor). Wider Caribbean Sea Turtle Conservation Network (WIDECAST), 2008

Every year, GMTCS brings over 60 students, parents and teachers from traditional sea turtle harvesting communities in Region 1 to participate in 8 1-week long Environmental Camp. The direct interaction with sea turtles through this camp has made a significant impact on the youths since its commencement in 1980s. Past students are now captains/ leaders of their communities.



Indigenous drawing of a sea turtle

Activity 4: Egg-cellent Nest Protectors

Objectives:

- Learn how difficult it is for sea turtles to lay their eggs
- Name 2 adaptations that sea turtles have for nesting
- List 2 ways female sea turtles protect their eggs from predators

Subject: Science, Food Science

Materials Needed: Instant Jello pudding (any flavor), Graham crackers, Mini-marshmallows, Whipped cream, Styrofoam plates, Paper towels, plastic bag.

Duration: 70 minutes

INTRODUCTION

Students will learn about the egg laying process by participating in an exercise where they become a nesting female and must hide their eggs in the sand (this game involves food).

GETTING READY

1. Prepare the pudding as directed on the package, making enough so that each student receives at least 1/2 cup of pudding.

2. Place the graham crackers, one full cracker per student, in a Ziploc bag. Crush them by applying pressure with your hands.

NOTE: Be sure to check that the students participating in this game are not allergic to any of the ingredients used in this activity!

WHAT TO DO

1. Ask the students how nesting females dig their nest. Do they have hands to help them dig their nest? No, they use their hind flippers. Are they able to see the hole they are digging? No, they rely on their instincts. After laying their eggs, do they immediately return to the sea? No, first they cover their eggs.

2. Explain to the students that they will be acting as nesting females in this game. They will have to bury their Eggs (marshmallows) in the Sand (pudding, whipped cream, and graham crackers) only using their mouths. They can not use their hands!

NOTE: Some students may not want to participate in this game. Encourage all students to give it a try but if they decide not to, involve them in cheering on their classmates.

3. Provide each student with a plate and a napkin. Give each student 5 marshmallows, and have them place them on their napkin.

4. Next, give each student one-half cup of pudding, followed by some graham cracker crumbs and lastly some whipped cream, on the plate.

5. Have all participating students stand in front of their nesting materials with their hands behind their back.

6. When given the signal (1,2,3, Nest!), the students begin to move their Eggs (marshmallows) from their napkins into the Sand (pudding, graham cracker crumbs, and whipped cream), one at a time. They must continue to move the Eggs and bury them until all Eggs are safely covered in the Sand.

7. After fully covering 5 Eggs, ask the students to raise their hand to signal that they are done. The teacher will check the nest to determine if the Eggs are fully protected or if they need to keep covering.

8. The first Turtle to successfully cover all her Eggs wins!

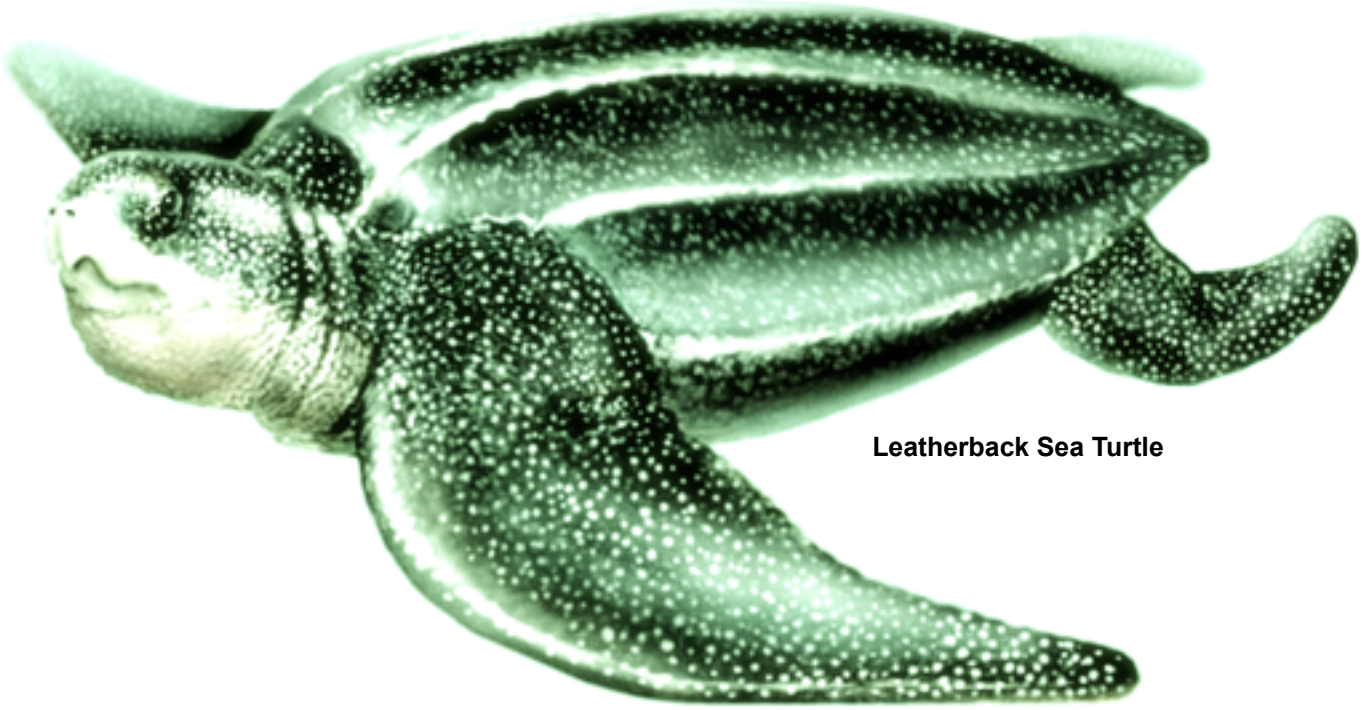
9. As the students enjoy their “nest”, discuss with them their experience. Was it easy or hard to bury the Eggs in the Sand? What if the Sand was harder? Was it hard just using your mouth? What if you had to do it with your eyes closed? Would it have been easier if you could have used your hands? Would it have been easier if you could have used your feet?

10. After the students have finished their “nest”, have them wash their faces, and then wash and save their plates.

Adapted with permission from Marin, Alicia B. 2008. Sun, Sand and Sea Turtles: Inspiring Caribbean Youth through Nonformal Education (Karen L. Eckert, Editor). Wider Caribbean Sea Turtle Conservation Network (WIDECAST), 2008

The Leatherback Sea Turtle is the largest sea turtle in Guyana and the World. The Leatherback is the main predator for jellyfish. Jellyfish feeds on the larvae of commercially-important fish. Scientists have found that removal of sea turtles such as the Leatherback would cause a dramatic increase in jellyfish populations and as a result, fewer large fish for commercial fisheries and communities such as Almond Beach, Santa Rose and Waramuri to utilize.

Leatherback Sea Turtles can dive more than 300 metres staying submerged for as long as 5 hours. But this is dangerous because it slows down the Sea Turtles heart rate to conserve oxygen. 10 minutes can elapse in between heart beats.



Leatherback Sea Turtle

SCHOOLYARD ECOLOGY

INTRODUCTION

Schoolyard Ecology (SYE) facilitates the exploration of living organisms and ecosystems, including native, non-native, and invasive animals and plants. Students play the role of scientists who observe, measure, record, and analyze their own data.

SYE makes the schoolyard accessible to children and teachers as a "living laboratory". Small portions of the schoolyard become living science labs for students of all ages. Children and teachers can then observe and investigate ecological processes, interactions between species, and the varied effects of human activities using their schoolyards.

Objectives:

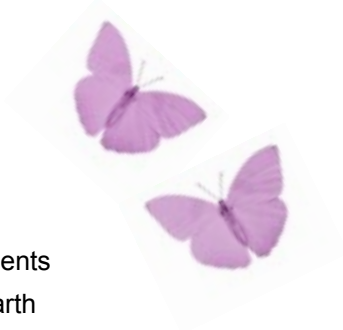
- To introduce students to the concepts of schoolyard ecology.
- To demystify science and stimulate critical thinking
- To help students develop enquiring minds while promoting learning through experience and discovery.

Subject: Art, English, Science

Duration: Varies

We are born with all the *tools* we need to do scientific observations.

As humans we are all curious about everything around us. It's in our nature!



Our most important **tools** are:

- **Eyes:** To SEE to view colors, forms, sizes, texture and movements
- **Ears:** To HEAR and detect/sense sound in the air, water, or earth
- **Skin:** To TOUCH and feel things around us -
- **Nose:** To SMELL scents in the air
- **Tongue:** To TASTE. We have 5 tasting areas on our tongue: bitter (back), sour (mid-side) sweet (front), salt sides
- **Brain:** Your thinking machine!

Our senses work together to paint the picture of our surroundings. Every living creature senses the world in its own unique way.

Where do SCIENTIFIC QUESTIONS come from?

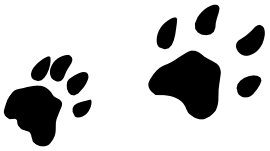
You make them up by being curious about your experiences using a "Cycle of Inquiry"

Curiosity + Observation and Imagination = Inquiry

Developing your QUESTION

All questions are worthwhile, but some are more worthwhile than others for starting off the Inquiry Cycle.

GUIDELINES for developing your QUESTIONS



1. The question must be **answerable through our own investigation**.

Questions that start with the following are good ways to make up questions:

- How
- Which
- How many
- Where
- What is the difference between….?

Questions that start with "WHY" are not good as they can lead to speculation or encourage you to make up an answer.

NO WHY QUESTIONS!

Teaching Tips

Try to provide hints or "cues" during the course of the lecture that students may use to remember important points.

2. The question must be **comparative**, and the comparison must relate to some broader concept or factor.

- "Which kinds of animals live in the leaf-litter of this shady corner of the schoolyard?" – This is not a comparative question.
- "Which kinds of animals live in the leaf-litter of this shady corner and the leaf-litter of that shady corner of the schoolyard?" – This is not a comparative question.
- "How do the kinds of animals in the leaf-litter vary between this shady corner of the school yard and that sunny corner?" – This question is *comparing* shady places and sunny places.

3. The question must be **interesting**. If you know the answer to the question beforehand then it is not interesting!

4. The question must be **simple and direct**; Avoid using fancy scientific words and equipment that is expensive to get or difficult to use.

THE CYCLE OF INQUIRY

A cycle is something that goes around:

- Sun: day and night
- Seasons: rainy and dry, fruiting and flowering
- _____
- _____

Observations + Curiosity equals

Construction of the **QUESTION**

ACTION

"Hands-on" and "Minds-on" Experience

1. Plan (design) how to answer the question
2. Answer it: collect the required information according to the design
3. Summarize, analyze and present the results

REFLECTION

1. What happened? (conclusion)
2. Why might it have happened in that way?
    a. Possible causes
    b. Design itself
3. And in the WIDER UNIVERSE

AN EXAMPLE OF THE CYCLE OF INQUIRY

Question: "How does the number of earthworms vary between the soil under the footpath, (trampled by so many feet) and the untrampled, grass-covered soil nearby?"

Method: Choose a point in the middle of the path and dig a hole 20 x 20 cm and 20 cm deep. Then choose a point in the untrampled grass and dig a same size hole. Count the number of worms you found in each. Is there a difference? Draw a pie-chart to compare the two numbers of earthworms that you found.

THINK ABOUT IT!

- Was this a fair test?
- Was the pie-chart the best way to represent the results?
- Did you dig enough holes?
- Are the areas with the 2 holes just as dry, just as wet, or were they different?

- Will the results reflect over a broader area or just the areas that were dug?
- Will you need to conduct another study comparing wet soils and dry soils?
- What about possible effects of footpaths upon earthworms and other soil creatures in parks, nature reserves and even the school garden?

So now you know how to form proper inquiry questions,
let us go out there and be scientists!

SOME QUESTIONS FOR YOU TO ASK:

1. How do things we see differ between different species? Draw a piece of land in the school compound as seen by:

    a. An Ant or Grasshopper
    b. A small bird
    c. A man
    d. A Vulture

2. How are the kinds and number of kinds of litter different in the school compound compared to outside the school compound and within 15 m of the school fence?

3. How do the types of animals vary between 3 medium-dry cow-dung compared to 3 fresh cow-dung?

4. Which ants prefer fish, salt-biscuit and honey, and how do their preference changes over time?

What other questions can you come up with?

Red Howler Monkey

Activity 1: Community Connections

INTRODUCTION

In Guyana, one of the best ways to prepare students for their future role as active citizens is to get them involved in local issues. By addressing a real community need, students can learn about environmental issues, the political process, careers, project planning and what it means to be a responsible citizen.

Every community faces environmental challenges that affect the well-being of both people and wildlife. For example, in Santa Rosa pollution affects both people and wildlife while in Kwebana deforestation is a major issue. By getting involved in a biodiversity-related project, your students will invest energy in their community and see that they can help to improve its condition.

Objectives:

- To identify components of local natural systems and how human systems interact with the environment

Subject: Social Studies, Science

Materials Needed: one large piece of paper for each group, coloured markers or pencils, chalkboard, chalk, notebooks and pencils

Duration: varies, approximately 2 hours, 15 minutes plus homework

In these activities, students use maps much the way scientists do, to document the current and past states of the environment and to help to make complex information easier to understand and analyse. Maps are good tools for understanding how different physical features are related and how an area changes over time. Scientists use maps to show how the land is shaped and how human populations change, as well as to identify patterns of ecological change, where species are found, and many other ecological phenomena.

Habitat Query

- Where are the streams, ponds and rivers?
- How is the land shaped? High/low points?
- What areas stay wet part or all of the year (wetlands)?
- Where does your drinking water come from?
- Where does your wastewater go?
- Where do different kinds of plants live?
- Where do different kinds of animals live?
- Where have humans built things? (roads, buildings, etc)
- Where does your food grow?

GETTING READY

1. Before you start, write the list of questions from 'Habitat Query' on the chalkboard. Ask questions that are relevant to the area you want your students to study.

WHAT TO DO

1. ***Map the present***. Divide the class into small groups of 3 to 5 students and give each group a large piece of paper. Each group will work together to create a map of their community. Tell them they should use the questions on the chalkboard to guide them. For example, to map "How is the land shaped?", they can draw the major rivers and hills in their community. Students can write in information or draw pictures or symbols - it doesn't have to be pretty or even accurate, just their best interpretation of where they live. They should have at least 20 - 30 minutes to complete their maps.

2. ***Share your maps***. Have each group share their map with the others and compare. Are the maps the same or are there significant differences? Ask the groups what was most difficult about the exercise and how they worked through it. Did it make them think differently about their community?

3. ***Verify your maps.*** Ask students how they could check the accuracy of their maps. Students can walk around with their maps (as a class or on their own as homework) in their community and check to see if they forgot or misplaced anything. Alternatively, students could ask their parents, grandparents or other adults to look at their maps and give their feedback.

4. ***Think about the past.*** Tell students that in the next class they will be drawing new maps. However, this time they will be drawing maps of what their community was like when their grandparents were their age. To create their maps of the past, they will have to gather information from older people in their families or communities. Use the questions from the first part of the activity to develop an interview. Students can add other questions as well, such as: Are there things you like better about the past? The present? Do you think humans are doing a better or worse job at conserving our environment? Why or why not? How have things changed? Ask students to copy down the interview questions and then interview elders, recording all information collected.

Tips for Interviewing

- Carefully prepare your questions in advance. Limit the number of questions to about ten. If there is a large class, divide students into groups for interviews.
- Before you begin asking questions, explain your purpose and how you will use the information.
- Ask your questions clearly and give the interviewee time to think and respond.
- Before you end the interview, thank the interviewee for taking the time to help you with your project.

5. ***Map the past.*** In the next class period, students should return to their previous groups. After sharing the results of their interviews, they will create new maps - this time portraying what their community was like in the past. After they have finished, each group should again share their new maps with the class.

6. ***Make a list of environmental problems.*** Explain to the students that they now have maps of their community as it is today and as it was in the past. Ask them if they can think of any changes they have seen since they were younger. What about changes their parents or grandparents mentioned? Were there any changes observed that indicate that the environment in and around their communities has gotten worse? Better? Discuss those changes as a group or class.

7. ***Finishing up.*** Talk with students about what has changed in their communities. As humans try to improve their quality of life, sometimes nature is harmed. How do we depend on healthy natural systems to live well? (We need clean water to drink, healthy soil to produce food, and wildlife for balanced ecosystems.) What happens to human quality of life if we don't conserve the environment? Ask students how they would like their community to look when they are grown and have children. As a homework assignment, or in class, students can draw a personal map of their vision for the future. If your community has a central place to display the children's work, such as the Council's office, Extension Centre bulletin board, health clinic or church, you could create an exhibit with the best maps - past, present and future.

Adapted with permission from Exploring Biodiversity, a joint publication of CI and WWF, 1999

Activity 2: Insect Safari

INTRODUCTION

Gardens usually have more insect inhabitants than plants! In this lesson, students sharpen their observation skills by going on an insect safari to learn more about these fascinating garden residents.

Insects are members of the animal kingdom. Despite coming in vastly different shapes, sizes, and behaviors, they're grouped together because they have common body structures: three body regions (head, thorax and abdomen), an exoskeleton, six legs, compound eyes, and antennae. Most also have wings.

Objectives:

- To compare preconceptions about insects to information gleaned through direct observation
- To understand that as a whole, insects are more helpful than harmful to the garden
- To stimulate curiosity and a desire to study insects further.

Subject: Maths, Art, Science

Materials Needed: Paper, Pencils, Clipboards, or cardboard pieces and clothespins, Insect field guides, Optional: hand lenses, insect nets

Duration: 45 minutes

GETTING READY

1. Ask students to share their thoughts about insects. As individuals or a class, write descriptions of insects, create word webs, and/or draw insects using their current conceptions. Ask questions that prompt students to reflect in greater detail. For instance, if they mention that insects have legs, ask how many and where on the body they're attached.
2. Have them brainstorm and list what they know about how insects interact with plants. You can revisit the list after they've observed and noted insect behavior in the garden.

WHAT TO DO

1. The day before your expedition, announce to students that they will be going on an insect safari in the schoolyard. Suggest that they come to school wearing comfortable clothing and shoes, and perhaps even a safari hat!
2. Before students head out, explain that their job is to observe, draw, and gather information about garden insects. They can work as individuals or in teams.
3. To adapt the activity for younger students, provide flash cards of specific groups of insects (e.g., butterflies and beetles) for which to search. With older students, consider providing equipment for more intense study, such as hand lenses or collecting nets.
4. Remind students that many insects carry on their lives out of sight, so they'll need to look in the soil, on the undersides of plant leaves, on flowers, and in the air.
5. Encourage them to include as much detail as possible in their drawings and written descriptions. Have them note the superlatives: the largest, smallest, most colorful, best camouflaged, fastest, and most interesting insects.

6. After you return to the class, talk about the insects observed and their characteristics. Refer to the students' reflections before the safari. Did they find any differences between their original ideas about insects and what they observed first hand? What preconceptions were accurate and which were false? What new things did they learn about insects?

7. Next, challenge them to group the insects based on similarities and differences. Follow up by having students research how scientists classify insects, then compare those categories with their own. Insects are grouped into orders according to physical characteristics and life cycles. Beetles, for instance, are in the order Coleoptera, the members of which are distinguished from other insects by their hardened outer wings (elytra) that form two halves when folded, a pair of flight wings that fold underneath the elytra, chewing mouthparts, and complete (four-stage) metamorphosis.

8. Finally, have students use field guides or Internet sites to try and more closely identify the insects observed. Tell them not to worry if they don't find exact matches – the point is to emphasize how many hundreds – perhaps thousands – of insect species may live in your schoolyard, and rather than being harmful, the vast majority of species help it thrive.

BRANCHING OUT

1. Use the information collected during the safari and the follow-up research to create an insect guide for your schoolyard to share with other classes. Point out which insects are garden pests and which are beneficial.

2. Ask students to consider if there might be beneficial aspects to the insects we consider garden pests. They aren't in the garden just to thwart our goals. What is their purpose in the web of life?

3. Have you noticed a problem with pests in the garden, but don't notice any beneficial insects preying on them? Identify the pests, then find out if there are beneficial species you can purchase and release that will help control them.

A butterfly farm has been established at FairView Village in the Iwokrama Rainforest partnering indigenous peoples, local researchers and foreign scientists. The project provides research opportunities on butterflies and ecologically sustainable economic gain for the community.

Ladybugs

Activity 3: Aqua-Architects

INTRODUCTION

This activity is designed to make each student more aware of the components involved in an aquatic environment . By creating a habitat in the classroom and observing it over a period of six weeks, each student will be involved and will gain hands-on learning experiences. This activity will make the students aware of how important habitats are for species.

Objectives:

- To create a journal consisting of observation notes concerning aquatic creatures and plants
- To work together using group communication and social skills while creating a habitat.
- To learn the components necessary for an aquatic ecosystem

Subject: Science, English

Materials Needed: 5 – 6 large empty plastic bottles, water, marker, scissors, tape, and a hole puncher, Aquatic life (snails, fishes, plant life, and sand), Fish food

Duration: twice a week for 6 weeks

WHAT TO DO

1. Place the students in groups of about three.
2. Cut off the top of one bottle and the bottom of another.
3. Using the bottom piece, cut some holes in it for proper ventilation (this will be used as our lid).
4. Before adding the water, add about an inch or two of dirt or sand to give it a pond or lake environment.
5. Add the plant life, but be sure to secure these plants in the sand and dirt so they won't fall.
6. Add the rest of the aquatic life. The teacher can aid the student in the identification of one male and one female fish, two snails, lots of plants.
7. Secure the lid and put a piece of tape on the bottle with the group members names and have them make a team name as well.
8. Store in a safe place and check it twice a week for 6 weeks noting any changes or differences that occur.
9. Ask students to observe and note the following in their notebooks: What happened to the plants in the bottle? What changes have occurred in your ecosystems? What could we do to make it a better ecosystem?
10. Next, ask the students to relate the aquatic ecosystem to our environment in which we live to see if they can identify some components of our everyday needs (air, water, food shelter, family, friends, etc...).

In 2001, Conservation International Guyana (CI-G) obtained an Timber Sales Agreement for over 200,000 acres of forest in the Southern part of Guyana. Instead of logging, CI-G is conserving the forest in its natural state to demonstrate that forests can be conserved and still improve local economies.

Activity 4: Trash Audit

Objectives:

- To define, give examples of, and sort waste
- To identify the amounts of solid waste produced by individuals and groups

Subject: Science, Maths

Materials Needed: 1 large garbage bag per student, large bucket, 'What's in Our Garbage"and 'Garbage Audit' worksheets, bathroom scale and gloves.

Duration: 45 minutes (collection done over a week)

INTRODUCTION

If students are going to help solve the garbage (waste) problem, they first need to understand the size of the problem. Throwing away a single gum wrapper or banana peel doesn't seem very important, until we see the cumulative impact of everyone's combined trash over a period of time.

By performing a classroom or school wide waste audit, students will gain the necessary perspective to realize that everyone's individual waste contributes to solid waste management problems. In this exercise, students will collect their own personal garbage for an entire day, at home and in school.

WHAT TO DO

1. Ask students to explain in their own words, what is garbage and waste. Waste (garbage, trash) is material thrown away because it is worn out, used up or no longer needed. Note: one person's garbage may be another person's treasure!

2. Tell students that for a week they will be putting all of their garbage from home and school in their own personal trash bag. They will not be using the garbage cans/bins from home or school. Hand out a bag to each student. You may wish to cover the class garbage bin, so students do not use it. You might tell students to collect dry materials only. No sharp items or bathroom waste should be included.

3. Ask the class to hypothesize which type of material will be present in the greatest amount at the end of the week. Write this on a section of the chalkboard and leave it until the end of the week.

4. At the end of the week, ask students to look inside their garbage bags and see what they have. Get examples from students of what they have thrown away. Individually or as an entire class, sort and tally the number of pieces of garbage. Use the Thrash Audit sheet for this activity.

5. Ask students what they noticed from doing the thrash audit. How much did they think their trash weighs? Students should notice how much garbage is thrown away at school, and what types of things are thrown away. Weigh the individual bags or put all the garbage in a large bucket and weigh it as one pile. Get students to calculate how large the pile of garbage would be at the end of the month and all year. This helps students think in terms of volume.

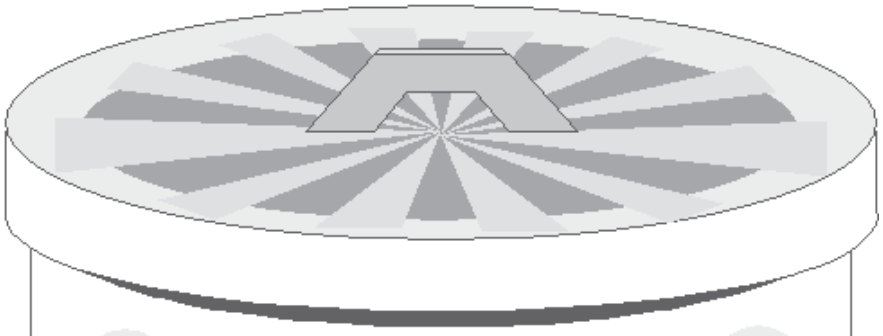
6. Ask students what would happen if there really was no place to throw our trash? Also ask what could you do to make less waste?

BRANCHING OUT

1. Have students write an imaginative essay about a make-believe community that no longer could collect its citizen's trash. Students should include what caused the problem and how the people tried to solve it.

2. After a month has passed, you can do this activity again to see if students have reduced their trash.

WHAT'S IN OUR GARBAGE?



Paper _____

Wood & Yard Debris _____

Food _____

Building Materials _____

Plastic _____

Metal & Glass _____

Miscellaneous _____

Carpet & Clothing _____

Hazardous Materials _____

TRASH AUDIT WORKSHEET

Name or Class or School: _____

Area of Audit (check one):

Classroom ____ Staff Room or Office ____ Home ____ Kitchen ____ Other____

Instructions: Students should appreciate that individual garbage may be only a small amount. However, this garbage must be combined and total weights and volumes will be recorded so that you may calculate daily/weekly/monthly/yearly amounts for your class, your school or per person.

Total weight of garbage including container or person's body weight _____**kg**.

Subtract the weight of the empty container or person's weight _____**kg**.

Total weight of garbage _____**kg**.

Total volume of the garbage _____**lts**.

(estimate based on the fullness of the bag or container)

Total weight of the garbage that is recyclable _____**kg**.

Waste Composition--What's in the Can?

(To do an in-depth audit, you will need to classify materials into types under each category. For example, Paper: writing, brown bags, cardboard, etc.)

Material Type	Weight		Number of Items	Volume	
	Kilograms	% Total		Litres	% Total
Paper					
Plastic					
Glass					
Metal					
Aluminum					
Bottle Bill (deposit)					
Other					

Activity 5: People, Culture and the Environment

INTRODUCTION

In order to provide students with some perspective on environmental issues, it is important to help them understand that people from other cultures and countries may think differently about the world around them. Many societies around the world brought their own values to the country they live in today, some see the environment as something that can be manipulated, rather than something with which they can coexist. This perception may produce many environmental problems which we see today, for example, populated cities and deforestation.

After going through this lesson, students should be able to appreciate that people have different cultural perspectives and that our own "cultural values" may have to be examined in order to protect the earth.

In order to discuss the indigenous people of Guyana, students should already have some knowledge of the Amerindians and other settlers in Guyana.

Objectives:

- To learn about indigenous cultures around the world and their relationships with the environment
- To understand that people from various backgrounds and parts of the world can think differently about the world around them

Subject: Science, Social Studies, History,

Materials Needed: paper, pencils, paste, handouts of 'People and Cultures around the world'.

Duration: 45 minutes per class session

WHAT TO DO

INDIGENOUS PEOPLES OF GUYANA

Patamona
Carib
Wapishiana
Wai-Wai
Warrau
Akawaio
Arawak
Makushi
Arekuna

1.Ask students to conduct a research on the various indigenous tribes of Guyana. You may want to divide the class into groups and assign a particular tribe to the groups. Ask them to find out where the tribes came from? What they eat? How they saw the environment? What they wore?, etc.

2.Write the poem "Santa Rosa" on the chalkboard. After reading the poem, discuss how the author describes the way Amerindians value nature and the environment? What words or phrases does the author use to convey appreciation for the environment? What natural resources does he identify in the poem?

3.Discuss with the students how they would feel if they lived in a society where they or their families made their own clothes, hunted and fished for their own food, and walked, rode horses, or took a canoe to get somewhere.

4.Ask the students to name some types of pollution that would be lessened by living this way? (List responses on the chalkboard - students should identify less air pollution from factories and cars, less chemicals from factories, less waste produced because people use the natural resources around them!) Even though today, Guyanese live in a "modern society" with electricity, cars, and lots of things for our homes and offices, can you think of some ways we can lessen our impact on the environment? (List the responses on the chalkboard: examples include: riding a bike, recycling, reusing things, donating unwanted clothes,

SANTA ROSA

by Basil Rodrigues,

from the Arawak peoples of Guyana

Santa Rosa, dear Santa Rosa
My hill of untold fruit trees!

Of umpteen coloured, plumed birds
Singing happily in the breeze.
Of winding tracks 'neath shady palms,
Criss-crossing, life giving cassava farms.

Santa Rosa, the old village, the friendly folk
The quite graves spreading o'er the slopes
Where loved ones in eternal slumber lie
Serenaded by the canary flitting by.

Early morning fire boiling casreep stew
Of smoked wild meat, fresh water fish too
Cadukoorue, pepper season sauce
Which with arasoka, no dish can surpass.

Kayap, manual work and then a spree
Puntuated by calabashes of piwari.
This great custom of ages past
Alas, battling for survival but changing fast.

Our islands bear twisting names in fading tongues
Whose meanings now escape our young.
Imakabara, haven of the hanaqua;
Peanuts prosper at Huradiah and Kumaka

Moruka, land of my first home
Amidst coffee trees where I in childhood roamed
Pleasant are my thoughts of you,
Of thatched troolie homes, sun-tanned faces and
of leaking canoes.

Santa Rosa lingers in my mind,
Green islands I have deserted for a time
Abide with me! I will return to see
My ancestral heritage, still home to me.

learning to take and buy only what we really need and thinking about the things we buy and how they impact the earth - natural resource extraction, transportation to market, etc.).

5. Discuss the various ways in which people depend on natural resources such as wind, rain, plants and animals in order to live.

6. Using the "People and Cultures around the World" worksheet, read the various ways indigenous cultures around the world view their environment. Cultures around the world have a long history of coexisting with plants and animals. Discuss with the students how this is different from today's society. Bring out ideas like: we raise certain animals on large farms to produce food like chicken, beef, milk and cheese instead of hunting for our food; and grow plants like rice and sugarcane on a large scale using pesticides and fertilizers, etc. Help students understand that while these changes have "modernized" society, they have also created much more pollution in the air, water and land that we have to deal with over the long term.

7. Ask students to talk to their elders about their culture. Students should document traditional stories, myths and folklore about the environment, plants and animals.

8. In a follow-up class session, ask students to do a presentation for the class on what they have learned from their elders. Ask them why they think that indigenous and other peoples tell stories to their children? This is oftentimes to help them gain a "sense of place" - to understand the environment in which they live and to learn to respect the natural things around them. Why is it important to respect our surroundings and understand the relationships of nature? Because we have to learn to coexist with the earth. For example, it is okay to use wood for our houses and for paper, but if we take too many, we are destroying the homes for animals in the wild. Also, if we cut too many trees in one area, rain makes the soil run into our rivers, lakes and streams which can kill the fishes.

9.Compile all the stories, myths and folklore into a scrapbook for the class.

10.Discuss the concept of "stewardship" (a person who takes care of sometime) and help students understand that no matter what our cultural values are, it is important to think of ourselves as stewards of the earth so that we can leave a happy, healthy environment for future generations.

PEOPLE AND CULTURES AROUND THE WORLD

The **Comcáac people of Mexico**, commonly known as the Seri Indians has a profound connection to their natural surroundings. It is so earnest that they regard their land as their body, the mountains and rocks as their bones, the soil their skin, the sea and rivers their blood and the wind their breath. Their relationship to the sea turtles is particularly central to their culture. According to their culture, they believed there was one God, who was also the God of the Comcáac who ordered the animals to dive for some sand to use to construct the world. Many of the animals tried until they could not anymore and then there was the sea turtle. When it was his turn to find the sand, he dove down and buried himself. He surfaced with the sand, and with that sand the world was created. The Seri Indians also strongly believed that sea turtles were their ancestors. Due to their traditions and stewardship they have protected the environment and sea turtles to this day.

Aborigines of Australia, believed that ancestral spirits came to earth and created the landforms, the animals and plants. The Dreamtime or Dreaming stories tell how the ancestral spirits moved through the land creating rivers, lakes and mountains. Today, they know the places where the ancestral spirits have been and where they came to rest. These places tell the Aborigines how people learnt languages, dance and how they came to know about fire. In essence, the Dreaming comes from the land. In Aboriginal society people did not own the land it was part of them and it was part of their duty to respect and look after mother earth. It is a powerful living force that must be maintained and cared for.

Native Indians of North America show a great affinity with nature. One figure who constantly appears is Coyote. Coyote is at the same time both good and bad, kind and cunning, a fighter against crime and a perpetual troublemaker. He wants so hard to be first in line when the Great Spirit hands out bows and arrows, but in the end, he comes in last. Feeling sorry for him, the Great Spirit gives Coyote cunning, and the ability to die and live again. This is the start of his many adventures. While Coyote teaches the children of the west how to catch and prepare Salmon, Little Deer teaches budding hunters how to respect the animals, and hunt only when food or clothing are needed. Many stories tell of how young warriors befriend animals such as wolves, or bears, and become great medicine men whose visions help guide their people. Very few Native American stories are told about humans alone, for the Indian world is not centered around "man". People will change into animals or fish and change back again. People will talk with the animals, ask for help, or receive advice.

The **Yoruba tribe of Africa** believed that in the beginning there was only water and chaos. So the creator called Olurun or Olodumare who is often assisted by the lesser god, Obatala, sent Obatala or Orishanla down from the sky to create some land out of the chaos. He descended on a long chain (umbilical cord) and brought with him a rooster, some iron, and a palm kernel. First, he put the metal on the earth and the rooster on top of that. The rooster scratched the metal and spread it out to create land. Then he planted the palm seed and from it grew the earths vegetation. Olurun named earth "Ife" and the first city "Ile–Ife." Orshilana created humans out of the earth and got Olurun to blow life into them.

ACTIVE PARTICIPATION IN CLASSROOMS USING WETLANDS

INTRODUCTION

Objectives:

- To introduce the idea of active participation
- To ensure teachers understand the actions that must be taken to increase participation in classrooms
- To introduce students to wetlands and their importance

Subject: All subjects

Duration: 1 hour 30 minutes

Increasing participation is an obvious goal when teaching students in the classroom. The goal of increasing participation is not to have every student participate in the same way or at the same rate, but to create an environment in which all participants have the opportunity to learn and explores issues and ideas from a variety of perspectives.

Some students will raise their voices more than others; this is due to the differences in learning styles as well as in personalities. For example, some students who do not speak often in class are reflective learners, as they typically develop ideas and questions in their minds before speaking; others are shy students who may feel uncomfortable speaking in front of groups. Many students who frequently volunteer to contribute are active learners, who typically think while they speak. The teacher's goal is to create conditions that enable students of various learning styles and personalities to contribute. To reach this goal, you will need to take extra steps to encourage quiet students to speak up and, occasionally, ask the more talkative students to hold back from commenting in order to give others a chance.

PARTICIPATION STRUCTURES

1. Shaping the Environment.

(a) **Arrange the classroom that will accommodate the kind of participation you have in mind.** Keep in mind the number of chairs you will need, whether you will need to move the chairs around, do you want a circle or "U" setting, which ensures that students can see and speak to one another. If you are teaching in a large room, consider asking students to move so that they are concentrated near the front of the room. Move the chairs back to their original setting at the end of class.

(b) **Make clear from the beginning your expectation that students will participate.** Explain what you see as valuable about class participation. Indicate that you want to ensure that the classroom activities support full participation, including calling on students who do not raise their hands and sometimes asking frequent contributors to allow others to have a chance. Ask students to inform you if you can make any changes to improve participation. Give students a clear idea of what to expect regarding participation - whether talks with questions, discussion sessions, etc.

2. *Planning*

(a) **Assign to your students some of the responsibility for increasing participation by all.** For example, you might tell students your goals for class participation (e.g., informed and lively discussions in which everyone participates) and ask them to come up with a list of guidelines that will help the class reach this goal. Post this list in a corner of the classroom for everyone to see. Students who feel part of the process from the beginning will be more likely to work together to increase participation. Consider requiring students to lead discussions or to submit discussion questions before class. If you are having trouble getting students to participate, consider asking students to submit

anonymous comments on class participation as well as suggestions on how to get more people involved; often, they will let you know that there are problems with the classroom setting that you may not see yourself.

> **Teaching Tip**
>
> **Learn and use students' names. Students will be more engaged if they believe that you perceive them as individuals, rather than as anonymous members of a group. Encourage students to learn one another's names, as well; this strategy will increase the possibility that they will address one another by name and direct their comments to one another, not just to you.**

(b) **Use a variety of teaching strategies as described in this manual.** If you are teaching a particular subject, set aside time during each lesson to ask and answer questions, to ask students to solve a problem, or to discuss an issue. Pause every 15-20 minutes for this purpose. When students learn to expect these opportunities for discussion or questioning, they will listen more actively to the lesson. Use small-group discussions and informal writing assignments, before or at the start of class to prompt student thinking about the discussion topic. Commenting on the insights that quieter students contribute in small-group discussions and on informal writing assignments can encourage them to speak up in the larger group; you might comment on a student's written work, for example, "this analysis is insightful; the entire class would benefit from hearing your ideas more often".

(c) **Organize each class session to include opportunities throughout to ask and answer questions; prepare initial and follow-up questions and activities ahead of time.** Use questions to assess student learning, to signal to students which material is the most important, and to help students advance their knowledge and thinking. Encourage students to ask questions throughout the class, not just at the end.

3. Listening and Responding

(a) **Use verbal and non-verbal cues to encourage participation.** Do not rely on the same students to answer every question. Move to a part of the room where quiet students are sitting; smile at and make eye contact with these students to encourage them to speak up. If some students speak frequently, look around the room rather than only at them to encourage others to respond. Reduce students' anxieties by creating an atmosphere in which they feel comfortable "thinking out-loud," taking risks, asking questions, and admitting when they do not know something; one of the best ways to do this is to model these behaviors yourself.

(b) **Give students time to think before they respond to your questions.** Do not be afraid of silence. Give students 5-10 seconds to think and formulate a response. If 10-15 seconds pass without anyone volunteering an answer and the students are giving you puzzled looks, rephrase your question. Do not answer your own questions as students will expect you to supply "the answer". Often, there is at least one student in every class who will quickly raise her or his hand to answer nearly every question. If you consistently call on this student, those who require more time to formulate answers will simply learn to wait for this student to answer.

(c) **Provide specific, encouraging, varied responses.** Point out what is helpful or interesting about student contributions. Pick up on comments that were made but not discussed. Do not use the same, standard praise to respond to every comment. When students hear "good point" again and again, they start to lose motivation. Ask follow-up questions to prompt students to clarify, refine, and support their ideas. When a student gives an incorrect or ill-conceived answer, respond in a way that challenges them to think more deeply or to reconsider the evidence. The best way to shut down participation, and learning, is to embarrass a student.

(d) **Repeat student responses to summarize or clarify ideas.** Use this strategy when a student's comments are vague, but do not over-use it, leading students to rely on you to "translate" or validate their ideas.

(e) **Redirect comments and questions to other students.** Encourage students to respond to one another, rather than to you. When a student is speaking, look around the room, not just at the student who is speaking; making eye contact with other students let them know that you expect them to be listening and responding. Learn to limit your own comments. Otherwise, students will learn to wait for you to respond rather than give their own responses.

(f) **Place the emphasis on student ideas.** Encourage students to share their ideas and use those ideas whenever you can. Referring back to a comment made by a student in an earlier class demonstrates that you have thought about and appreciated what your students have to say.

WHAT ARE WETLANDS?

Teaching Tip

Listen fully to your students' questions and answers; avoid interrupting. Resist the urge to interrupt when you think you know what the student is going to say or ask. Often, well-meaning and enthusiastic teachers make incorrect assumptions and leave their students' actual questions unanswered or misrepresent what the students had planned to say.

Wetlands are areas where water covers the soil all year or for periods of time during the year. There are many different types of wetlands due to differences in location, soil types, climate, water level, and vegetation. The extent and amount of water determines the types of plants and animals living in a wetland. There are coastal wetlands and inland wetlands.

Coastal wetlands in Guyana are found along the Atlantic coast. They are linked to estuaries, where sea water mixes with fresh water from rivers to form an environment that is brackish. Mangrove ecosystems along the coast of Guyana are typical coastal wetlands. Mangroves are found along the coast and also at estuaries and along riverine areas in Guyana.

Inland wetlands are very common on floodplains along rivers and streams and are referred to as riparian wetlands. Inland wetlands include marshes and wet meadows dominated by small plants, swamps dominated by shrubs, and wooded swamps dominated by trees.

Where are wetlands found in Guyana? *North Rupununi Wetlands is an example of inland wetlands and the Shell Beach - Northwest Region is an example of coastal wetlands.*

FUNCTIONS AND VALUES OF WETLANDS

Wetlands were once regarded as wastelands but are now recognized as important ecosystems that provide many beneficial services. Some of these services, or functions, include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, and maintaining the flow of water during dry periods. These beneficial services, considered valuable to communities worldwide, are the result of unique natural characteristics.

The main functions of wetlands include:

- improvement of water quality
- floodwater storage
- fish and wildlife habitat
- aesthetics
- enhancing and maintaining biological productivity

The value of a wetland is dependent on how communities use them. For example, a value can be determined by the amount of money generated from the sale of fish found in wetland, from tourists who pay money to visit wetlands, or by local and community who support protecting fish and wildlife in a wetland. Although large-scale benefits of how a wetland functions can be valued, determining the value of individual wetlands is difficult because they differ widely and do not all perform the same functions. We must understand that negative impacts can destroy the functions and values of wetlands.

Water storage. Wetlands function like natural sponges, storing water and slowly releasing it. This process slows the water's speed and erosive potential, reduces floods, and allows for groundwater to be restored, which contributes to water flow during the dry seasons. Although a small wetland might not store much water, a network of many small wetlands can store an enormous amount of water. The ability of wetlands to store floodwaters reduce the risk of costly property damage and loss of life—benefits that have economic value to us.

Water filtration. Wetlands act as a natural filter for polluted and sediment-filled water. Nutrients from fertilizers, manure, leaking septic tanks, and municipal sewage that are dissolved in the water are often absorbed by plant roots and microorganisms in the soil. Other pollutants stick to the soil. In many cases, this filtration process removes much of the water's nutrient and pollution by the time it leaves a wetland. Some types of wetlands are so good at this filtration function that scientists construct similar artificial wetlands to treat storm water and wastewater.

Wetlands are considered valuable because they clean the water, restore water supplies, reduce floods, and provide homes to fish and wildlife. In addition, wetlands provide recreational opportunities, aesthetic benefits, sites for research and education, and commercial fishery benefits.

Biological productivity. Wetlands support many different kinds of plants and animals. Abundant vegetation and shallow water provide diverse habitats for fish and wildlife. Aquatic plants flourish in the nutrient-rich environment, and energy converted by the plants is passed up the food chain to fish, waterfowl, and other wildlife and to us as well. This function supports valuable commercial fish industries. Plants also shelter for young organisms, provide structural stability, and absorb water in the system. Students should always be aware of the connection between the plants and animals in a wetland.

WETLANDS AND HUMANS

Wetlands benefit human communities by:

- Helping to improve the water quality.
- Providing habitat for birds and other wildlife.
- Generating revenue from ecotourism.
- Providing research opportunities.
- Traditional and cultural significance.
- Providing recreational opportunities.
- Educating the public on the importance of wetlands/ wetland education

RAMSAR CONVENTION

The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are presently 158 Contracting Parties to the Convention, with 1758 wetland sites, totaling 161 million hectares, designated for inclusion in the Ramsar List of Wetlands of International Importance.

The Conventions mission is the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world (Ramsar COP8, 2002).

THREATS TO WETLANDS

Human activity is probably the most common cause of wetland destruction. Pollution, habitat disturbance and development - whether it is drainage, damming to form lakes or ponds, adding pavement, or diverting water flow - affect the presence of water in the soil and water quality. Ultimately, if there is no water, there is no wetland.

There also are natural threats to wetlands, such as droughts, hurricanes and flooding. Even though wetlands are sponge-like and can hold water in for a long time, they can't do it forever. Some wetlands will eventually dry out if they aren't replenished. Overgrazing by animals can cut down on the area's vegetation, leaving wetlands vulnerable to erosion.

While wetlands act as a buffer against these weather occurrences, they also pay the price with diminished vegetation and pollution from runoff. Pollution also degrades wetlands and water quality. Again, wetlands

act as a natural filter for polluted water, but they can only absorb so much. Pollution enters the water table through pesticides, sediment, sewage, animal waste, fertilizers and many other forms. Polluting substances can originate from many sources, including runoff from urban, agricultural, silvicultural, and mining areas; air pollution from cars and factories; old landfills and dumps that leak toxic substances and wharves and stellings where boats release pollutants.

Teaching Tip

Visual aids help a great deal. Try to mix up lectures with film, graphics, guest lecturers and outdoor activities.

NOW CAN YOU NAME SOME THREATS TO WETLANDS IN GUYANA? Some threats to wetlands in Guyana may include draining, filling, dredging, polluting and introduction of alien, or non-native species. Now let us discuss these threats and say what people can do about stopping or reversing them.

WHAT YOU CAN DO TO CONSERVE WETLANDS

- Conserve and restore wetlands in your region and community.
- Support local wetlands and watershed protection initiatives.
- Work with your local groups to protect and restore wetlands.
- Encourage neighbors and developers to protect the function and value of wetlands in your watershed.
- Avoid wetland alteration or degradation during project construction.
- Maintain wetlands and adjacent buffer strips.
- Practice and promote the conservation of wetlands.

CONSERVING OUR WETLANDS

Conservation means the wise and sustainable use of natural resources. This is different from simply setting aside or “preserving” natural resources. The teacher should let students give reasons why conservation of wetlands and their resources is important. Some of the reasons why wetlands should be conserved may include:

- They provide homes for a rich diversity of plants and animals.
- They help maintain water quality.
- They provide water storage areas which can reduce flooding in down stream areas.
- They offer a variety of recreation and tourist opportunities (canoeing, fishing, birdwatching, hunting).
- They provide people with food, medicine and materials.
- They provide people with income through harvesting of plants and trapping of wildlife.
- They provide an area for outdoor education.
- They are areas of scientific interest.
- They are simply beautiful!

What do you think will happen if people didn’t care about wetlands and the conservation of wetlands? What can you do to help conserve wetlands?

The North Rupununi Wetlands (NWR) in south-west Guyana are dominated by the Rupununi, Rewa and Essequibo Rivers, and include over 750 lakes, ponds and inlets covering approximately 22,000 ha. The NWR is a seasonal water bridge between the Amazonian and Guiana Shield basins representing a link for species and biodiversity, and is a key site for species migration, as well as providing an abundance of food, breeding grounds and diverse habitats. It is also a known fact that indigenous communities have been interacting with the wildlife present in the NWR for thousands of years.

Activity 1: What In the World Is A Wetland?

Objectives:

- To determine the level of knowledge students have about wetlands.

Subject: Art, English, Science

Materials Needed: Pencil, Paper, Crayons

Duration: 60 minutes

INTRODUCTION

Students will be able to say what they know about wetlands and demonstrators will be able to determine where to start and what additional information will be needed to improve student's knowledge about wetlands.

WHAT TO DO

1. At the start of the activity ask each student to write down or draw the following:

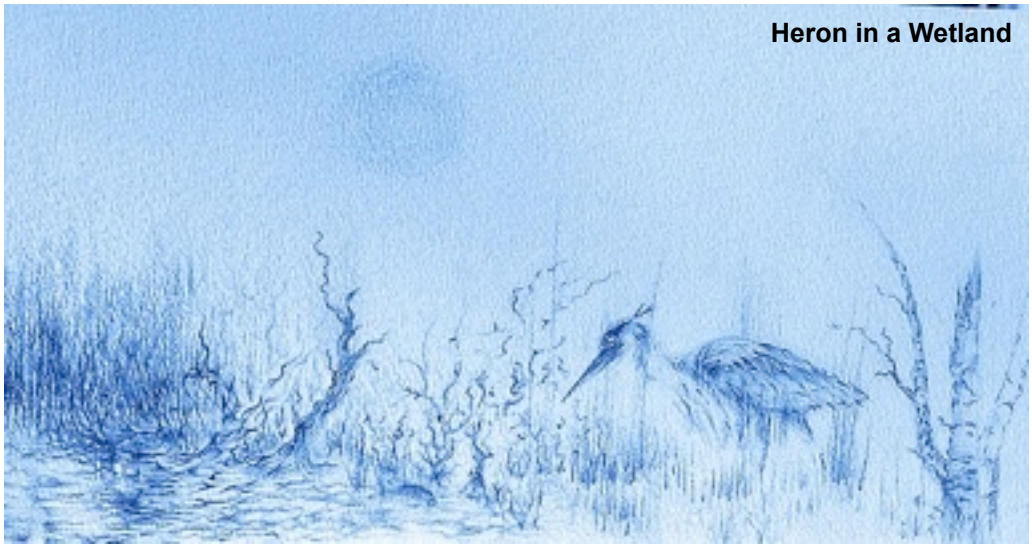
   I. a type of wetland,
   II. a type of animal associated with a wetland,
   III. a plant associated with a wetland, and
   IV. three adjectives that they will use to describe a wetland.

2. After the students have answered the questions, the demonstrator will then poll the class on the answers for each item. These answers will help the demonstrator to identify the general level of knowledge, along with any preconceptions about wetlands.

Students are then asked further questions about the answers they have written.

   I. Why is the particular type of animal or plant found in the wetland?
   II. Is there a relationship between the animals and plants found in the wetland?
   III. What is special about the plants and animals that live in the wetland?

3. At the end of the session students will have shared their knowledge of wetlands with each other. They would have become aware of some of the different plants and animals that are found in wetlands. They would have also become familiar with some of the reasons why the particular plant and animal is found in the wetland habitat. This would have allowed students to begin to link the different adaptations of animals and plants to their habitats.



Heron in a Wetland

Activity 2: Wetlands - More than just Water!

Objectives:

- To facilitate an understanding of wetlands by reading information on wetlands and completing the puzzle.

Subject: English, Science

Materials Needed: Pencils, Wetland Puzzle

Duration: 45 minutes

INTRODUCTION

Students will read the information provided on wetlands and the complete the puzzle. This will help to reinforce the information and increase their scope of knowledge on wetlands.

Wetlands are important to the well-being of many plants and animals, including people. But we must ask ourselves the simple question, “What are these areas, and what is their value? A simple answer is that a wetland is an area between dry land and open water. Such areas are sometimes covered with a shallow layer of water, but there are also wetlands which can be dry for part of the year.

The plants and animals which live there are adapted to this unique environment. In any wetland, the relationships between the plants and animals are very important. More attention is usually given to the animals in a wetland, but the role of the plants is a vital one. The plants are a fundamental link in the food webs of a wetland; but they are also critical as shelter for young organisms, for structural stabilization, and for water retention in the system. Students should always be very aware of the connection between the plants and animals in a wetland since human activities which impact either plants or animals will inevitably affect the entire ecosystem.

There are many different types of wetlands and each has a different and special role or function to play. Here are a few.

WETLAND TYPES

Swamp - A generally wet, wooded area where standing water occurs for at least part of the year.

Marsh - Marshes are the wet areas filled with a variety of grasses and rushes. They can be found in both freshwater areas and in the saltwater areas near our coast.

Pocosin - These are the wet areas with evergreen trees and shrubs growing on peat or sandy soils. Peat is a spongy-feeling material made up of decaying plants. The word pocosin comes from the Algonquin Indian word meaning "swamp on a hill."

WETLAND FUNCTIONS

Flood Control - Excess water from heavy rains is slowed by wetland plants and stored in the low-lying areas of wetlands, preventing the waters of nearby rivers and streams from overflowing and damaging property.

Storm Buffer - Along our coast, wetlands take a beating from high winds and waves, yet remain intact. The thick vegetation buffers the forces of storms and protects the land from erosion.

Water Banks - Wetlands hold water during the wet season. This water seeps through the soil and into our underground water supplies.

Water Filter - Wetlands help purify runoff waters which carry pollutants. Silt and soil, which choke aquatic life, settle out. Wastes are broken down and absorbed by aquatic plants, as are many harmful chemicals.

Nurseries - Many fish and animals use wetlands as nurseries. They provide an abundant supply of food and shelter for they young.

Home Sweet Home - Wetlands are home to many animals. A thriving wetland probably has more life in it than any other kind of habitat.

Wildlife Pantry - Wetlands are so productive, many animals depend on them for food. Many migrating birds stopover in wetlands each spring and fall to rest and feed before continuing their trip, and some will spend the winter in the wetlands.

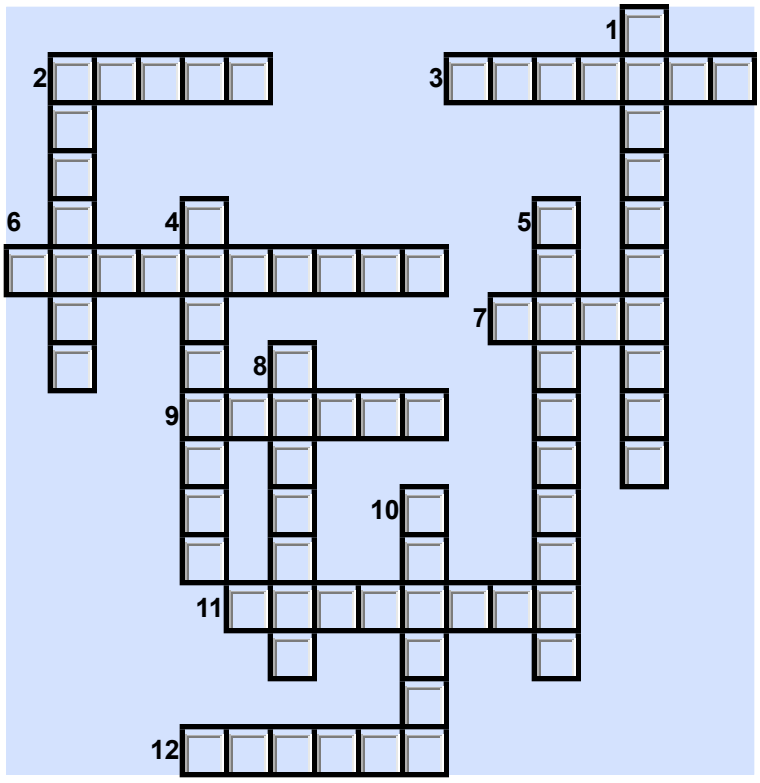
Recreational Opportunities - Wetlands provide us with places to watch birds and animals, and to fish, boat, and hunt.

Economics - Commercial fisherman depend on the wetlands to supply us with crabs and many other types of seafood.

WETLANDS IN DANGER!

A lot of wetlands have been lost in Guyana and around the world over the years. In the USA alone more than half of the U.S. wetlands have been lost since the 1600's. They have been drained to make farm fields, or filled for developments or dredged for waterways. Wetlands become "drylands" when people fill them, build dams, or divert the water that feeds these areas.

In the past wetlands were considered useless wastelands. Now we know that they are very valuable to people and wildlife. Changing opinions are resulting in new laws to help save wetlands, but there is still much work to be done to stop the destruction and to restore these wonderful ecosystems called wetlands.



WETLAND'S CROSSWORD PUZZLE

Now that you have read the information on wetlands, test your wetlands knowledge by completing this wetlands crossword puzzle.

ACROSS

2._____are wetlands that are flooded with water for most or all of the year, and are vegetated with trees and shrubs.

3. A use of wetlands for food and cover by young fish and other animals.

6. A wetland type found along streams and rivers. They are flooded for part of the year and dry for part of the year.

7. The type of soil often found in pocosin wetlands. It is made up of decayed plants.

9. Peat soil feels _____.

11. Many kinds of _____use wetlands for sources of food, resting sites, and cover.

12. Wetlands along the coast may lesson the damage caused by storms, and protect land from erosion since they function as a _____.

DOWN

1. A use of wetlands by people.

2. Commercial fishermen depend on wetlands to supply us with _____to eat.

4. Bottomland wetlands are often _____.

5. A _____ marsh does not contain salty water.

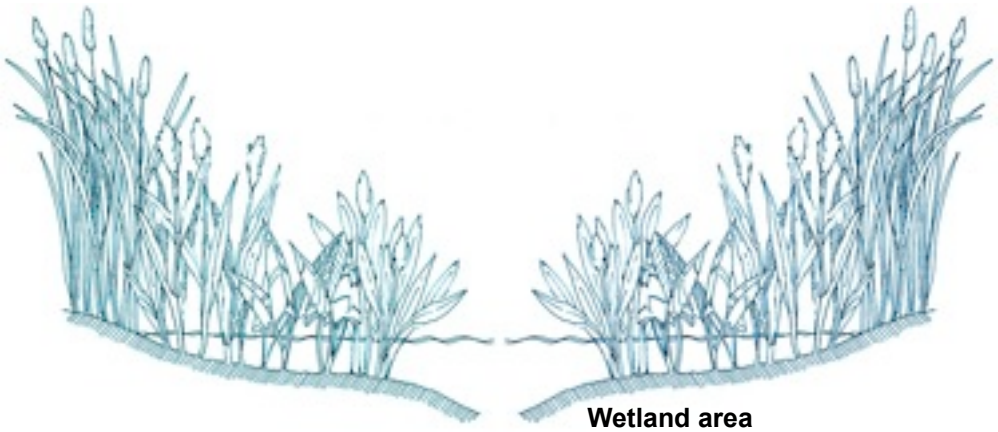
8. A wetland type with evergreen trees and shrubs. This word means "swamp on a hill" to the Algonquin Indians.

10. Wetlands have the ability to remove, or _____ out, pollutants from water.

ANSWERS

Across
2. Swamp; 3. Nursery; 6. Bottomland; 7. Peat; 9. Spongy; 11. Wildlife; 12. Buffer

Down
1. Recreation; 2. Seafood; 4. Forested; 5. Freshwater; 8. Pocosin; 10. Filter



Wetland area

Activity 3: Magnificent Mangroves

INTRODUCTION

Mangroves are trees that grow in tropical and subtropical intertidal zones. These areas are tough places for plants to grow. During low tides intertidal zones are exposed to air. During high tides they're covered by salt water. They flood frequently. The soil is poor. But mangrove trees survive and even thrive in these harsh conditions. Big groups of mangroves and other plants that live here are called mangrove swamps, mangrove forests, and sometimes simply mangal.

Objectives:

- To introduce students to mangrove, their threats and conservation efforts
- To show the various adaptations used by mangroves

Subject: Maths, Science

Materials Needed: Small pieces carrots or potato (2 per student or group), Tap water , Salt, Measuring cups, Small metric scale, Metric ruler, Thin strips of paper for measuring diameter, Shallow dishes or saucers (2 per student or group), Spoons, Toilet paper, Paper towels, Pencils, Masking tape for labels, Salted Carrot Data Sheets

Duration: 20 minutes per day (2 days) – not more than 2 days apart

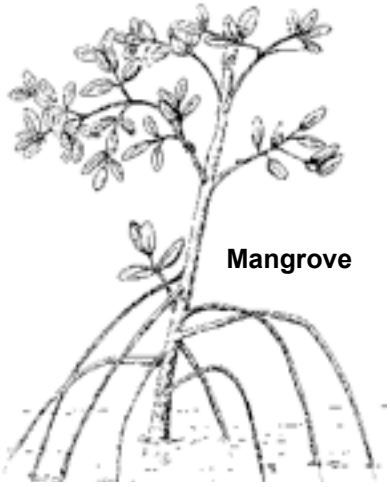
Where are Mangroves located?

Mangroves live in more than two-thirds of the saltwater coast areas of tropical and subtropical Africa, Asia, Australia, and North and South America including the largest intact mangrove forest at Shell Beach, Guyana. They're found only in a thin fringe right along the coast. Altogether, mangal covers 172,000 sq. km.

Special adaptations used by Mangroves

Not many plants can make it in the mangal. Only about one hundred plant species are found in most mangrove swamps. Some swamps are home to only one or two species! (The rain forest, on the other hand, has many thousands.) Ferns live in mangrove swamps, as well as some kinds of palm trees. The plants that do survive have "tricks" up their sleeves called adaptations to deal with the special challenges. One of the biggest challenges is the salinity, or the amount of salt in the water. The water in a mangrove swamp is so salty it would kill most plants. But the roots of red mangroves contain a waxy substance that helps keep salt out. The salt that does get through this barrier is sent to old leaves that the trees then shed. It's like taking the trash to the curb so the garbage truck can haul it away.

Just as mangroves can keep salt out, they have other adaptations to keep freshwater in. They can close up the pores in their leaves. They can also turn their leaves away from the sun to keep from drying out. All of the plants found only in mangroves are woody and tree-like. They tend to be short with tough, evergreen leaves – another adaptation that keeps the moisture in.



Mangrove

Lack of oxygen is a huge challenge in mangrove forests. The soil is covered with salt water every time the tide comes in. Salt water's low oxygen level means bacteria can thrive. These bacteria free up chemicals and substances harmful to plants, like phosphates, sulfides, and methane. So mangrove trees grow fancy systems of roots that make the trees look as if they're growing on a bunch of stilts. The roots "breathe" through knobby holes called lenticels. They take in carbon dioxide directly from the air, instead of from the soil like other plants.

The tangle of mangrove roots offers safe habitats for fishes, and other invertebrates. The roots help stop erosion by anchoring the ground and also lessening the effects of the waves. They prevent silt (fine sand or clay) from damaging reefs and sea grass beds. They trap sediments that can contain dangerous heavy metals, keeping them away from inland waters and fragile animal and human populations.

Mangroves are habitat for many plants and animals

Mangrove forests are nesting grounds for hundreds of species of birds and act as nurseries for fishing that we use everyday. They're home to manatees, monkeys, turtles, and lizards. In Florida, mangroves shelter endangered species such as hawksbill turtles and American crocodiles.

The Many Uses of Mangroves

Millions of people in developing parts of the world where mangroves flourish rely on the mangal for a huge portion of their daily needs. They use mangrove wood for fuel and to build boats and furniture. They use the bark for dye and medicine. They use leaves for tea and animal feed and the fruit for food. These coastal swamps protect property and lives during storms and hurricanes by acting as a buffer against the winds and waves.

Threats to Mangroves

Mangrove trees survive harsh natural conditions, but threats from pollution and industry are an even bigger problem. The land where mangroves live has often been sold cheaply to businesses, which cut down many of the trees. Sewage, weed-killers, and spilled oil are extremely unhealthy for the mangroves. As human activity around mangroves increases, more and more mangrove forestland is lost. Dredging coastal areas and filling them in to make them suitable for building also leads to destruction of mangroves. Artificial dykes cause long-term flooding that the mangroves simply cannot handle. Thousands of acres have been cut down to make room for the artificial ponds required by the shrimp industry. Even the beauty of mangrove swamps threatens them. More tourists are coming to see them, and with more tourism comes more garbage, along with air and water pollution.

A Rescue Mission for Mangroves

According to some experts, half of the world's mangrove swamps have already been lost. So is all hope lost? Not at all. Environmental activists are raising awareness of mangrove swamps' unique features and benefits around the world. They are trying to pass laws to protect mangroves, and to encourage people to stop buying shrimp grown in areas where mangroves once used to thrive. The Mangrove Replenishment Initiative (MRI) could make a difference around the world. One of MRI's goals is to research and develop effective ways of replanting mangrove forests. Growing these trees from seeds, from the ground up, is difficult. It's not enough to drop seeds and hope for the best. In Guyana, the Environmental Protection Agency, the Guyana Marine Turtle Conservation Society and the University of Guyana are all involved in studying ways to protect mangroves.

GETTING READY

1. Put the scales, measuring cups and rulers, tape, and containers of salt where students can share them.

2. Give each student or group two carrots, a dish, a stirring spoon, tissue paper, a paper towel, directions and data chart, and a pencil.

WHAT TO DO

1. On Day 1, review the information on mangroves, paying special attention to the adaptations. Consider how these trees have developed for life in salt water.

2. After lecturing on mangroves, using masking tape, label one dish #1 Fresh Water and the other dish #2 Salt Water. Put one carrot in each dish.

3. Ask students to take the carrots out, one at a time, and measure their: Length - measure in centimetres and millimetres with the ruler; Diameter at its center point - wrap the strip of paper around the carrot, marking where the end meets the paper on the other side; measure that length with the ruler and Weight of each carrot in grams - weigh on the scale.

4. Students should record the data on their charts in the columns for Carrot #1 and Carrot #2 and make observations about the carrots, noting them on their charts.

5. After recording data and observation, ask students to measure 10 millilitres of tap water and pour it into dish #1– leave the carrot in the dish. Remove the carrot from dish #2. Measure 120 millilitres of tap water and pour it into the dish. Place a thin piece of tissue paper on the scale. Put a small amount of salt on the paper. Add or remove small quantities until it weighs 15 grams. Put the salt into the second dish and stir until it is thoroughly dissolved. Place the carrot back into dish #2. Ask them to write down what they think will happen to the two carrots (their hypothesis). Record their hypothesis on their chart.

Mangrove Forest

6. On Day 2, ask students to remove the carrots from the dishes and dry them with the paper towel, being careful not to mix them up. Repeat the measurements for length, diameter, and weight and note the data on their chart. Repeat observations and note them on the chart. Compare the carrots and the differences seen in their observations and measurements in the Results section of their chart.
   Be sure to include a conclusion related to the hypothesis in the results section, noting whether their guess was correct.

7. Ask students to look at the results: Do the carrots look the same? Has the texture changed? Has the color changed? Are the carrots as stiff as they were before? Do you see any other changes? If so, what? Why do you think the salted carrot changed? Was your hypothesis correct? Ask them to return to the information on Mangroves and its Adaptations. Which adaptations do you think relate to your carrot experiment? How?

8. Teachers should discuss osmosis and the effect it has on the carrots and plants that live in salt water. Inform the students that mangrove trees and other plants living in the Mangal have to survive in salty water that would kill most plants. Salt affects plant tissues through a process called Osmosis. Mangal plants have special adaptations to outwit Osmosis and limit the amount of salt in their tissues so they don't die. Osmosis is the passage of water molecules through a membrane (semi-permeable), from an area of purer water, such as tap water (low concentration), to an area of water that has other things dissolved in it, like salt or sugar (high concentration). Think of it as "light" water and "heavy" water. If the light and heavy water were on a balance scale or a see-saw, the heavy water would sink down and the light water would roll into it until all the water was mixed together. Then the water on both sides would weigh the same. Nature is always trying to balance things, including the concentration of seawater and plant sap in relation to each other. If most trees and plants were placed in seawater, their low concentration sap would flow out through their cell membranes into the higher concentration salt water, and they would shrivel and die.

   Some ways mangroves outwit Osmosis are:
   a) **Stay Out!:** Some trees, like the Stilted Mangrove, exclude salt from entering with a membrane that acts like a gate. Red Mangroves have roots containing a waxy substance that keeps salt out.

b) **Pass the Salt:** Others, like White Mangroves, excrete salt through special glands in their leaves. People do the same thing when they sweat. The salty leaves are washed by rain; we take a bath or shower.
c) **Game of Concentration:** Some Mangroves concentrate salt by storing it in their leaves. When the leaves get old, they die and fall off, carrying away the salt.
d) **Dilution Solution:** Mangroves can also close their leaf pores (stomata) to keep water from evaporating away, helping to dilute the salt that enters through their roots. When the salt gets too concentrated, they can open the pores to release it.

A Salted Carrot: Data Chart

Day 1	Carrot #1	Carrot #2
Length		
Diameter		
Weight		
Texture		
Color		
Stiffness		
Other observations		
Hypothesis		
Day 2	**Carrot #1**	**Carrot #2**
Length		
Diameter		
Weight		
Texture		
Color		
Stiffness		
Other observations		

Activity 4: WoW! Wild About Wetlands

INTRODUCTION

Wetlands are a home (habitat) for many different types of wildlife. Have your students think of reasons why wetlands are important to wildlife (wetlands provide shelter and protection, feeding, drinking, cooling off, breeding, resting and nursery sites for many species). They are also used by many bird species as gathering places during migration.

WHAT TO DO

The following activities are designed for students to highlight the concepts of connectedness in a wetland ecosystem.

Objectives:

- To highlight the concepts of interdependency and interaction of organisms in wetlands

Subject: Science, English, Maths

Materials Needed: varies.

Duration: 20 – 30 minutes

i) **Create a wetland plants and animals poster.** This sheet when completed should include images of a variety of common wetland plants and animals. Students can cut out pictures from this source sheet and use them to complete the other activity sheets.

ii) **Create a wetland energy flow poster.** Using images cut out from different sources (e.g. old magazines, newspapers, etc…) complete this activity by pasting the images in the appropriate category. Students should research what the animals eat to help them decide whether they are a herbivore, carnivore, omnivore or scavenger. Students may also draw pictures of animals instead of cutting and pasting.

iii) **Create a wetland food chains poster.** Ask students to create three different wetland food chains by pasting or drawing pictures of wetland plants and animals in the correct space. Start each food chain at the bottom of the sheet with a producer (plant) and indicate what may eat it on the line above. Continue until the food chain is complete. Encourage students to share their results with the rest of the class to show the variety of possibilities.

iv) **Create a wetland food web poster.** The aim of this exercise is to show the complexity of interactions among living organisms in a "real" wetland ecosystem. To create this poster, students should paste or draw pictures of a variety of different wetland plants and animals in the space provided and show the relationships between them by drawing arrows. The arrows should show the flow of energy from one level of the food web to the next. Encourage students to share their results with other classmates.

The North Rupununi Wetlands in Guyana

In the recent past, almost the entire coast of Guyana was covered with mangrove formations, dominated by Black Mangroves. However, today, the largest and remaining intact mangrove forests are found at Shell Beach and along the Eastern Pomeroon Coast.

Activity 5: Fragile Fringe

INTRODUCTION

Wetlands are found in many places around us. They are areas which may be flooded throughout the year or for specific times of the year (seasonal). Wetlands support many different types of plants and animals.

Half of the world's wetlands have been destroyed over the last 100 years through conversion for commercial development, drainage schemes, extraction of minerals, overfishing, tourism, siltation, pesticide discharges from intensive agriculture, toxic pollutants from industrial waste, and the construction of dams and dykes, often in an attempt at flood protection, are major threats to wetlands everywhere. In this lesson, students learn about some of the threats to wetlands and what they can do to conserve these areas (use the Introduction to Wetlands at the beginning of the Chapter for more information).

Objectives:

- To identify the various plants and animals living in wetlands
- To identify the threats to wetlands and ways to conserve them.

Subject: Science, Art

Materials Needed: paper, pencil, chalkboard, chalk, colouring pencils or crayons

Duration: 60 minutes

WHAT TO DO

1. Ask students to identify threats that mangroves face in Guyana, the Caribbean and in the world. List these threats on the chalkboard.

2. In the box below, ask students to draw a scene of a wetland area, showing the different types of plants and animals living in a wetland but also one threat and how they would solve this problem. Ask students to present their conservation ideas to the class.

Animals and Plants found in Wetlands

FRAGILE FRINGE DRAWING

PROBLEM-BASED LEARNING

INTRODUCTION

Problem-based learning (PBL) is an instructional method that challenges students to "learn to learn," working cooperatively in groups to seek solutions to real world problems. These problems are used to engage students' curiosity and initiate learning the subject matter.

In problem-based learning, the traditional teacher and student roles change. The students assume increasing responsibility for their learning, giving them more motivation and more feelings of accomplishment, setting the pattern for them to become successful life-long learners. The school in turn become resources, tutors, and evaluators, guiding the students in their problem solving efforts.

Objectives:

- To introduce the idea of active participation
- To ensure teachers understand the actions that must be taken to increase participation classrooms
- To introduce students to wetlands and their importance

Subject: All subjects

Duration: 1 hour 30 minutes

Students involved in problem-based learning acquire knowledge and become experts in problem solving, self-directed learning, and team participation. Studies show that PBL prepares students as well as traditional methods and are in fact better practitioners of their professions.

Specific tasks in a problem-based learning environment include:

- determining whether a problem exists;
- creating an exact statement of the problem;
- identifying information needed to understand the problem;
- identifying resources to be used in order to gather information;
- generating possible solutions;
- analyzing the solutions; and
- presenting the solution, orally and/or in writing.

Generic skills and attitudes

- Teamwork
- Critical evaluation of literature
- Chairing a group
- Self directed learning and use of resources
- Listening
- Presentation skills
- Recording
- Cooperation
- Respect for colleagues views

STEPS IN PROBLEM-BASED LEARNING

There are specific, established steps in problem-based learning.

1.***Present the problem statement.*** Introduce an "ill-structured" problem or scenario to students which they do not have enough prior knowledge to solve the problem. This simply means they will have to gather the necessary information or learn new concepts, principles, or skills as they engage in the problem-solving process.

2.***List what is known.*** Student groups list what they know about the scenario or problem. This information is kept under the heading: "What do we know?" This may include data from the situation as well as information based on prior knowledge and their own personal experience.

3. ***Develop a problem statement.*** A problem statement should come from the students' analysis of what they know. The problem statement will probably have to be refined as new information is discovered on the situation.

4. ***List what is needed.*** Presented with a problem, students will need to find information to fill in missing gaps by conducting researches - directly or indirectly via books, etc. A second list is prepared under the heading: "What do we need to know?" These questions will guide searches that may take place in the library, in the field (outdoor activities) and other searches.

5. ***List possible actions, recommendations, solutions, or hypotheses.*** Under the heading: "What should we do?" students list actions to be taken (e.g., interviewing an expert, conducting a simple research, doing a book review), and form and test hypotheses.

6. ***Present and support the solution.*** When finishing the lecture or topic, teachers may require students to communicate, orally, artistically and/or in writing, their findings and recommendations. The product should include the problem statement, questions, data gathered, analysis of data, and support for solutions or recommendations based on the data analysis.

Creating the ill-structured Problem

1. Students need more information than is initially presented to them. Missing information will help them understand what is occurring and help them decide what actions, if any, are required for resolution.
2. There is no right way or fixed formula for conducting the investigation; each problem is unique.
3. The problem changes as information is found.
4. Students make decisions and provide solutions to real-world problems. This means there may be no single "right" answer.

(Adapted from Stepien, Gallagher, and Workman, 1993)

In PBL, students must feel that this is their problem, otherwise they'll spend their time figuring out and delivering exactly what the teacher wants. This process can be facilitated as individuals or in groups. The advantages of using group learning is that it facilitates the gaining of knowledge, and also increasing or develops communication skills, teamwork, problem solving, independent responsibility for learning, sharing information and respect for others.

Activity 1: Fishing vs. Overfishing

INTRODUCTION

Every year, many millions of fish are hauled from the ocean. How much is too much? The answer seems to vary depending on whom you ask. A scientist might say fishers should catch as many as would allow the maintenance of fish populations - this is a sustainable fishery. Fishers may be more inclined to catch as many fish as they can to earn a living,but many are also concerned about the future of the fishery for their children and grandchildren. Governments want to keep the fishing economy healthy and the environment healthy,too. A healthy environment is one in which fish can reproduce and the food web is unbroken.

To avoid overfishing it is important to strike the right balance between what we take and the number left behind to reproduce so the size of a fish population is maintained. But this is not a simple thing to agree on. While marine resources may have sustained entire human coastal populations in the past, demand has increased with population growth and tourism development,and technology has made it easier to harvest larger quantities.

Objectives:

- To learn a method for estimating fish populations
- To identify various ways of managing fisheries in Guyana.

Subject: Science, Maths, Social Studies

Materials Needed: Ruler, Craft knife , For each group of students: container with plastic lid — like a large (1-litre) plastic tub or a small coffee can; toothpicks, dry beans, or small straws cut in 6-cm lengths (100 or so per group — exact quantities aren't necessary); coloured marker; worksheet; calculator.

Duration: 60 minutes

Traditional fishing methods such as bait and line have been replaced in many places with diving apparatus, spearguns, seines, long lines, dredges, and use of global positioning systems to place and relocate traps.

GETTING STARTED

1. Write the 'Calculate the Population of Guyana's red snapper' on the chalkboard for students.

2. Cut a slot in each of the container covers (1.5 cm x 7.5 cm). Read through the worksheet and the example in Step 2 below to familiarise yourself with the procedure for the experiment.

WHAT TO DO

1. ***Introduce the activity.*** Explain to students that they are going to conduct an experiment to find out how many red snapper there are in an area adjacent to Shell Beach. Of course,counting every single snapper is impossible, so scientists have methods for estimating the total number of fish. One way they can do this is to:(1) catch and tag fish in a specific location,and then release them;(2) periodically return to the same place and catch additional batches;and (3) count the total number of fish caught in each batch as well as the number of tagged fish caught. Using these totals,scientists can estimate the total population. With this information, they can consider management strategies to help prevent snapper from being depleted in that area. Can students think of ways to solve this problem? Ask them to use their methods to estimate the red snapper population rather than those used by scientists.

2. ***Go over an example of the method***. Demonstrate the procedure to students and fill in numbers in a table on the board as you go along, using the example numbers and calculations provided here, or actual numbers from a demonstration. Catch and tag the first batch of fish: Let's say the first time you

give the container five shakes over a tabletop, 22 toothpicks ("fish") fall out. These should be tagged with a coloured mark, the number recorded, and the toothpicks returned to the container. Go fishing: Now you are ready to conduct the experiment. With the cover on the container and a hand over the opening, shake it vigorously to mix up all the fish. Repeat the shaking process over the table as you did to mark the first batch of fish. Let's say this time 20 toothpick "fish" fall out. Count how many of them are tagged (suppose there are four). The total number of fish "caught" and the number of tagged fish are recorded for Round 1 in the table below. (Remember that the first batch was to tag fish before starting the experimental rounds.) To find out how many similar batches it would take to recover all of the tagged fish,divide the number of fish tagged in the first batch (22) by the number of tagged fish "caught" in Round 1 (4). The answer (5.5) multiplied by the total number of fish caught in this round (20) equals an estimated total of all the fish in the area (110). The calculations are recorded in the table. Repeat: It is important to repeat the procedure several times to get to a closer estimate of the actual total. Starting again with all of the tagged and untagged fish in the container,repeat four more times the steps for mixing, shaking out, and recording the total number of fish and the number of tagged fish. Examples are filled in for Rounds 2 – 5 in the table.

If Tagged Fish = 22

	Total Fish in Catch/ Tagged Fish in Catch	Total Tagged Fish ÷ Tagged Fish in Catch = Number of Catches to Recover all Tagged Fish	Number of Catches x Total Fish in that Catch = Estimate of Total Fish in Area	Total Estimates of Fish ÷ 5 *(# of times you fished)* = Average Estimate of Total Population
1	20/4	22 ÷ 4 = 5.5	5.5 x 20 = 110	
2	9/2	22 ÷ 2 = 11	11 x 9 = 99	
3	30/7	22 ÷ 7 = 3.1	3.1 x 30 = 93	
4	25/5	22 ÷ 5 = 4.4	4.4 x 25 = 110	
5	22/5	22 ÷ 5 = 4.4	4.4 x 22 = 96.8	
			Total Estimates = 508.8	**509 ÷ 5 =101.8 or 102 fish**

Calculate:The total of the five estimates is 509, rounded to the nearest whole number (or "fish"). This is divided by five (the number of times fished once fish were tagged) to get the average.

3. ***Do the experiment.*** Divide students into small groups and give each the necessary materials. Explain that they are going to do the experiment themselves. Make sure students understand the instructions on the worksheet. Have students write a paragraph explaining how estimating the population of fish in a particular area helps to make management decisions or set regulations. Ask them to think about: What kinds of regulations are there in Guyana and why? What would happen in the future if there were no fishing regulations?

4. ***Discussion.*** Explain to students that once the number of fish is determined,this information and other important factors — such as the species' life span and the effects of changes in the environment - can be considered to develop strategies for fisheries management. There are a variety of regulations in place in Guyana, and others that could be implemented,such as setting quotas,or limits, on catches. The key is to make sure that with all the fish caught by fishers plus those lost to pollution and other causes,there will still be enough left in the ocean to mature and reproduce at a rate that keeps the population from getting smaller.

CALCULATING THE POPULATION OF GUYANA'S RED SNAPPER

1. **Catch and tag the first batch of fish**. Without counting your toothpicks (“red snapper”), put them into the container (“ocean”) and put on the cover. Hold your container upside down a few inches above a tabletop and give it five good shakes so that some of the toothpicks fall out. Tag each toothpick with a coloured mark. Count the toothpicks and write down the number of these “tagged red snapper.”

   Tagged Fish = _____

   This number should be entered in all rows of column c below.

2. **Go fishing**. Put the tagged fish back in the container and replace the cover. Hold a hand over the opening, and shake it vigorously to mix up all the fish. Then give the container five shakes over the table to let the “red snapper” fall out. Count the total number of toothpicks that fall out this time and how many of them are tagged. Enter these numbers in columns a and b below. Repeat until you have done a total of 5 rounds and filled in the table.

3. **Calculate**. Fill in columns d and f. Do the calculations in columns e and g to estimate the total of all the red snapper in the area. Then add up the five estimated totals and divide by 5 (the number of times fished) to get the average. Once you have the final estimate of the number of red snapper in the area, count all of the toothpicks and see how close you are to the real total.

	a	b	c		d		e		f		g
Round	Total fish in catch	Tagged fish in catch	Total tagged fish		Tagged fish in catch (from column b)		# of catches to recover all tagged fish		Total fish in that catch (from column a)		Estimates of total fish in area
1				÷		=		x		=	
2				÷		=		x		=	
3				÷		=		x		=	
4				÷		=		x		=	
5				÷		=		x		=	
									Total Estimates		

Total estimates of fish (from column g) ÷ 5 (number of times fished) = Average Estimate of Total Population

_____ ÷ 5 = _____

Activity 2: Thinking about Tomorrow

Objectives:

- To explore the issue of sustainable use of natural resources
- To describe several consequences if unsustainable use of natural resources from both people and other species
- To recognise the difficulty in identifying sustainable ways to use resources when demand and supplies change

Subject: Science, Maths, Social Studies

Materials Needed: Chalkboard, dry beans, flat containers or trays for beans, a stopwatch or clock, paper

Duration: 45 minutes

INTRODUCTION

Natural resources are the raw materials that we use everyday. That includes everything we eat, as well as the materials we use to build our houses and make our clothes, tools, and many other things. The air we breathe, the water we drink, and the land we use to grow our food are also natural resources.

We can therefore say that natural resources are all the things that humans as well as other species depend on for their survival.

Since natural resources encompass so many different things, scientists have created two categories for talking about them:

1. ***Renewable resources:*** are those that can be replenished, either naturally or through human processes. Trees, for example, are a renewable resource since they can either be replanted by humans or naturally seeded. Sunlight is also a renewable resource because we always have a steady supply of it, no matter how much we use. For a resource to be considered truly renewable, it must either be constantly generating itself (such as sunlight), it has to replenish itself in a couple of generations or less, or we have to be able to replenish it in the same amount of time.

2. ***Non-renewable resources:*** exist only in definitive quantities. This means that once they are used up, they may take millions of years to be replenished, or they may be gone forever. This includes the fossil fuels that our factories, boats and cars run on and the minerals such as gold and diamond. It also includes the topsoil that we need to grow our crops.

Many scientists would agree that we are using our natural resources faster than they can be replenished. Since we rely on natural resources for our survival, we can neither afford to use them all up nor stop using them completely. Between the two extremes, however, is ***sustainable use***. Sustainably using a natural resource means using the resource in a way that allows people and other species to get what they need today while ensuring that future generations will also get what they need.

However, figuring out how to sustainably use a natural resource is not easy. For example, different kinds of forests have many different uses that require different management techniques. Since the speed with which we consume natural resources is always changing, it is sometimes difficult to tell whether a resource is being used sustainably at any particular moment. Sustainable management also depends on whether a resource is renewable or non-renewable.

GETTING READY

1. Make sure you have plenty of room in the classroom. Pour half a bag of beans onto a tray and place the tray on a table in the middle of the room.

2. Familiarize yourself with the rules of the game and do a trial run, if needed, on your own to figure out how many beans you'll need for each group. In order to find out how much beans you'll need for the

rounds, pick up beans from the tray using two of your fingers (the tips of your index finger and thumb) for ten seconds. Make sure you time yourself accurately. Repeat this for the number of people you'll have in each family (usually 4-5 students). Count the total number of beans you've collected from the tray. It you have four families, you'll need four times as many beans as you have collected to cover the entire class. Playing the game with too many beans won't illustrate the concepts as clearly. For a family of four, you should start with approximately one cup of beans.

3. On the chalkboard, copy this chart:

Round 1, 2 or 3	Family Name	Family Name	Family Name	Family Name
Great-great grandparent				
Great grandparent				
Grandparent				
Parent				
Children				
Total beans remaining				

Make six separate 'condition cards'. The individual cards should read:

a) Fire - Remove 1/2 cup of beans
b) Surplus - Add 1 cup of beans
c) Average Yield - Add 1/2 cup of beans
d) Disease - Remove 1/2 cup of beans
e) Drought - Remove 1/2 cup of beans
f) One card should be left blank.

WHAT TO DO

1. ***Create student groups.*** Divide the students into equal-sized groups (there can be 4 or 5 students in each group, but groups need to be equal in size). Tell the students that each group represents a family. Have each group select a family name to represent them, and then have each group member select a generation of the family to represent (a great-great grandparent, a great grandparent, a grandparent, a parent and a child). Make sure that each student remembers his/her family name and the generation that he/she represents. Place the tray at the centre of the room on a table and ask each family to form a line at a different side of the tray of beans.

2. ***Explain Round 1.*** Tell the students that the tray of beans represents a non-renewable natural resource (minerals, oil or wood from forests) that their 'families' rely on. Each family member will have the opportunity to 'extract' some of the natural resource (beans) using only the tips of two fingers (index

and thumb). As they collect the beans for 10 seconds they should place them into a container that must not be lifted from the table. Beans that fall on the floor do not count. They represent wasted resources. When the 10 seconds are up, ask students to count the number of beans they have collected and to record their results on the chalkboard.

3. ***Begin Round 1.*** Have the first family member (great-great-grandparent) from each family put one arm behind his/her back and use the other to collect the beans. Remind students of the rules of the game. Next allow the second family member (great grandparents) to repeat the same steps. When they are done ask the third family member to go while the second calculates and records their results. This process should be repeated until all family members have had a chance to 'extract resources'. The amount of beans remaining represents the amount of natural resource left for future generations.

4. ***Begin Round 2.*** Place all beans back into the tray. Have the beans represent the same non-renewable natural resource as in the previous round. Inform the students that they actually need only 10 beans worth of the natural resource to survive. Repeat the same procedure from Round 1. Record the results in a table labelled Round 2. After all family members have had their turn, count how many beans are left over. Again, the amount left over represents the amount of natural resources left for future generations. Look at the results to see how many students were able to extract at least 10 beans. (They represent those family members who were able to get enough of the natural resource to survive). Ask how many students were unable to extract at least 10 beans. (They represent family members who could not get enough of the natural resource to survive). Ask how many students got 10 beans or more. (They represent family members that used more of the natural resource than needed.)

Use the following questions to discuss the classes' observation:

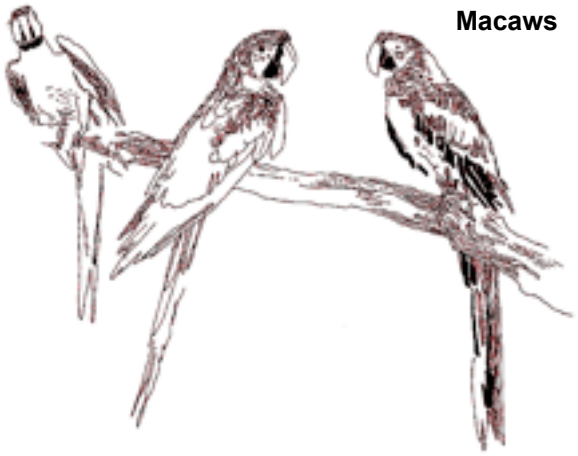
- For both rounds, did each successive generation collect more or fewer beans than the previous generation?
- Compare the number of beans left over after Round 1 to the number leftover after Round 2. Did one round have more left than another? Why? (If the students were taking only enough beans to survive, all students in Round 2 should have had enough beans, and more beans should have been left over than in Round 1,)
- Why might a particular generation consume more natural resources than they need? (People many not realise they are depleting natural resources, or they may think they really need to use them to survive. Or, in other cases, people are indifferent or greedy.)
- .Are there any reasons a particular generation would want to conserve its natural resources? (People may feel it is important to save enough resources for their children or grandchildren to use. They may also feel it's necessary to conserve natural resources for the benefit of their community and culture, the future health of the environment, or for the sake of other species.) Explain to students that using natural resources in a way that protects them for future generations and other species is called sustainable use.
- Who did not survive? How did it feel? Who got too much of a resource? Did it affect whether the next generation of the family got enough of the resource?
- Did knowing how much of a natural resource is needed to survive help your students decide how much to collect from the tray? (Students who want to make sure that all of their family members get enough beans might take only as much as they need to survive.)
- Did either round produce a lot of wasted resources? What could have been done to reduce the amount of wasted resource? (In rushing to fill their cups, the students will drop many beans on the floor. Designing a community strategy for effectively filling up the containers could decrease the amount of resources wasted.)

5. ***Explain Round 3.*** Rounds 1 and 2 dealt with non-renewable natural resources. Tell the students that the tray of beans now represents a renewable natural resource. Ask students if they can think of some renewable natural resources that people use (food, crops, solar energy, trees, and so on). Each person still represents a member of a family that is part of a community. Using the same rules, play the next round, but this time introduce a different condition card at the end of each round (for each generation). Explain that most renewable resources have limits to their rate of replenishment. Physical, environmental, and human conditions can change how much a resource is renewed every generation. This round will illustrate sustainability under different conditions.

6. ***Begin Round 3.*** Place the beans back in the tray. Follow the same procedure for collecting the beans as in round 1 and 2. In this round, however, after each generation's turn, adjust the bean amounts according to the five conditions on the cards you prepared earlier: drought, fire, surplus, average yield or disease. Two conditions increase the number of beans in the tray: average yield (+1/2 cup) - only an average amount of the resource was replenished; surplus (+1 cup) - more of the resource was replenished than expected. Three conditions remove beans from the tray: drought (-1/2 cup) - lack of available water caused a decrease in the resource; fire (-1 cup) - an uncontrolled fire destroyed some of the resource; and disease (-1/2 up) - some of the resource was infected to unusable levels. All conditions represent situations that can affect natural resources. Students can also create their own condition on the blank card. Shuffle the condition cards. When the 10 seconds are up, ask someone to draw a card and add or subtract the beans accordingly from their trays. (At each turn in Round 3, all families should be following the same condition card that was read out loud.) After each generation's turn, the cards should be replaced in the deck and the deck should be reshuffled. Students should count their beans and record their results. Other family members can begin collecting beans while the previous generation counts and records their results. (Remind students that they'll still need 10 beans to survive.)

7. ***Discuss the results.*** Have students discuss their observations about the rounds. What will happen if we use our natural resources faster than they can be replaced? (They will eventually run out.); What happens when generations do not use a cooperative strategy for natural resource use?; Did the condition cards affect the number of beans you collect? (Some students may have decided not to take so many beans if a drought or a fire card was drawn. Some may have decided to collect more beans after a surplus card was drawn.); What are the similarities in strategies for sustainably managing a renewable resource and a non-renewable resource? (Both involve conservation and identification of alternative resources. Even though there are often renewable alternatives to non-renewable resources, a renewable resource can be depleted to the point where it can no longer renew itself.)

8. ***Individual Investigations.*** Have students select an issue about resource use in their communities to investigate. Some dilemmas might revolve around the following situations: sea turtles that were over-hunted and are now facing extinction; fisheries that have been reduced in size because of over-harvesting; forests that have been cut down without being replaced to cater for development (building houses, shops, roads, etc); savannahs that have been left to burn due to uncontrolled fires; freshwater levels have been reduced because of over-consumption and poor management. Once students have identified a problem, ask them to collect data and determine what laws exist to protect the resources they are investigating - within the community and nationally. After completing this section, ask them to prepare a poster on how to balance the use of natural resources with conservation. This is the central issue of sustainability and sustainable development.



Macaws

Adapted with permission from Exploring Biodiversity, a joint publication of CI and WWF, 1999

Activity 3: Environmental Jeopardy

INTRODUCTION

A variety of environmental problems now affect our entire world. As globalization continues and the earth's natural processes transform local problems into international issues, few societies are being left untouched by major environmental problems.

Some of the largest problems now affecting the world are flooding, air and water pollution, global warming, overpopulation, deforestation, habitat loss and fragmentation, topsoil removal, mining, and overharvesting of resources.

Every environmental problem has causes, numerous effects, and most importantly, a solution.

Objectives:

- To identify actions that will reduce their impact on the environment.

Subject: Science, Maths, Social Studies

Materials Needed: Chalkboard, paper and pencil, question cards made from cardboards

Duration: 45 minutes

GETTING READY

1. Draw the jeopardy template on the chalkboard. Using the jeopardy template below, select 5 topics on biodiversity or environmental problems in your community/country to cover. Enter them in the column headers.

2. Write 5 questions for each topic on the question cards, making it progressively challenging but realistic. As such, questions should progress from easy (100 point question) to intermediate to difficult (500 point questions). Include one behavior change question for each category.

3. Familiarize yourself with the rules of the game.

Category Heading	Category Heading	Category Heading	Category Heading	Category Heading
100	100	100	100	100
200	200	200	200	200
300	300	300	300	300
400	400	400	400	400
500	500	500	500	500

WHAT TO DO

1. Divide your class into groups of 4 to 5 students. Each group will be competing against each other to gain the most points.

2. Write the number of groups on a piece of paper and place in a bag. Shake the bag so that the numbers will be shuffled. Ask each group to select a paper. This will tell students the order in which they will play this game.

3. The first group will select a topic and then a question, for example, Topic 1 - 400 points. When the first group has selected the points, the teacher will read out loud the question the group has to answer. Each group has one minute in which to respond. If they answered correctly, they gain the points. If they do not answer correctly, the points are deducted from them (oftentimes groups may get, for example, -400) and other groups can 'buzz in' (raising hands, etc) in order to answer the question. The fastest of the group to 'buzz in' gets to answer the question.

4. After completing all questions, tally the total for each group. The group with the most points wins the game.

5. Follow-up this game by asking students to write an essay on how they would solve one of the environmental/biodiversity problems facing their community. Ask students to gather information by interviewing experts and adults.

The World Wildlife Fund (WWF) signed an agreement with the Guyana Gold and Diamond Miners Association (GGDMA) to assist small and medium scale miners in improving their tailings management practices. A major problem in mining is the large volumes of tailings generated through dredges which leads to permanent loss of organic cover and slow re-vegetation of the area.

Frogs

APPENDIX A: BRANCHING OUT

There are numerous ways you can involve students in learning about biodiversity and conservation. The following are ideas that you can use to expand environmental and conservation education throughout your school and community.

Wildlife Clubs: Start an environmental or wildlife club in your school or with students after-school. Ask parents, other teachers, conservationists and other adults to assist with activities. Ask students what they want to do, or use some of the ideas below to get started. Also, ask other wildlife clubs in Guyana or conservation organizations about activities that they're doing and guidance in setting up your own club, for example, GMTCS has been assisting schools and communities to establish environmental/wildlife clubs for years. Iwokrama has also assisted communities in the North Rupununi to establish clubs.

Contests: Organize art, poetry, essays, or singing contests about biodiversity. You can also hold debates in schools and the community on biodiversity.

Fun Days and Celebrations: Organize 'fun days' and celebrations around special days or animals such as Earth Day or Sea Turtle Fun Day in your school and community.

Field Trips: Organize a visit to a proposed or protected area such as Shell Beach, a unique natural area or to the local conservation organizations such as GMTCS, Iwokrama, or Guyana Zoological Park. You can even go on a nature hike around your community. You can even do exchange visits with other schools in your community or with other schools in other communities to learn more about a different area and what they are doing to conserve biodiversity. For example, you may wish to visit Almond Beach Primary at Shell Beach to see the sea turtle conservation efforts, or North Rupununi to see the arapaima conservation project.

Murals: Paint a biodiversity mural in a central place in the community or at school. Get permission from local authorities and principals beforehand. Get help from an art teacher or local artist to help you design the mural and ask private companies for paint supplies.

Plays, Shows and Festivals: You may wish to present a play or puppet show for the community around the theme of environment and biodiversity. Hold a music festival with songs and dances about biodiversity.

Guest Speaker: Invite a scientist, conservationist, community leader or elder to speak to your class about his/her work and views on conservation. You can hold a environmental workshop where invited persons talk about the various careers in conservation e.g. science, communications, education, policy and economics.

Environmental Camps: Organize a day or week long camp during the school vacation period, allowing students to participate in hands-on learning activities e.g. they can plan their own conservation projects e.g. clean-up the beach, river or community; plant trees; collect bottles for recycling; creating a school garden or compost pile; and/or improve animal habitats near your school or in your community (e.g. making bird houses, etc).

Awareness Campaigns: Choose an important local environment issue and design and implement a campaign to raise awareness about that issue, for example, sea turtle conservation. You can ask businesses around your area for help as well as local experts and artists. Students can design logos and key messages on posters, radio programmes, articles in the newspaper, and so on.

Newsletters and Articles: Students can do surveys, printing the results in a class or school newsletter. They can also write journalistic stories and articles for the local newspapers. You can also create a student newspaper on local or national conservation issues.

APPENDIX B: GLOSSARY

Biological Productivity - the amount of plants and animals that grow and thrive in a defined region. A typical indicator of biological productivity is the annual biomass accumulation of an ecosystem.

Visual Aids - any device such as charts, slides, pictures, drawings, etc, used to support oral presentations.

Nursery - a place where young animals and plants mature.

Mangroves - trees and shrubs that grow in saline or salty coastal habitats in the tropics and subtropics.

Adaptations - special traits that help living organisms survive in a particular environment.

Mangal - another name for a mangrove swamp.

Renewable Resource - resources that replace themselves naturally and quickly, such as sun, wind, and hydroelectric power.

Non-renewable Resource - resources that are not naturally regenerated or renewed such as gold, diamond, and oil.

Food Webs - all feeding relationships of organisms in an ecosystem.

Food Chains - a series of organisms connected by their feeding habits; each link in the food chain is eaten by a larger one, which is eaten by a still larger one.

Plastron - the bottom or lower shell of turtles.

Carapace - the upper part of a turtle shell.

Scutes - the bony "plates" on turtles' shells.

Ecology - the study of how organisms interact with each other and their physical environment.

Community - a group of people sharing a common understanding who reveal themselves by using the same language, manners, tradition and law. A community, in ecology, can also mean an assemblage of populations of different species, interacting with one another.

Garbage - any leftover waste or scraps or material deemed useless or disposable. Waste, rubbish, trash, garbage, or junk are all used interchangeably to mean the same thing.

Waste management - a sustainable process for reducing the environmental impact of the disposal of all types of materials used by businesses, individuals and communities.

Hazardous materials - chemical substances (solid, gas, or liquid) that are toxic to humans.

Culture - the arts, customs, and habits that characterize a particular society or nation.

Tradition - a long-established custom or belief that is passed on from person to person and generation to generation.

Deforestation - the removal of forest stands by cutting and burning to provide land for agricultural purposes, residential or industrial building sites, roads, etc., or by harvesting the trees for building materials or fuel.

Mining - is the extraction (removal) of minerals (like coal, gold, or silver) from the ground.

Participation - is a process through which stakeholders influence and share control over initiatives and the decisions and resources which affect them.

Strategies - techniques or methods use to implement proposed instructional, assessment, evaluation, and/or curricular activities.

Laws - the rules adopted by government that govern our lives in various respects.

Convention - an international agreement.

Wetlands - land areas that are wet due to a close relationship to a body of water or groundwater, or land areas that are flooded regularly.

Environment - surroundings in which an organization operates, including air, water, land, natural resources, flora, fauna, humans and their interrelation.

Ecosystem - all the living and nonliving things in an environment, including their interactions with each other.

Species - a group of similar organisms having common characteristics capable of interbreeding.

Keystone Species - a plant or animal species that many other organisms in a community depend on.

Biodiversity - the variety of life on Earth. The abundance of different plant and animal species found in an environment.

Over-harvesting - the use or extraction of a resource to the point of depletion (or extinction).

Conservation - the protection or wise use of natural resources that ensures their continuing availability to future generations.

Habitat Loss - animals and plants losing their home. It is the major reason plants and animals become extinct.

Pollution - the introduction of contaminants into the environment that cause harm or discomfort to humans or other living organisms, or that damage the environment.

Habitat Fragmentation - the process by which isolated patches of habitat are created through land clearing and deforestation.

Invasive, Alien or Introduced Species - non-native species of plants or animals that out-compete native species in a specific habitat.

Protected Areas - areas of land and/or water dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources.

Sustainable Use - the use of resources at a rate which will meet the needs of the present without impairing the ability of future generations to use resources.

Habitat - the place where a plant or animal lives.

About the Authors

MICHELLE KALAMANDEEN works as the Scientific Officer of the Centre for the Study of Biological Diversity at the Department of Biology, University of Guyana. She was a Commonwealth Scholar in 2004 -2005 where she completed a Masters' in Biodiversity Conservation and Management at the University of Oxford. She has been involved in herpetological research that involves indigenous peoples, especially at Shell Beach in the Northwestern region of Guyana for over nine years. She has previously coordinated the sea turtle monitoring programme at Shell Beach from 2005-2008; and is currently the Protected Areas, Education and Research Coordinator of the Guyana Marine Turtle Conservation Society. Ms. Kalamandeen has developed the capacity of hundreds of indigenous youths and leaders in conservation issues through her work with the University of Guyana, Iwokrama International Centre and GMTCS. Michelle is the Country Coordinator in Guyana for the Wider Caribbean Sea Turtle Conservation Network (WIDECAST). Her interests include protected area designation and management, the role of indigenous peoples in conservation and species distribution and ecology.

MARIE-LOUISE FELIX: is a wildlife conservation scientist with the World Wildlife Fund Guianas Programme Office, in Paramaribo, Suriname. Dr. Felix has worked with WWF Guianas for seven (7) years and is responsible for the Regional Species Conservation Programme, (which includes Wildlife Trade Management and Control) and also serves as the Marine Turtle Conservation Coordinator at WWF Guianas. Dr. Felix holds a PhD in Biology (specializing in Aquaculture and Freshwater Fisheries), from the University of the West Indies and an MSc degree in Conservation and Management of Wildlife in International Commerce from the University of Andalusia in Spain. Prior to joining WWF, Dr. Felix worked as the Aquaculture and Fisheries Officer in the Ministry of Agriculture, Lands, Forestry and Fisheries in St. Lucia where she also had responsibility for Marine Turtle Conservation and Management.

WALDYKE PRINCE: is the ecotourism coordinator at the Iwokrama International Centre for Rainforest Conservation. He has over 12 years of experience in field research including faunal surveys, applied wildlife and fisheries research, and environmental education. Mr. Prince was the manager of the Audubon Citizen Science Programme in Guyana – a project that focuses on community-based wildlife management, environmental awareness and education and research within 14 indigenous communities in the North Rupununi. Waldyke was a past recipient of the UNOPS Fellowship for the Smithsonian Institution's Man and the Biosphere Biodiversity Programme.

PHILLIP DASILVA is a Senior Lecturer in the Department of Biology, Faculty of Natural Sciences, University of Guyana. He has served as Dean of the Faculty of Natural Sciences and Manager of the Centre for the Study of Biological Diversity. He is a graduate of the University of Guyana where he completed the BSc Degree (Biology) and also of the University of the West Indies where he completed a Post Graduate Diploma in Environmental Science and the MSc degree in Marine Resources and Environmental Management. He has been involved in teaching and research in conservation biology, natural resource management, tourism and integrated coastal zone management for over fifteen years.

The Guyana Marine Turtle Conservation Society (GMTCS)

GMTCS would like to express its heartfelt thanks to the German Development Bank (KfW) and Environmental Protection Agency (EPA) for financing and supporting the development of this Manual, Thanks also to the Ministry of Education and National Centre for Educational Resource Development (NCERD) for reviewing and supporting the Manual.

We would also like to thank Wider Caribbean Sea Turtle Conservation Network (WIDECAST) and Conservation International-Guyana for permission to use their educational material in this Manual. Special thanks also to the GMTCS Board for their constant support.

When Dr. Peter Pritchard, one of the world's sea turtle experts, first visited Shell Beach in 1962 there were large numbers of sea turtles nesting there. Only female turtles leave the ocean to lay their eggs in nests on the beach. This made them easy targets for hunters who killed the turtles for their eggs and meat for consumption and profit. Additionally, many turtles were accidentally caught in fishing nets and either drowned or were harmed by fishermen. In an attempt to reduce the harvesting of marine turtles, Dr. Pritchard, Compton Edmonson and Audley James, two Amerindian converted turtle hunters, appealed to fishermen and local residents to stop or greatly reduce sea turtle meat and egg consumption, and in some instances, purchased the eggs and turtles from hunters.

The essence of this project, which still continues today, is the empowerment of the resident indigenous peoples to become stewards of the resources upon which they ultimately depend. In 2000, the Sea Turtle Project officially registered as the Guyana Marine Turtle Conservation Society, making it the first and longest homegrown conservation organization in Guyana. In 2008, GMTCS celebrated the 20th Anniversary of the Sea Turtle Monitoring Project.

GMTCS THEMATIC AREAS

1. **Direct Turtle Conservation** – conducting marine turtle surveys and protection patrols at main nesting beaches. Field camps are manned by local Amerindians.

2. **Education and Awareness** – working with stakeholders at all levels to promote awareness of the need to protect the marine turtles.

3. **Research** – organize and carry out research that will promote the protection and conservation of cultural, natural and archaeological resources within the Shell Beach area.

4. **Empowering the Local Community** – which seeks to identify economic alternatives for user communities as a mean of achieving sustainable livelihoods. Recently, GMTCS in collaboration with various communities have established the Moruca Embroidery and North West Organics brands, two economic alternative projects aimed at improving the social conditions of local user communities.

5. **Establishing Shell Beach as a National Protected Area** – Shell Beach has been recognized nationally as an area warranting protected areas status from the standpoint of its rich ecological and cultural diversity. GMTCS in response to its role as Lead Agency has outlined a process for Shell Beach and is committed to working with all stakeholders particularly the local communities.

For more information on *Conservation In Classrooms* and other activities, or information on GMTCS, please contact:

GUYANA MARINE TURTLE CONSERVATION SOCIETY (GMTCS)

c/o Le Meridien Pegasus, Kingston, Georgetown.
Guyana, South America
Tel: (592) 225-4483/4
Email: gmtcs@bbgy.com
Website: http://www.gmtcs.org.gy