Surviving the Ecosystem!

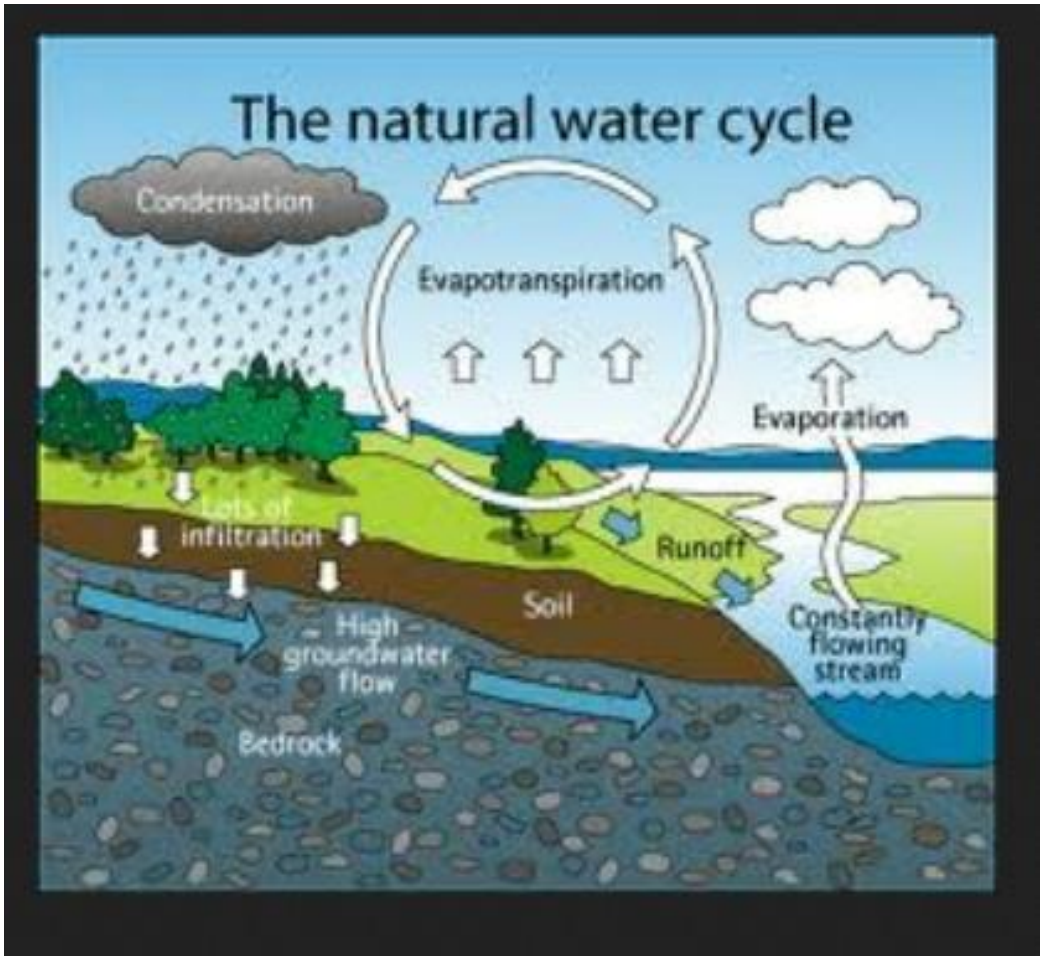
Rainforest Part Two

Day One:

Why do they call it the Rain Forest?

The rain forest is a natural resource that is a necessity in the world. Unfortunately it is disappearing at an increasingly high rate of more than 29 million acres per year. Many of the countries that have rain forests are less industrialized nations with fewer natural resources therefore using their one large resource, the rain forest.

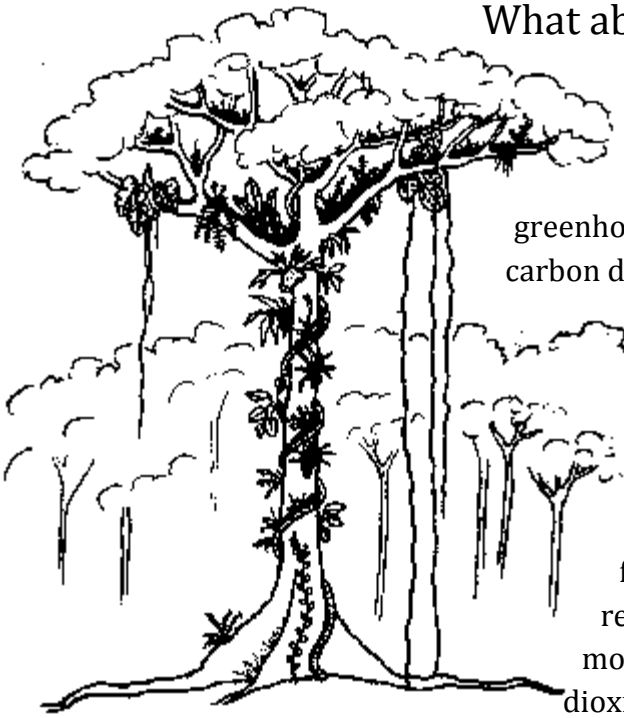
It is called the Rainforest for a reason. In contrast to the dry climate of the desert, the jungle is an abundant source of water. In many jungles, rainfall is common and can be used as a source of hydration. Some rain forests receive nearly one inch of rain every day of the year. A rain forest acts as a funnel



for the rain water so that it doesn't saturate the soil.

Water moves in a never-ending cycle. The forms of water are always changing. Water moves from sky to Earth and back to sky again. The water that we use today has been around since the beginning of the earth. The water we use has been precipitation and water vapor. It has traveled through rivers, oceans and even been consumed by other animals like dinosaurs. The water we have coming out of the tap could have traveled through a river in Africa and been used by a herd of elephants to bathe! This never-ending cycle is called the WATER CYCLE.

What about the Trees?



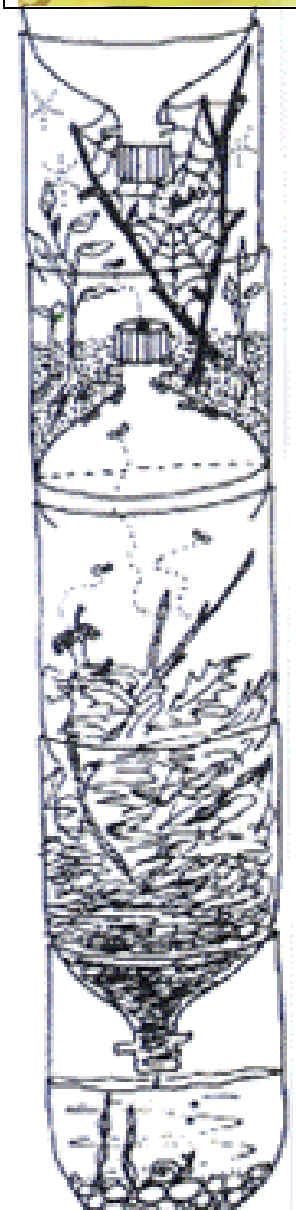
Rainforests may not always be around like water is. When rainforest trees are cut down (deforestation) occurs, the release of greenhouse gasses and the earth's capacity to absorb carbon dioxide are effected. Global warming is the trapping of heat in the earth's atmosphere due to greenhouse gasses. In rain forest soil, there are 20-100 times more carbon dioxide than regular soil. However, when the rain forest is burned, the carbon dioxide within the soil is released. When the forests are flooded and the trees are left to rot, methane is released into the air (methane on a molecule for molecule basis is 70 times as powerful as carbon dioxide for trapping heat in the earth's atmosphere.) Also by cutting down trees the carbon dioxide that humans release is not being taken up by these trees. Therefore there is more carbon dioxide to contribute to global warming.

Another effect of deforestation is the increase of flooding that occurs in the remaining areas of the rain forest. A rain forest acts as a funnel for the rain water so that is doesn't saturate the soil. The water is released into the soil so that all of it can be used efficiently. However, when deforestation occurs the funnel is

no longer there and rain saturates the soil so much that it creates soil erosion. Most of the soil that is washed away is top soil, therefore plant life is completely uprooted.

The rain forest is home to half the species plant species on the earth, and is also home to old human civilizations. Even though the United States does not have any rain forests, bird watchers will notice the consequences of deforestation. Song birds that spend their summers in North America, and winter in South America are at risk. Tanagers, Orioles, Warblers, and humming birds are among the migratory population that have declined over the years because of deforestation.

Tanager	Orioles	Warblers	Humming Birds
			



In terms of medical potential in the rain forest, there is a tremendous amount of medicines that can be made from plants in the rain forest. The medicines that can be made come from toxins that plants produce in order to protect themselves from being eaten. Only 1% of all tropical plant species have been screened for medical application, and from that 1%, we have aquired many types of medication. For example, the rosy periwinkle, a plant from Madagascar, has greatly increased the odds of surviving from Hodgkin's disease and childhood lukemia. Because of medicines made from the rosy periwinkle, 99% of childhood lukemia patients have a chance of remission, and Hodgkin's disease patients have a 70% chance of recovering. Only 30 years ago, 1 in 5 people with childhood lukemia recovered and patients with Hodgkin's disease almost always did not survive

Understanding the Rainforest Funnel

Create a Tropical Ecocolumn

Plastic beverage bottles provide the primary material for this activity. They are readily available - millions are produced and discarded daily and are easy to cut and combine in a wide variety of ways for science projects. These basic instructions are meant to get you started, showing how plastic bottles can be taken apart, cut, and connected. Once these basic techniques are mastered, you can follow the directions to make a tropical ecocolumn.

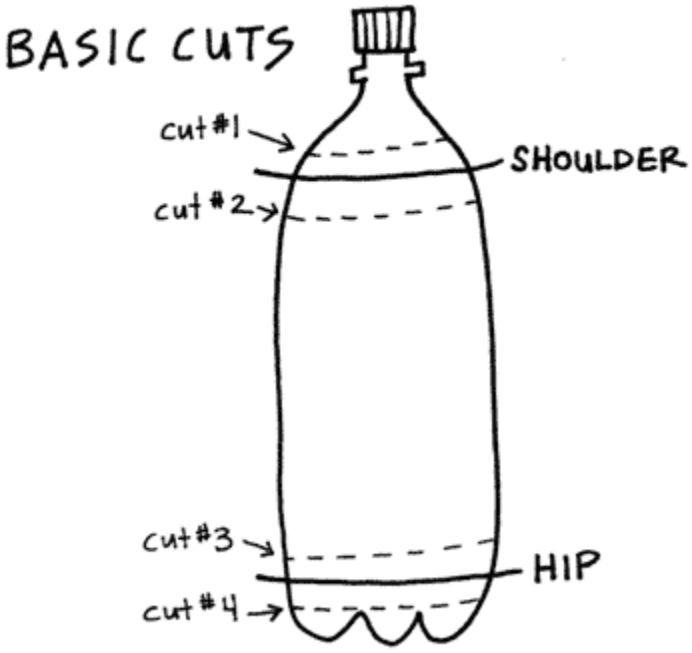
Removing the Label and Base.
Both the bottle label and base may be readily removed. The label and base are held in place with a heat-sensitive glue. To remove them, the glue must be softened with heat.

Follow these instructions:

- A) Fill the bottle about 1/4 full with very hot (120 - 150 degrees F) water. If the water is too hot (170 - 212 degrees F) the plastic will soften, warp, and may permanently crumple. Screw the cap back on firmly. This will retain pressure inside the bottle allowing you to hold the bottle tightly without crushing or denting it.
- B) Tip the bottle on its side so the water warms the area where the label is attached to the bottle - this will soften the glue. Catch a corner of the label with your fingernail and gently peel it from the bottle. If there is resistance, you may need hotter water.
- C) To remove the base, tip the bottle upright so the hot water warms the glue holding the bottle bottom to the base. Hold the bottle tightly and slowly twist off the base.
- D) Remove the cap and pour the water out slowly. You might try swirling the bottle around as it begins to empty, causing the water to form a vortex resembling a tornado funnel. This lets the water to swirl slowly out of the bottle mouth without buckling the sides.
- E) Usually most of the glue from the label and base is left on the bottle. It can be removed by scraping with a sharp-edged piece of metal or plastic while the glue is

still warm. It can also be chemically softened and removed with a solvent such as cleaning fluid. Put a small amount on a paper towel and rub. This works best if most of the glue has been removed by scraping. Be sure there is adequate ventilation.

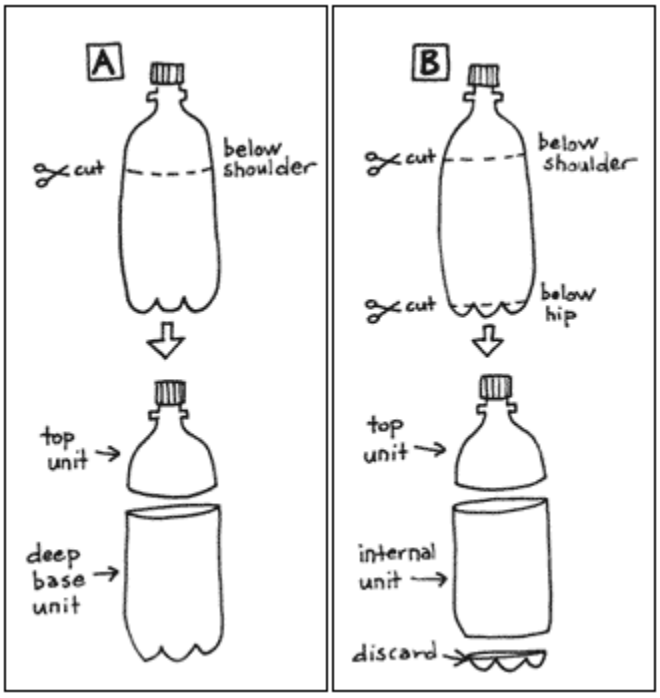
- F) Save all parts - bottle, cap, and base. You may need them later.

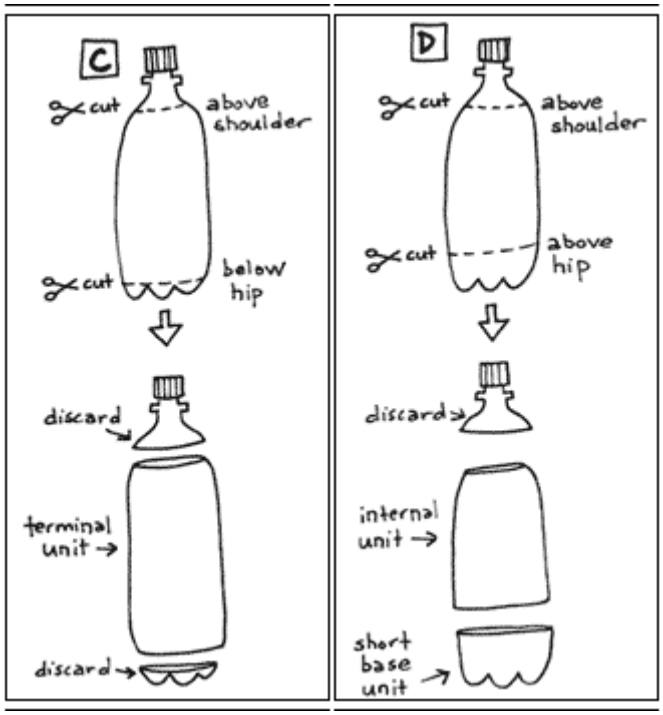


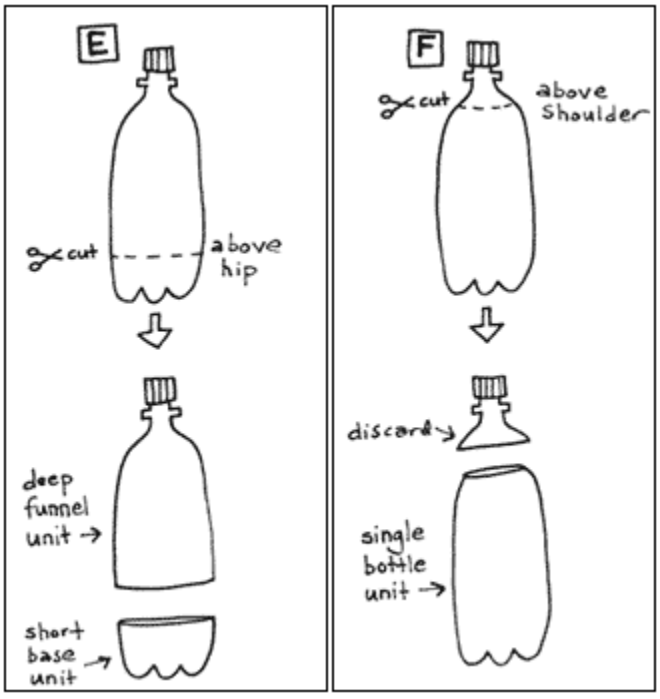
Cutting Techniques. Plastic bottles can be cut and modified in a great variety of ways but before you begin cutting, plan carefully. Remember that some bottles are wider than others, some have larger bases, and some have more tapered shoulders. The bottle shape and location of the cuts affect how your pieces fit together.

1. Place bottles on their sides in an empty drawer, tray, or box. Shallow cardboard flats and computer paper box tops work well. Hold the bottle up against the side and corner of the box to stabilize it while rotating. Brace a felt-tip pen against the box with the tip just touching the bottle and roll the bottle slowly around. This will leave an even line encircling the bottle. Sometimes it's easier to do this cooperatively. One person holds the bottle and rotates, while the other keeps the pen tip touching the bottle.

2. Use a single-sided razor blade or utility knife to begin the cut, slicing along the cutting line about two inches. Insert the tip of the scissors and snip your way around the rest of the cutting line. Because the scissor blades tend to catch in the plastic, it may be easier to snip along with just the tips. Trim away rough edges and irregularities with the scissors. Once the bottle is cut open, you can snip more from the shoulder, hip or side if you decide shorter lengths are needed. When in doubt about how pieces may fit, cut them a little too long - you can always re-move the extra length. Because it is more difficult to draw lines once a bottle has been cut, draw all intended lines before cutting.





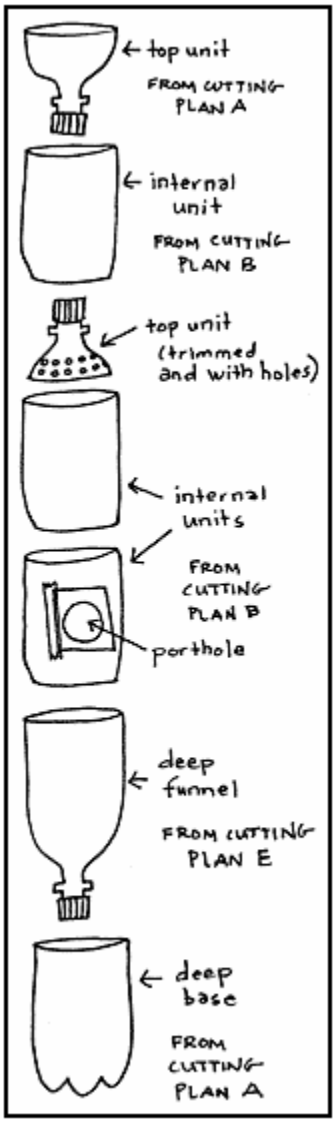


Joining Bottles. Tape is the best material for joining bottles and will help columns survive handling in the classroom. However, not all tape is created equal! Postal tapes that are clear, waterproof, and wide (about 5cm), work well. For a large number of constructions, buy a dispenser. The best tape, and most expensive, is bookbinding tape.

Some construction requires waterproof joints. Since even a waterproof tape will eventually leak, we recommend using silicone sealant.

A few tricks when using silicone:

- Silicone cures over a 24-hour period and is slippery when fresh. Fix the joint to be sealed with small pieces of tape, which you can remove after the seal has solidified.
- Buy your sealant in a tube with a nozzle that you can fit as far into the joint as possible. This will give you a strong and waterproof seal.
- Keep the silicone bead thin, 2mm in diameter, so it sets in 24-hours.
- The chemicals used in silicone sealant are a health hazard. Use silicone only in a well-ventilated area.



Now lets take a look at the Tropical Forest Ecocolumn. Rain forests are composed of four general layers of vegetation: canopy, sun seekers, understory, and forest floor.

The canopy is composed of tall trees which rise to a height of 100 feet or more. Their crowns form an interlocking canopy which absorbs the strong tropical sunlight, allowing as little as 1 % to reach the forest floor. They also buffer the forest floor from strong winds. Most of these trees have oval leaves with an elongated tip to "drip" rain down below to other levels of the forest.

Sun seekers compose the next layer. They are plants just below the canopy and these plants like to take advantage of the trees and their access to sunlight. Vines climb up the trunks of the trees from the dark forest floor, then sprawl out along tree branches once they near the canopy.

Another group of plants, called epiphytes, (literally "upon plants") also inhabit the upper tree trunks and branches. These plants, including ferns, mosses, lichens, orchids, bromeliads and even cacti do not actually live off the tree like parasites, but use it for mechanical support and access to sun and nutrient rich rainwater.

Epiphytes disperse their seeds by wind and often grow on top of one another: a fern on a moss on a lichen on a tree trunk. Because they are not in contact with the ground these " hangers-on" must conserve their own supplies of water and nutrients. Some orchids store water in bulbus stems. Tank bromeliads have large, water tight pockets, which can hold over two liters of water. Canopy trees have smooth or flaky bark to make it more difficult for sunlight-hungry vines and epiphytes to gain a footing.

Far below the canopy is the forest under story, a shady, humid and calm level of the forest. Shade adapted herbs, shrubs, and small trees grow to several meters in height. These

plants germinate and grow to maturity in the absence of any direct sunlight, although they may include species adapted to take advantage of any gaps in the canopy. If a branch or tree falls, perhaps pulled down by heavy loads of epiphytes, the gap can create a sudden column of light, photosynthetic energy for any plant that can grow quickly to take advantage of the light before the canopy closes in again.

Mosses, ferns, seedlings and a layer of leaf litter lie on the forest floor. Below this fallen plant material lie tangled rootlets of forest trees and the pale strands of fungi, which rapidly decompose plant matter and recycle nutrients back into the forest. Many house plants are from the tropical regions of the world. Below you can see an examples of common house plants and their origin in the tropical regions of the world.

House Plant Origin Cape primrose (streptocarpus).....S.Africa Moss fern or spike moss (selaginella).....Asian, African, Australian, American Miniature gloxinia (Sinningia pusilla).....BrazilianStrawberry begonia (geranium) (Saxifraga sarmentosa).....China and JapanMiniature African violets (Saintpaulia).....E. AfricaSwedish ivy (Plectranthus nummularius).....Australia and Pacific IslandsArtillery plant (Pilea microphylla).....West IndiesAluminum plant (Pilea cadierei.....VietnamBaby's tears (Pilea depressa).....Puerto RicoWandering Jew (Tradescantia fluminensis).....Argentina & Brazil Spider plant (Chlorophytum comosum).....Cape of Good HopeMaidenhair fern (Adiantum).....South America

Plants that generally grow well in bottle environments include small leaf ferns, small bromeliads, small leaved ivies, mosses, liverworts, small sebum plants and small cacti.

Now that you have thought about diversity within tropical forests, think about how plants have adapted to a particular tropical climate or rain forest layer.

In determining what types of house plants to put in what layer of your tropical Ecocolumn, think of the leaf shape and size, tolerance to wind, light requirements, and flower and fruiting times.

Using your house plant knowledge, plant an Ecocolumn with common house plants. Each chamber can represent a different rain forest layer. You may have to simulate plants for some layer, providing sticks or other structural support for epiphytes, for example.

The following is a list of tips when constructing your Ecocolumn:

- Precipitation - Punch two or three small holes in the cap of a bottle top funnel in order to "water" your Ecocolumn. *Note: you can also cap your Ecocolumn using a bottle top to or base in order to make a closed system.*

- Air Holes - Poke plenty of air holes for the living creatures inside. You will need to keep the holes small so that fruit flies do not escape. In aquarium chambers be sure the air holes are made well above the water levels.
- Drainage Holes - The number and height of the drainage holes you poke will effect the environment in any soil-filled chamber. Sandy soil with holes poked low in the base of the chamber will mean quick drainage and drier conditions. Peaty soil and a few high drainage holes will make for wetter conditions. Create a variety of plant habitats by using different soils and drainage.
- No mistakes are possible - Remember, there is no right or wrong way to build an Ecocolumn. Change is a natural part of this experiment, so when things change, try to figure out what happened and why. If insects or plants die in your Ecocolumn, think again about the natural habitat of the living creature and what it might need to live.
- A few words of caution - Ecocolumns can become very top heavy and tip easily. Some people Velcro them to a wall. You can also weight the bottom with gravel or water. Avoid exposing Ecocolumns to full sunlight.

Discussion

1. What parts of the plants in the Ecocolumn did you examine to determine their place in the ecocolumn?
2. What plant level is most fragile? Why?
3. Could one level of the forest be removed and the other parts of the forest still function properly?
4. Are there any rainforests in North America?
5. Name several rain forest animals that use special parts of their bodies to help them move around in the rainforest? For example, the spider monkeys grasping tail enables it to hold onto branches.
6. What are two products that come from tropical rainforests?

Extensions

1. Design and construct a mural about the birds in your state and their dependence on the tropical forested regions of other countries.
2. Write a letter to a rain forest conservation organization and ask them what your class can do to help protect tracts of rain forest.
3. Keep a careful notebook as you plan your Ecocolumn. Record exactly what you have put inside. Once set up, keep a careful watch and written record of what the conditions are and how they change.

Teachers: Visit these links for more information on the ecocolumn and a variation projects.

https://sites.google.com/site/ecocolumnproject2012/abiotic-and-biotic-factors-list

http://www.bottlebiology.org/investigations/

Decomposition Column

Decomposition column instructions can be found at this link. This is helpful for students to learn what happens on the rainforest floor.
http://www.bottlebiology.org/investigations/decomp_main.html

The U.S. generates 190 million tons of solid waste a year — enough to fill a bumper-to-bumper convoy of garbage trucks halfway to the moon. So why aren't we up to our necks in garbage?

Nature recycles garbage all the time, and this recycling is essential to the availability of nutrients for living things. Nature's recyclers are tiny bacteria and fungi, which break down plant and animal waste, making nutrients available for other living things in the process. This is known as decomposition.

Decomposition involves a whole community of large and small organisms that serve as food for each other, clean up each other's debris, control each other's populations and convert materials to forms that others can use. The bacteria and fungi that initiate the recycling process, for example, become food for other microbes, earthworms, snails, slugs, flies, beetles and mites, all of which in turn feed larger insects and birds. You can think of the Decomposition Column as a miniature compost pile or landfill, or as leaf litter on a forest floor. Through the sides of the bottle you can observe different substances decompose and explore how moisture, air, temperature and light affect the process.

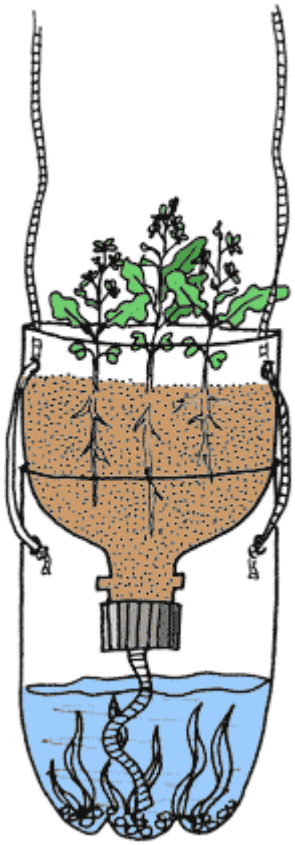
Many landfills seal garbage in the earth, excluding air and moisture. How might this affect decomposition? Will a foam cup *ever* rot? What happens to a fruit pie, or tea bag? Which do you think decomposes faster, banana peels or leaves? If you add layers of soil to the column, how might they affect the decomposition process? What would you like to watch decompose?

TerrAqua Column

The TerrAqua Column provides you with a model to explore the link between land and water. The model has three basic components: soil, water and plants.

What common substance falls from the atmosphere, flows through our bodies, runs through the soil beneath our feet, collects in puddles and lakes, then vaporizes back into the atmosphere in a never-ending cycle?

Water, as it cycles between land, ocean and atmosphere, forms the major link between the terrestrial world (involving anything living on the earth) and the aquatic world (involving anything living on or in the water).



Water drips off rooftops, flows over roads, off your toothbrush, and down the drain, percolates through the soils of fields and forests and eventually finds its way into rivers, lakes and oceans.

During its journey, water will pick up leaf litter, soil, nutrients, agricultural chemicals, road salts and gasoline from cars, all of which have profound impacts on life in aquatic systems. Water can also be filtered or purified as it percolates through soil.

The TerrAqua Column provides you with a model to explore the link between land and water. The model has three basic components: soil, water and plants.

By varying the treatment of just one of these components you can explore how one variable can affect the whole system. How does salt affect the growth of plants? How does adding fertilizer to the soil affect algal growth in the water chamber? What type of soil best purifies water?

Experimentation with the TerrAqua Column is practically unlimited. You can define a question, and then design your experiment to explore it.http://www.bottlebiology.org/investigations/terraqua_main.html

Standards K-8

K

- **K.G.4. Analyze and compare two- and three-dimensional shapes and objects, ex. bottles, in different sizes and orientations, using informal language to describe their similarities, differences, parts (e.g., number of sides and vertices/"corners") and other attributes (e.g., having sides of equal length).**

- **7.3.1a Recognize that living things require water, food, and air.**

Students will use the bottles to create their ecocolumn. They will follow instructions on how to put the ecocolumns together. During this process they will compare the different parts of the bottles

and determine which ones are the same and then describe their similarities. They will also group them with those that are similar. Those that are not they will explain their differences.

Through the ecocolumn activities they will learn to recognize through their observations and class discussions that living things require water, food, and air.

1st

- **7.5.1a Investigate how plants and animals can be grouped according to their habitats.**
- **7.3.1b Conduct investigations and record data about the growth of different plants under varying conditions.**

Students will determine which plants need to be in the different parts of their rainforest ecocolumn according to their normal needs and that will be related to habitats.

They will observe the ecocolumns overtime to record data about plant growth in the various levels and conditions in the ecocolumn.

2nd

- **7.3.2 Design a model of a habitat for an organism in which all of its needs would be met.**
- **7.2.2 Investigate ways that plants and animals depend on each other.**

Students will help in the design and construction of the ecocolumns. They will ensure that the needs of the plants and organisms are met.

They will observe what happens overtime with their ecocolumn and then record their observations in relation to how the organisms in the ecocolumn rely on each other. They will learn how this relates to how plants and animals depend on each other all over including in the rainforest.

3rd

- **7.5.2 Investigate the connection between an organism's characteristics and its ability to survive in a specific environment.**
- **7.5.1b Create representations of animals or plants that have characteristics necessary to survive in a particular environment.**

Students will plan what their plants need to be able to survive in their ecocolumn.

They will ensure that the plants in each layer have the characteristics to survive in that specific layer. They will observe this over time to see if the plants thrive or not.

4th

- **7.8.1b Prepare a model that illustrates the basic features of the water cycle.**
- **7.3.1 Demonstrate that plants require light energy to grow and survive.**

Students will make their ecocolumns to illustrate how water travels through the rainforest. This will be compared to the full water cycle.

Through the ecocolumn project students will demonstrate that plants require light energy to grow and survive.

5th

- **7.2.3 Create a simple model illustrating the interspecific relationships within an ecosystem.**
- **7.2.1 Investigate different nutritional relationships among organisms in an ecosystem.**

Through the ecocolumn project students will demonstrate that plants require light energy to grow and survive. This model will illustrate the relationship that the plants and other organisms have in an ecosystem.

Students will determine the nutritional needs of the plants in the ecocolumn before they are planted in the column. They will look for ways to ensure that the plants have their needs met in the ecocolumn.

6th

- **7.2.2b Interpret how materials and energy are transferred through an ecosystem.**
- **7.T/E.2 Apply the engineering design process to construct a prototype that meets certain specifications.**

Students will observe over time what happens in the ecocolumn. They will note how both materials and energy are transferred through the column.

7th

- **7.3.3 Identify the materials used by plants to make food.**
- **7.T/E.1 Identify the tools and procedures needed to test the design features of a prototype.**

Students will learn about the process that plants use to make food.
They will follow procedures and instructions to design their own ecocolumn. The instructor will give students basic instruction on how to build the column and then give students the chance to design it the best way possible to replicate what happens in the rainforest.

8th

- **7.T/E.1 Identify the tools and procedures needed to test the design features of a prototype.**
- **7.T/E.2 Evaluate a protocol to determine if the engineering design process was successfully applied.**

They will follow procedures and instructions to design their own ecocolumn. The instructor will give students basic instruction on how to build the column and then give students the chance to design it the best way possible to replicate what happens in the rainforest.

Students will make observations overtime to determine if they designed an effective ecocolumn. They will modify as necessary to ensure that it works properly.

Day Two

Water, water everywhere and not a drop to Drink!: Finding Water in the Wild

Tribal Challenge

Have students sit with their tribes. Have them imagine they are in the rainforest and they are thirsty. It's the rain forest so there should be water everywhere but what is safe to drink?

Water Search Simulation

Under supervision of staff give students a plastic cup. Have them take a walk outside on the school ground and see if they can find water.This should be water that does not come from the water fountain. Have a tribal challenge to see which group if any are able to locate water. Have them collect as much water as they can. See which tribe was able to gather the most water from their excursion outside.

What to do with the water.

So now that we have found water (maybe they didn't find any… if that is the case have them imagine they did.) is it okay to drink?

In the rainforest there are some common things that are used to find water.

Bamboo Stalks:

The bamboo collects water during rainfall. To collect this water we would have to bend the bamboo to allow the water to flow out into a container.

Green bamboo thickets are an excellent source of fresh water. Water from green bamboo is clear and odorless. To get the water, bend a green bamboo stalk, tie it down and cut off the top. The water will drip freely during the night. Old, cracked bamboo may contain water.

CAUTION: Purify the water before drinking it.

In the rainforest wherever you find banana or plantain trees, you can get water. Cut down the tree, leaving about a 30-centimeter stump and scoop out the center of the stump so that the hollow is

bowl-shaped. Water from the roots will immediately start to fill the hollow. The first three fillings of water will be bitter but successive fillings will be palatable. The stump will supply water for up to four days. Be sure to cover it to keep out insects.

Some tropical vines can give you water. Cut a notch in the vine as high as you can reach, then cut the vine off close to the ground. Catch the dropping liquid in a container or in your mouth.

CAUTION: Do not drink the liquid if it is sticky, milky or bitter tasting.

The milk from green (unripe) coconuts is a good thirst quencher. **Have students try coconut water. Do they like it?**

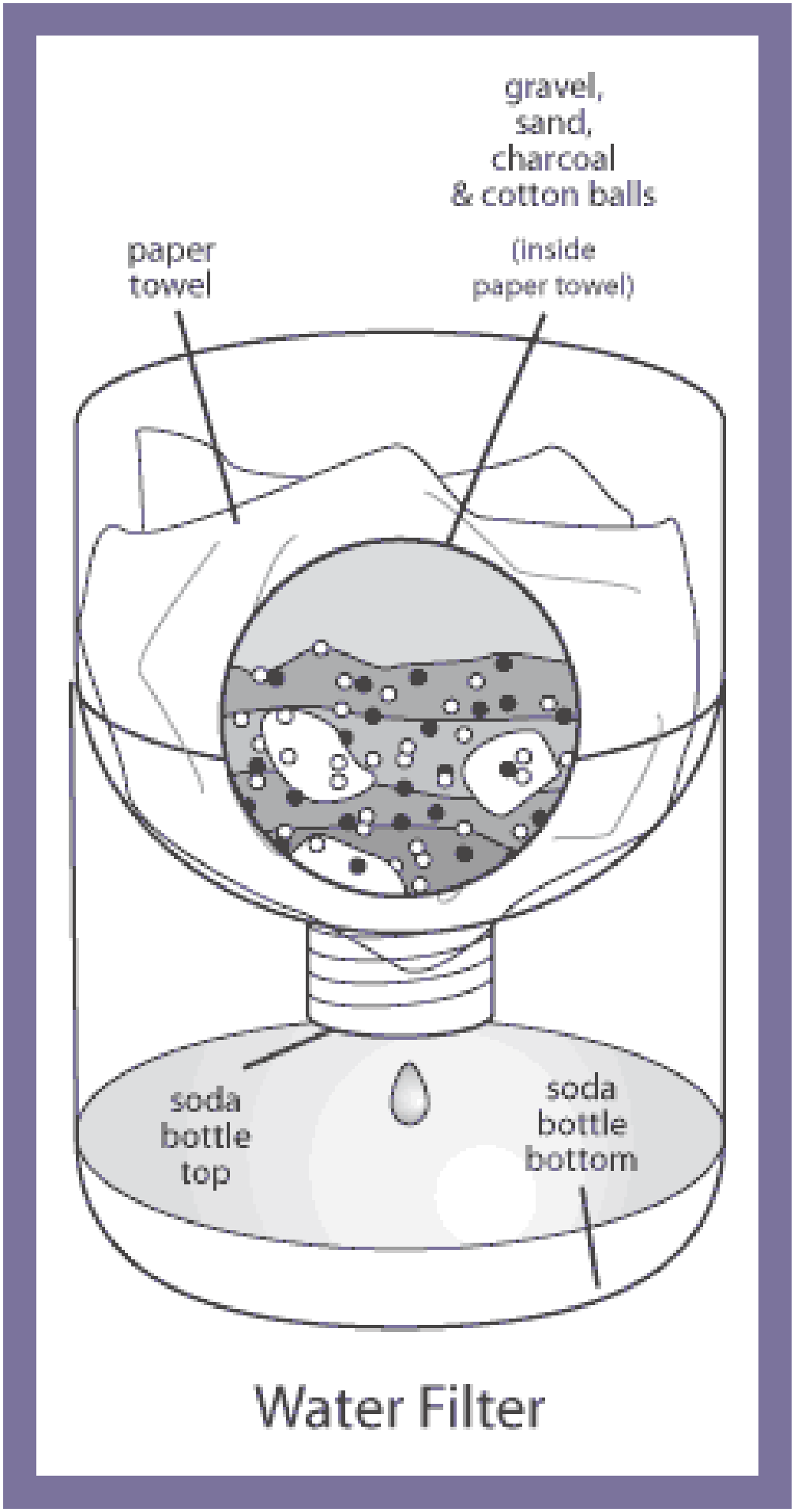
However, the milk from mature coconuts contains an oil that acts as a laxative. Drink in moderation only. In the American tropics you may find large trees whose branches support air plants. These air plants may hold a considerable amount of rainwater in their overlapping, thickly growing leaves. Strain the water through a cloth to remove insects and debris.

Make your own water filter.

What you will need.

2-liter soda bottle cut in half (by an adult)
napkins or paper towels
gravel, sand and cotton balls for your filter
Dirty water, you can make it by adding cooking oil, food coloring, pieces of paper, and tiny pieces of Styrofoam to water

1. Put the top half of the soda bottle upside-down (like a funnel) inside the bottom half. The top half will be where you build your filter; the bottom half will hold the filtered water.
2. Layer the filter materials inside the top half of the bottle. Think about what each material might remove from the dirty water and in what order you should layer the materials. For an added challenge, use only two of materials to build your filter.
3. Pour the dirty water through the filter. What does the filtered water look like?
4. Take the filter apart and look at the different layers. Can you tell what each material removed from the water?
5. Wipe the bottle clean and try again. Try putting materials in different layers or using different amounts of materials.



Water Filter

Tribal Survival Challenges:

Have students:

- Race with a friend to see who can be the first to pour all the water from one cup to the other.
- Try using two strings instead of one to make a water bridge.
- Once you figure out how to transport water across a two-foot gap on the string, try transporting water across the room using only string.
- Race with a friend to see which type of string transports water more quickly and keep track of their data.

Materials:

- Two cups/glasses
- water
- absorbent cotton twine/string (needs to be thicker than thread).
- The follow up experiment uses wax paper, a toothpick, and water.

Procedure:

1. Cut a 2' long segment of the string
2. Fill one cup about halfway with water
3. Soak the string in the water for 10 seconds or until it is soaked through
4. Put one end of the string into the cup with water and hold the other end above the empty cup
5. Hold the cup with water up, using your pointer finger to keep the string at the bottom of the rim as you turn it towards the empty cup
6. Pour the water slowly along the string… watch as it clings to the string and drips off the end into the empty cup! (Be prepared to clean up a little as spilling is bound to happen...)

Explanation:

Water has some special properties, making it a very unique substance. It has both strong "cohesive" and "adhesive" properties. What this means is that water can stick to itself (cohesion) and other things (adhesion). This goes down to the molecular level in how a water molecule looks: it has two hydrogen atoms and one oxygen atom. These atoms end up having positive and negative charges, which cause them to stick to one another. This is why you see raindrops clump

together on your windshield when it rains, why water makes nearly spherical drops, and why it makes a stream of water as it flows down the string in this experiment!

At first, you soak the string in the water, and the water adheres to it. Even though water may drip out of it, it is still soaked in there. That is adhesion. When you pour water along it, you notice the water clings to other water molecules attached to the string, and you see it form a little stream underneath the string. That is cohesion!

What does it take to make the water safe for drinking?

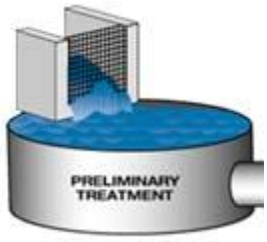
It is one thing to take out the visible contaminants in the water. There is another process needed to take the bacteria out of the water. Ask students questions about how they think these are cleaned from the water they drink.

Possible Contaminant	*Stage(s) of Water Treatment*
Bacteria	Disinfection and Storage
Hydrogen Sulfide Gas	Aeration
Gravel	Coagulation, Sedimentation, Filtration
Viruses	Disinfection and Storage
Sewage	Aeration, Coagulation, Sedimentation, Filtration, Disinfection and Storage
Fertilizers	Aeration, Coagulation, Sedimentation, Filtration
Methane gas	Aeration
Sand	Coagulation, Sedimentation, Filtration
Leaves	Coagulation, Sedimentation, Filtration
Parasitic Worms	Coagulation, Sedimentation, Filtration, Disinfection and Storage
Pesticides	Aeration, Coagulation, Sedimentation, Filtration

The Stages of Water Treatment

PreliminaryTreatment

Preliminary treatment or pretreatment is any physical, chemical or mechanical process used on water before it undergoes the main treatment process. During preliminary treatment:



- screens may be used to remove rocks, sticks, leaves and other debris;
- chemicals may be added to control the growth of algae; and
- a presedimentation stage can settle out sand, grit and

gravel from raw water.

Coagulation

After preliminary treatment, the next step is coagulation. Coagulation removes small particles that are made up of microbes, silt and other suspended material in the water. Treatment chemicals such as alum are added to the water and mixed rapidly in a large basin. The chemicals cause small particles to clump together (coagulate). Gentle mixing brings smaller clumps of particles together to form larger groups called "floc". Some of the floc begins to settle during this stage.

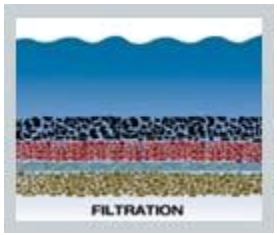
Flocculation

During the flocculation stage, the heavy, dense floc settles to the bottom of the water in large tanks. As you can imagine, this can be a slow process! Once the floc settles, the water is ready for the next stage of treatment.

Clarification

Clarification occurs in a large basin where water is again allowed to flow very slowly. Sludge, a residue of solids and water, accumulates at the basin's bottom and is pumped or scraped out for eventual disposal. Clarification is also sometimes called sedimentation.

Filtration



Turbidity is a physical characteristic that makes water appear cloudy when suspended matter is present. The filtration process removes suspended matter, which can consist of floc, microorganisms (including protozoan cysts such as *Giardia* and*Cyrptosporidium*), algae, silt, iron, and manganese precipitates from ground-water sources, as well as precipitants which remain after the softening process.

These suspended materials are filtered out when water passes through beds of granular material, usually composed of layers of sand, gravel, coal, garnet, or related substances. (Measure

turbidity with a Hach turbidimeter.)

Fluoridation & Disinfection

Fluoride (F^-) is added to water to reduce tooth decay. Fluoridation is an effective, economical process endorsed by many public health groups worldwide. Fluoride is fed into the water system as either a dry powder or in solution. (A Hach fluoride test detects fluoride levels in the water.)

During disinfection, disease-causing organisms are destroyed or disabled. Chlorine (Cl_2) is the most common disinfectant used in the United States because it is practical, effective and economical.

Because chlorine dissipates rapidly, it is important to add the right amount of chlorine at the water treatment plant to make sure disinfection continues while the water is flowing through the distribution system. (Use a USEPA-approved Hach method to measure chlorine in water.)

Holding Tanks

Finished water (the term water treatment professionals use) is stored in holding tanks. The tanks provide a water reserve to meet the changing water demands of the communities they serve.

How can I purify my own water?

Explain to students that once water is found, a major issue remains: is it pure? Is it drinkable? And if not, how to make it drinkable?

In today's world this is a much more complex issue than it was previously. Just 20 years ago in Canada you could still drink water from the streams, rivers, and lakes in the north -- for example, in northern Ontario, including northern Lake Huron and the Bruce Peninsula. However, the spread of Giardia in recent years has greatly increased the risk of drinking water straight from these sources.

Giardia is a non-native organism (actually a cyst) that can seriously debilitate you if you get it. It infects your digestive tract. The primary way it spreads is through the droppings of beaver. However, recent research has suggested that other animals spread it as well.

Additionally, industrial and chemical pollutants are probably more widespread than they were in previous years. Certainly they are more widespread than 50 years ago. And this in spite of increased awareness of the dangers of these!

One important point to remember: segregate the containers you use. Always use a different container for impure water from the container you store purified water in. Never mix the functions of the two types of containers. That is, never store impure water in the container that you are using for purified water, and vice versa.

ASSESSING WATER PURITY

Here are some general rules for water purity. Please bear in mind that these are general rules only. Every situation must be assessed on its own. This section does NOT take into account pollutants (see next section).

- Running water is generally better than still water.
- Water coming out of the ground from a spring is generally more pure than water that has been running over the ground
- Look for clear water
- Avoid water that has algae growing in it
- Avoid discoloured water
- Avoid water in marshes and swamps

POLLUTANTS

The modern world has added a whole layer of complexity when it comes to assessing water purity: human-made chemicals and pollutants. And even if there are no human-made, manufactured pollutants in an area to worry about, human activity such as mining releases elements that may be harmful, such as heavy metals, mercury, cyanide, arsenic, etc.

Here are some general rules to follow. Again, every situation must be assessed on its own.

- Stay away from water that is near roads. Automobile engines spew out a very toxic brew of pollutants that are harmful, and they don't all go up into the air.
- Don't drink water downriver of mine sites, industry, factories, cities and towns, or any human habitation.
- Don't drink water that has passed through agricultural lands - it may contain fertilizers and pesticides.
- **Boiling**
- This is the surest method of purifying water of bacteria and microbes. Sources conflict as to how long it is necessary to boil water to kill all of the harmful microbes. However, it should be boiled at least 5 minutes, and boiling for more like 20 minutes is probably the safest.
- Boiling water requires heat, and therefore a fire of some sort. And as well you will need a container. If you have a fire-proof container, then you can put the water into

the container and place the container on the fire. Otherwise you will need to use rock-boiling.

- With rock boiling you place stones in a fire, wait for them to heat up, then remove them and place them into the container full of water. The water will quickly heat up as the hot rock transfers its heat to the water. You will need enough rocks in the fire to keep adding them to the container of water often enough that the water comes to a boil and stays boiling for the required time (5-20 minutes).

Day 2 Standards Alignment K-8

K

- **7.1.3 Take apart an object and describe how the parts work together.**
- **7.T/E.2 Apply engineering design and creative thinking to solve practical problems.**

Students will design and then deconstruct a water filter. They will work to see if their filter can effectively clean materials from the water.

1st

- **7.T/E.3 Use tools to measure materials and construct simple products.**
- **7.T/E.2 Apply engineering design and creative thinking to solve practical problems.**

Students will be given the challenge to design a simple water filter with provided supplies. It will be up to them to design and effective filter and then deconstruct a water filter to determine if it is working properly. They will work to see if their filter can effectively clean materials from the water.

2nd

- **7.T/E.2 Apply engineering design and creative thinking to solve practical problems.**
- **7.7.4 Identify simple methods for reusing the earth's resources.**

Students will be given the challenge to design a simple water filter with provided supplies. It will be up to them to design and effective filter and then deconstruct a water filter to determine if it is working properly. They will work to see if their filter can effectively clean materials from the water

They will learn how filtering and cleaning water helps us reuse one of the earth's most precious resources.

3rd

- **7.5.3 Describe how environmental factors change over place and time.**

- **7.7.4 Determine methods for conserving natural resources.**

Students will learn about water quality and how it has changed over time. As they create their water filter they will learn how water is filtered today and how this helps us conserve natural resources.

4th

- **7.8.1c Identify the basic features of the water cycle and describe their importance to life on earth.**
- **7.T/E.5 Apply a creative design strategy to solve a particular problem, ex. one generated by societal needs and wants.**

Students will learn about the basic feature of the water cycle. They will learn how water is filtered and then using the materials provided determine the best design strategy to create a homemade filter that is a replica of how water can be filtered.

5th

- **7.2.3a. Establish the connections between human activities and natural disasters and their impact on the environment.**
- **7.T/E.5 Apply a creative design strategy to solve a particular problem, ex. one generated by societal needs and wants.**

Students will learn about the importance of water filters. They will learn how their drinking water is filtered today. They will discuss the importance of good drinking water and discuss how that can be compromised in natural disasters such as floods or hurricanes.

They will then design with the materials provided a filter to clean the dirty water they are given.

6th

- **7.T/E.2 Apply the engineering design process to construct a prototype that meets certain specifications.**
- **7.T/E.1 Identify the tools and procedures needed to test the design features of a prototype.**

Students will learn about the importance of clean water. They will learn about how water is filtered in city water treatment plants. They will then be given the challenge to clean water that is given to them. This water will contain dirt, cooking oil and debris. They will be given their choice of materials from all of the materials needed. They will come up with their own design and test it's effectiveness in cleaning the water. Through this process they will identify the tools and procedures needed to construct their prototype.

7th

- **7.T/E.2 Apply the engineering design process to construct a prototype that meets certain specifications.**
- **7.T/E.1 Identify the tools and procedures needed to test the design features of a prototype.**

Students will learn about the importance of clean water. They will learn about how water is filtered in city water treatment plants. They will then be given the challenge to clean water that is given to them. This water will contain dirt, cooking oil and debris. They will be given their choice of materials from all of the materials needed. They will come up with their own design and test it's effectiveness in cleaning the water. Through this process they will identify the tools and procedures needed to construct their prototype.

8th

- 7.T/E.2 Apply the engineering design process to construct a prototype that meets certain specifications.
- 0.3.5 Construct models of the water cycle.

Students will learn about the importance of clean water. They will draw the model of the water cycle. They will learn where in the cycle the water is cleaned. They will then learn about how water is filtered in city water treatment plants compared to nature. They will then be given the challenge to clean water that is given to them.This water will contain dirt, cooking oil and debris. They will be given their choice of materials from all of the materials needed. They will come up with their own design and test it's effectiveness in cleaning the water. Through this process they will identify the tools and procedures needed to construct their prototype.

Day Three

Rules of Three's

In any extreme situation you cannot survive for more than:

3 minutes without air - 3 hours without shelter

3 days without water - 3 weeks without food.

Being a “survivor” has captured the imagination of millions of TV watchers. But a survivor is much more than a TV fantasy. A survivor is someone prepared to live—and live as healthfully as possible—when life far from home doesn’t go exactly as planned.

Taste the Rain…forest?

What do chocolate, popcorn, cola, and salsa have in common? They are all foods whose ingredients were originally discovered in the rainforest! Did you know that tropical rainforests are the most diverse ecosystems on earth? More than 50% of every plant and animal species on the planet makes their home in the 7% of our world that is covered in rainforest.

While you may never have visited the rainforest, your everyday life wouldn’t be the same without it. An astonishing amount of the food we eat originated in the rainforest. The Kola nut, which provided the original flavor for soda-pop, comes from the rainforest. And can you imagine life without chocolate? An astounding number of fruits (bananas, citrus), vegetables (peppers, okra), nuts (cashews, peanuts), drinks (coffee, tea, cola), oils (palm, coconut), flavorings (cocoa, vanilla, sugar, spices) and other foods (beans, grains, fish) originated in and around the rainforest. Plus, there are many tasty treats that haven’t made it yet to our grocery stores – today we eat about 200 rainforest fruits while indigenous peoples eat over 2,000!

Besides food, many of our most important modern medicines are derived from plants found only in the rainforest. For example, 25% of the active ingredients in today’s cancer-fighting drugs come from rainforest organisms. And since less than 1% of rainforest plants have even been tested by scientists so far, who knows what cures remain to be discovered!

Unfortunately, 500,000 trees are cut down **every hour** in tropical rainforests, and we lose 20,000 to 100,000 species a year… Unless we can protect the rainforest we may never discover many important medicines, not to mention your next favorite snack!

Now it’s time to taste test items as we ‘travel’ that we’ll find in the rainforest or that come from the rainforest & make power bars

Materials:

- Samples of Rainforest fruit, ex.
    - Bananas
    - Citrus (oranges, grapefruit, lemons)
    - Pineapple
    - Mango
    - Avocado
    - Guava

- Chocolate
- Coconut

Arrange small amounts of rainforest fruits for children to taste. Make a chart where students can record their reactions to each rainforest fruit and have them choose vivid and descriptive terms other than 'yucky' or 'good'. Have them imagine they are describing these foods to someone who has never eaten them. (Note: teams can earn points for their survive the tribe competitions by being willing to try every type of rainforest food.)

Eating foods that come from the rainforest is not always good. For instance, in order to make enough orange juice for everyone, some orange juice companies destroy rainforest land to plant orange groves. One thing we can do to help save the rainforests is to drink orange juice made from oranges that are grown in the United States. Orange juice containers will usually say where their oranges are grown. Oftentimes it will say that the oranges are from Brazil, which means they were grown on cleared rainforest land. If that's the case, try to find another brand of orange juice to buy.

Thousands of acres of rainforest are slashed and burned each year to grow grass for cattle pastures. Cows eat this grass and then get butchered and sent to the US to be made into fast-food burgers. For every quarter pound fast food hamburger that comes from the rainforest, 55 square feet of rainforest is destroyed! That's about the size of a small kitchen—and that's just for one hamburger!

Trail Mix Math

Have students try their hand at making their own batch of rainforest trail mix. Give them a math challenge for measurements. Have them make 1/4th or 1/8th or ½ of a batch. Have them measure out their ingredients and make their mix.

Rainforest Trail Mix

1 cup **macadamia nuts**
1 cup **cashews**
1 cup **chocolate** chips
1 cup peanuts
1 cup dried **bananas**
¾ cup **coconut**
1 cup dried **pineapple**

Directions:
Pour items together in a large bowl. Stir until evenly mixed. Serve in small paper cups or plastic bags. Makes about 10-12 servings

Around the World

Quick thinking is needed to survive in the rainforest. Have students test their quick thinking abilities through playing some rounds of around the world.

This game is played with **flash cards** to *improve speed of recall*. You can use multiplication, division, addition, or subtraction cards. Just depends on where your students are. Using more than one operation works well too.

Students sit in a circle, or around a table. The teacher or leader sits where the players can see her. One student, the challenger, gets up and stands behind the person to her right. The teacher holds up a flashcard; the student (of those two) who gives the correct answer first advances to challenge the person in the next seat.

Students can only give one answer; if someone blurts out the wrong answer, the other person has as much time as she needs to think of the correct response. The challenger continues until she makes a mistake, at which point she takes the seat of the person she was competing with, and that person continues around the circle.

When a student has advanced around the circle back to her original seat (either in one turn or over the course of the game, depending on circumstances), she is the winner. Any number of people can win; this game can go on for an indefinite amount of time.

Standards Alignment for Day Three K-8

K

- **K.OA.2. Solve addition and subtraction word problems, and add and subtract within 10**
- **K.OA.5. Fluently add and subtract within 5.**

Students will practice these math skills through the Around the World math problem review game.

1st

- **1.OA.6. Add and subtract within 20, demonstrating fluency for addition and subtraction within 10.**
- **1.OA.5. Relate counting to addition and subtraction (e.g., by counting on 2 to add 2).**

Students will practice these math skills through the Around the World math problem review game

2nd

- **2.OA.1. Use addition and subtraction within 100 to solve one- and two-step problems**

- **2.OA.2. Fluently add and subtract within 20 using mental strategies.**

Students will practice these math skills through the Around the World math problem review game

3rd

- **3.OA.7.Fluently multiply and divide within 100, using strategies such as the relationship between multiplication and division (e.g., knowing that 8 × 5 = 40, one knows 40 ÷ 5 = 8)**
- **3.OA.7.b) Fluently multiply and divide within 100, using strategies such as properties of operations.**

Students will practice these math skills through the Around the World math problem review game

4th

- **4.NBT.4. Fluently add and subtract multi-digit whole numbers**
- **4.NBT.5.a Multiply a whole number of up to four digits by a one-digit whole number**

Students will practice these math skills through the Around the World math problem review game

5th

- **5.NBT.5. b Fluently multiply multi-digit whole numbers**
- **5.NBT.5. a Perform operations (addition, subtraction, multiplication, division) with multi-digit whole numbers**

Students will practice these math skills through the Around the World math problem review game

6th

- **6.NS.2. Fluently divide multi-digit numbers**
- **6.NS.3. Fluently add, subtract, multiply, and divide multi-digit numbers using the standard algorithm for each operation**

Students will practice these math skills through the Around the World math problem review game

7th

- **7.NS1.1 Apply and extend previous understandings of operations, ex. with fractions, to add, subtract, multiply, and divide rational numbers.**
- **7.NS.3. Solve real-world and mathematical problems involving the four operations with rational numbers.**

Students will practice these math skills through the Around the World math problem review game

8th

- **A-APR.1. Add, subtract, and multiply polynomials.**
- **A-APR.7. b Solve real-world and mathematical problems involving the four operations with rational numbers and/or rational expressions.**

Students will practice these math skills through the Around the World math problem review game

Day Four

Tropical soils may often be described as being thin. This is certainly not so - did you know that tropical soils are among the deepest in the world! Many tropical soils have been under forest cover for millions of years. Over this period, and under high rainfall conditions, deep tropical soils have been formed from the underlying rock.

Tropical soils are often several metres deep, but the soils are often washed out, or strongly leached, with large amounts of nutrients and minerals being removed from the subsoils and considerable thickness of rock broken down to produce soil. Over many millions of years this leaching has left most of the soils lacking many of the fundamental nutrients needed by the above ground vegetation.

So how does such a lush vegetation exist if the soils are so depleted of nutrients. The answer lies in the very thin topsoils, made up mainly of decaying vegetal and animal remains. An amazing cycle exists between the huge body of vegetation above ground and this thin topsoil. The rainforest depends for its nutrients on the constant recycling of its enormous biomass.

Plant remains fall to the ground, are consumed and broken down by the huge range of soil organisms in and on the soil, converted by these back into nutrients which can then be used by the dense vegetation above. It is a constant cycle. The thin layer of topsoil is the engine house for the food supply for the tropical forest and, together with climate, is responsible for the maintenance of the huge biomass. This is surely one of the most incredible cycles in nature - and it works.

The tropical rainforest is often in the news for various reasons. There are major concerns about deforestation of it and the consequent damage to the soil. From a soil point of view, cutting down of the rainforest disturbs the natural soil-plant cycle and makes the soils extremely vulnerable to soil erosion and loss of this vital topsoil.

To replicate this deep soil students will have to read and follow ingredients direction to make this delicious jungle snacks, teacher will have to provide a paper with instruction for students to read and learn how to make a Rainforest Dirt Pudding.

What You'll Need per batch:

- 1 Pack of Instant Chocolate Pudding
- Cold Milk
- Oreos
- Rolling Pin
- Gummie Worms

What You Do:

1. Mix the chocolate pudding and the milk together. (Check the box for the exact milk measurement.) Set aside for 5-10 minutes.

2. While you wait for the pudding to set, put some oreo cookies into a ziplock bag. If you plan on using all of the pudding mixture (it will feed about 10 kids – probably more) then use the entire oreo pack. If you're just feeding a few, a row will work (10 cookies or so).

3. Using your rolling pin, crunch the cookies down until they resemble dirt. The more you crunch, the white cream will get mixed in and will not be noticeable.

4. In a cup, put a little bit of the oreo crumbs in the bottom. Then layer some pudding 3/4ths of the way up. Add more oreo crumbs and stick a worm down into the "dirt".

Burning Calories

It is important to stay active and fit to be able to face the challenges of surviving. Guide students through these tribal competitions. Make the best team survive! Tribes get points for completing and participating in all of the competitions. They get extra points for winning!

Find a Lily Pad

Draw and cut several lily pads out of green paper. Spread the lily pads all over the floor and put out one less lily pad than you have players. Play jungle music and have the students hop around the lily pads like frogs. When the music stops, the players must find a lily pad. The person not standing on a lily pad is out of the game. Remove one lily pad for each new round, so there is always one less lily pad than players. The last player standing wins the game. Be sure the person controlling the music cannot see the players, to help keep the game fair.

Monkey Impression

Host a monkey impression contest by judging players on their monkey impressions. Each player stands up one at a time and does his best imitation of the sounds and actions a monkey makes**.**

Jungle Fruit Bop

The children pass around the jungle fruit (balloons of different shape and size) while dancing to the music. When the music stops all the explorers grab a fruit and freeze. You then pull a child's name out of the bag and that child must pop open their fruit and complete the jungle challenge inside. These challenges are simple and fun and geared to their age level. Some fun challenges can include:

- Acting like a monkey, lion, snake, bear etc.. for 30 seconds.
- Rub your tummy and pat your head at the same time.
- Give a bear hug to the person standing next to you.
- Sing your favorite song.

- Stand on your head.
- Stand on one foot and clap your hands.
- Crabwalk across the floor.
- Stuff a marshmallow in your mouth and sing your abc's

Use your imagination when coming up with challenges and give prizes out for effort. Have twice as many balloons prepared as there are players. This ensures every child has a balloon when the music stops. Start with one balloon for every child then add one after every round.

Catch a Lion by its Tail

Another game that will go great with your jungle/ safari theme is catch a tiger by his tail. It has all the fun of a piñata without the frustration! You (or another fun spirited adult) must play the loin. You don't have to wear a full lions costume but you will need a tail. The guests must chase the lion and, you guessed it, try to catch her by the tail. When she is caught she throws out candy and escapes again while all the children are collecting scooping it up. Then the chase is on again! This game continues until all the candy is gone. To make a tail you can use something as simple as a scrap of cloth or rope tied around your waist with a long piece hanging down the back.

Jungle Obstacle Course

In this jungle game the children must make it through our Jungle obstacle course to save the baby animals and return them to their mother. You can create obstacle out of so many things. You can even put mini games into the course. Here are just a few ideas:

- Running through hula hoops
- Jumping on a pile of cushions or pillows (a great finale)
- Limbo limbo limbo!
- Feed the hippo (use toy balls for the food and a bucket or basket for the hippo)
- Pop a balloon
- Make it through the quicksand (make rocks from cheap metal bowls from the dollar store or even cut from poster board). They must step on the rocks avoiding the quicksand (ground) to get to the next obstacle

Lilypad Relay

- For this safari game you'll need four lily pads, two for each team. You can make these out of green poster board. Divide the players into two teams. One person from each team goes at a time. They must use their lily pads to make it to the finish line and back without touching the ground. They do this by hopping on one lily pad the putting the other in front of them and hopping on that. When they return to the start they pass the lily pads to the next player. The team that finishes first wins.

Standards Alignment for Day Four K-8

K-2nd Grade

5.2.2 work on assigned tasks individually or with others in a productive manner

1.2.21 Demonstrate obedience to guidelines and behaviors for basic safety principles in physical education (implements, small and large equipment, environment)

7.T/E.3 Use tools to measure materials and construct simple products.

These standards will be met through the physical challenge activities. All students will be instructed on the rules and safety procedures. Teams will lose points for unsportsmanlike conduct, disobeying the rules, non-participation, or other infractions.

Students will tasked with reading, or listening to oral instructions, and following those instructions precisely to make the Rainforest dirt snack. They will have to measure ingredients to the correct volumes using the appropriate tools.

3rd-5th Grade

1.2.9 identify and apply safety principles in all activity situations

5.2.2 complete assigned tasks individually or with others in a productive manner

These standards will be met through the physical challenge activities. All students will be instructed on the rules and safety procedures. Teams will lose points for unsportsmanlike conduct, disobeying the rules, non-participation, or other infractions.

6th-8th Grade

5.2.2 Work cooperatively with a group to achieve group goals in competitive as well as cooperative settings

6-8.3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

These standards will be met through the physical challenge activities. All students will be instructed on the rules and safety procedures. Teams will lose points for unsportsmanlike conduct, disobeying the rules, non-participation, or other infractions.

Students will tasked with reading and following instructions precisely to make the Rainforest dirt snack. They will have to measure ingredients to the correct volumes using the appropriate tools.

Academic Vocabulary Guide

K

- Air
- Animal
- Change
- Collect
- Growth
- Observe
- Senses
- Soil
- Sun
- Tools

1st

- Balance
- Environment
- Insect
- Investigate
- Invent
- Light
- Mixed
- Precipitation

2nd

- Depend
- Distance
- Observation
- Habitat
- Organism
- Renewable
- Non-renewable
- Transform

3rd

- Conservation
- Mixture
- Rain gauge
- Atmosphere
- Water cycle
- Threatened
- Thriving

4th

- Camouflage
- Climate
- Condensation
- Ecosystem
- Erosion
- Physical change
- Radiant energy
- Transparent

5th

- Photosynthesis
- Implied
- Point of view
- Visual Image

6th

- Atmosphere
- Biome
- Cause
- Effect
- Control
- Design Constraint
- Energy
- Protocol
- Prototype
- Abiotic
- Biotic

7th

- Respiration
- Tissue
- Phenomenon
- Urbanization
- Impact

8th

- Order
- Species
- Consumption
- Human Impact
- Interdependence
- Exchange