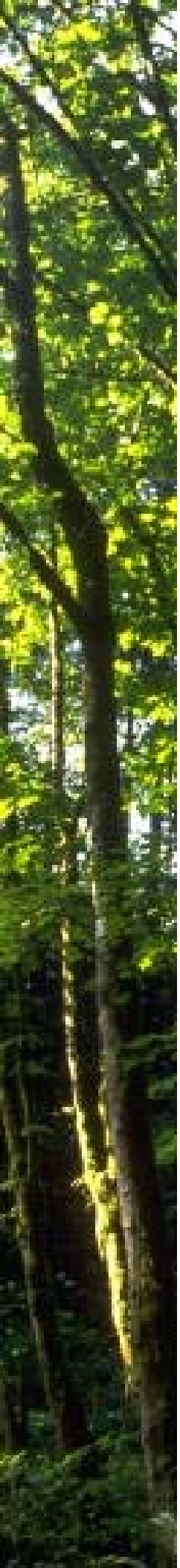

Rain Forest Teaching Curriculum

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Welcome to Rain Bird's Rain Forest Teaching Curriculum!

The Rain Bird Rain Forest Teaching Curriculum features "I can relate to that" science learning tools for teachers, students, and parents. The following is a list of answers to some frequently asked questions about the Rain Bird Rain Forest Teaching Curriculum:

What is it?

Rain Bird's Rain Forest Teaching Curriculum is an online educational tool for teachers to use and find specific lesson plans and related course work for kindergarteners through high school seniors. This content is also available online at www.rainbird.com.

What is its purpose?

To teach natural history, ecology, biology, physics, and chemistry through demonstrations, experiments, and classroom activities. Rain Bird and California State Polytechnic University, Pomona (Cal Poly Pomona) designed the program content, which focuses on endangered tropical rain forests in Latin America, South America, Africa, and Southeast Asia as the basis for teaching science through fun, hands-on things children already do and like—art projects, outdoor activities, and classroom demonstrations. The curriculum motivates kids to think about the part each of them plays—or the actions they can take—in preserving and protecting the environment.

Who should use it?

Teachers and parents. Teachers who are seeking a new, fun and engaging resource to teach children about science. Parents who are looking for friendly, but educational how-to's on "bringing science home." But most of all, it offers something for just about anyone and it's just plain fun for kids, no matter what their age.

Is the information easy to use?

Yes! The information is well organized and self-explanatory. The curriculum is arranged with grade-appropriate material (K-1, 1-2, 2-3, 3-4, 4-5, 6, 7, 8, and 9-12). As appropriate, each grade level contains projects that integrate science with art; data gathering, observation, and inference; analysis of physical matter; in-class demonstrations to be performed by teachers for students; and at-home projects that illustrate scientific principles in a manner both understandable and meaningful to school-age children.

Why the focus on rain forests?

Rain Bird has always supported and educated its consumers on the importance of the "Intelligent Use of Water." The curriculum ties into this philosophy because rain forests provide oxygen and consume carbon dioxide, playing a pivotal role in the climate control of our planet. This affects wind, rainfall, humidity, and temperature worldwide. Rain Bird is deeply concerned about the environment and has always promoted stewardship of Earth's resources, or which water is among the most precious. Some 30 million species of plants and animals—a majority of all things living on Earth—exist interdependently in tropical rain forests. In addition, rain forests are rich with plants vital in creating modern medicines.

What has the response to the curriculum been?

Thousands of online visitors each month learn about the important role tropical rain forests play in the world. And, because the information is being so well received, Rain Bird has expanded its commitment to university-level education through its partnership with California State Polytechnic University, Pomona. Jointly, they will unveil in 2002 three Rain Bird Learning Centers at Cal Poly Pomona's BioTrek Project, located on the Cal Poly campus.

About Rain Bird

Rain Bird Corporation, based in Glendora, California, USA, is the world's largest manufacturer of sprinkler and drip irrigation equipment. Founded in 1933, Rain Bird offers the industry's broadest range of irrigation products to golf courses, sports arenas, amusement parks, farms, and commercial and residential developers in more than 130 countries. For more information, visit Rain Bird's web site at www.rainbird.com.

This workbook is brought to you through a partnership between:

Rain Bird, Azusa, California

Science IMPACT, College of Science,
California State Polytechnic University, Pomona

The Rain Forest: An Introduction

What is a tropical rain forest?

A tropical rain forest is a forest that receives 4 to 8 meters of rain each year.

Where are tropical rain forests located?

Rain forests are located within a narrow region near the equator in Africa, South and Central America, and Asia.

Why are tropical rain forests important to our earth?

Rain forests play an important role in the climate control of our planet by having an affect on the wind, rainfall, humidity, and temperature. Within the rain forest, water, oxygen, and carbon are recycled. This natural recycling helps to reduce flooding, soil erosion, and air pollution.

The rain forests support over one half of the plant and animal life on Earth, even though they cover only 2% of the Earth's surface.

Approximately one fourth of the pharmaceuticals (medicines) we use come from plants of the tropical rain forests. According to the National Cancer Institute, 70% of the plants from which we make medicines and that are effective in the treatment of cancer can only be found in the rain forests.

What is happening to our rain forests?

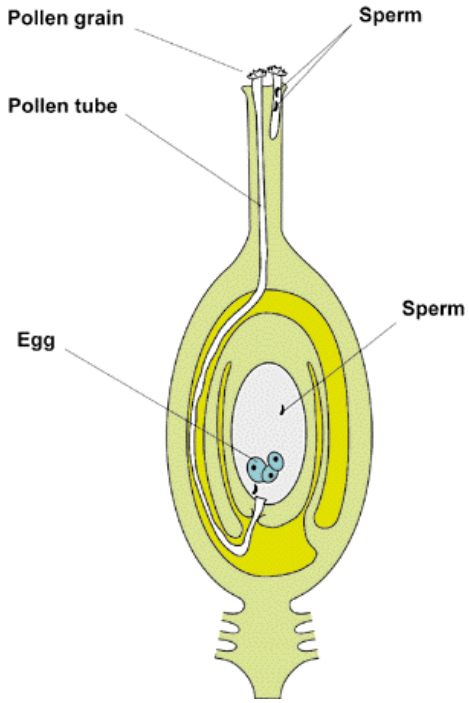
27 million acres of the Earth's rain forests are destroyed each year due to man. The activities which threaten the rain forests are: agriculture, clearing and developing of land, beef cattle ranching, logging, and the building of dams and hydroelectric plants. This results in a loss of 100 acres of rain forest per minute and 80% of the rain forests in the world are now gone. The destruction of the world's rain forests at this rate causes 10,000 plant and animal species to become extinct each year.

Grades 6-8 Activities Overview

The tropical rain forest is a wonderful environment to learn not only about natural history, ecology, and biology, but also physics and chemistry. So much goes on in the rain forest and so many plants and animals live there (approximately 50% of the plant and animal life on the planet) that exclusive existence on the ground is impossible for the abundance of species. That is why the rain forest exhibits a layering of habitats, or canopy. There are many plants and animals, including insects, which never spend any part of their lives on the ground. These plants and animals have developed very specialized adaptations that allow them to compete successfully for all of the resources they require to thrive.

As we look at our planet, we can observe that the closer we move to the equator, the greater the abundance of life. The tropical rain forests, which exist in the narrow band around our Earth called the equator, are environments that require all plant and animal species to become very specialized in their strategies for acquiring food, water, reproduction opportunities, and all aspects of survival, because the competition for these resources is so great. This is very different from other areas of our planet, farther north and south from the equator, where the concentration of life is less dense. In those areas, it is more advantages to have very general adaptations and to be able to utilize many different strategies and resources. In other words, survival depends on being a generalist. Indeed, the rain forest can be a study in economics—supply and demand.

It is interesting to note that many of the species living in the tropical rain forest have yet to be discovered. In this portion of the Rain Bird Rain Forest Curriculum, we will be making our own discoveries, as we explore the sciences in the context of the highly specialized adaptations that all life forms exhibit in this fascinating environment. At each grade level, there are three activities for students and one in-class demonstration to be presented by the teacher.



Grade 8 Activities At a Glance

- Activity: Growing Pollen Tubes and Pollen Examination Under the Microscope
- Activity: DNA Extraction from Strawberries and Bananas
- Activity: Making a Fish Print to Study External Morphology Characteristics
- Demonstration: Buoyant Forces and Stratification in Rain Forest Lakes

Grade 8 Activity: Growing Pollen Tubes, Pollen Examination Under the Microscope

Plants have evolved elaborate flowers to enhance their chances of attracting pollinators to vector pollen from one flower to the next in order for fertilization to occur. All flowers, no matter how beautiful we find them or how great we think they smell, exist for one purpose and one purpose only, to set viable seed for reproduction of the species. This is a fascinating area of study and we will focus on one small part of it—pollen.

We will not only collect and examine pollen, but we will also grow pollen tubes, the tiny structures that must grow once the pollen reaches the stigma on the top of the pistil of the female reproductive parts of the flower. Pollen is produced in the anthers, which are the male reproductive structures of the flower. When the pollen is vectored by the wind, insects, birds, or even bats, and deposited on the stigma of the same species, a chemical signal triggers the growth of a pollen tube. It is down this tube that the sperm travels in an effort to reach the ovules and fertilize the eggs inside. Once the egg is fertilized, a viable seed develops and a new plant life begins.

Materials:

Glass microscope slides, petroleum jelly, flowers, microscope, sugar, water, shallow dish with glass cover or plastic wrap, hand lens or dissection microscope.

Procedure:

1. Make a strong sugar solution and place it in a petri dish or other shallow dish (like a saucer), cover with lid or plastic wrap.

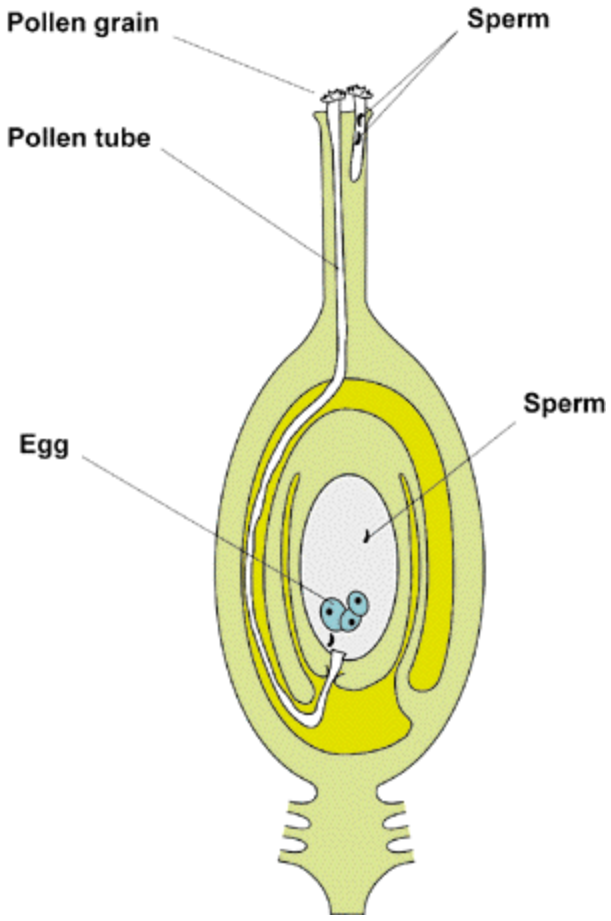
2. Shake pollen from flowers (select several kinds to ensure success) onto the surface of the sugar water. Cover with a glass lid or plastic wrap and let stand in a warm place for several hours. Pollen tubes will appear.

3. Examine some pollen by smearing a little petroleum jelly on a glass microscope slide and shaking the pollen onto the jelly.

4. Focus on several pollen grains and make sketches.

Questions for Students:

1. How would you describe the pollen grain?
2. Does your description give you any clues as to why people suffer from pollen allergies? Why or why not?
3. Describe the pollen tube and a make a sketch.
4. Do a little extra research and create a labeled diagram of the flower, identifying the male and female reproductive parts.
5. If a flower is long and tubular, what type of organism would most likely pollinate it?
6. When bees, birds, or other organisms pollinate flowers they are unaware that they are providing this "service". So why do they go from flower to flower? What attracts them?



Notes to the Teacher:

You may want to grow the pollen tubes a day ahead of time to make certain that you have them available when you need them. In the K-3 section of the Rain Bird Rain Forest Curriculum there is an activity for building a flower model that you may want to incorporate here. It is an activity that is adaptable to any grade level.

Grade 8 Activity: DNA Extraction from Strawberries and Bananas

All living things contain DNA (deoxyribonucleic acid—the genetic code material of cells). It is the DNA that determines all of the unique characteristics of species and accounts for the great biological diversity of organisms on Earth. Any research into the study of recombinant DNA (genetic research) requires the first step of isolating this molecule. Extracting DNA can be a complex and lengthy process, even when working with plants. However, Dr. Kristin Bozak in the Biological Sciences Department at California State Polytechnic University, Pomona has developed the following simple but effective way of isolating and extracting DNA.

Materials:

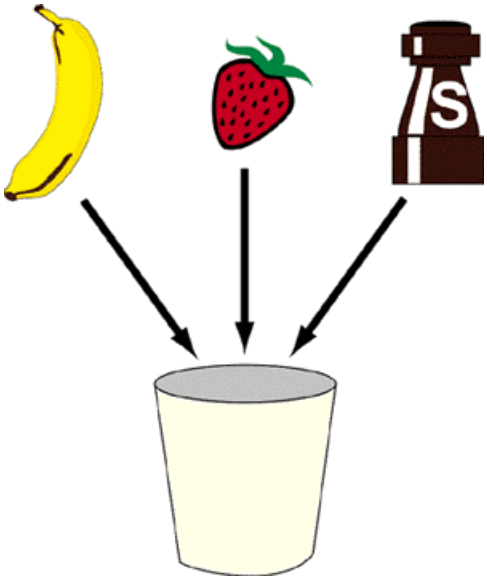
Plastic cup with a mashing rod or a spoon, or a mortar and pestle, funnel, plastic cup for catching liquid, glass rod or plastic "swizzle stick", one third of a banana and/or 3 to 6 strawberries, water, tablespoon of salt, a few drops of liquid dish washing detergent (Dawn works well), several layers of cheese cloth, about 200 ml of 91% rubbing alcohol (available from the drug store).

Procedure:

1. Place 1/3 of a banana and 3 to 6 strawberries in a cup and mash into a pulp. The back of a spoon against the side of the cup works well if you go not have a mortar and pestle handy. This mashing process separates the cells and breaks up the cell walls.

2. Add an equal amount of water to the volume of the mashed fruit so that you have a rough 50/50 mixture of fruit and water.

3. Add 50 grams (one tablespoon) of salt to make the solution of fruit and water about one molar. Continue to mix and mash to further break down the cell walls, cell membranes and nuclear membranes in order to release the DNA from the nuclei of the cells.



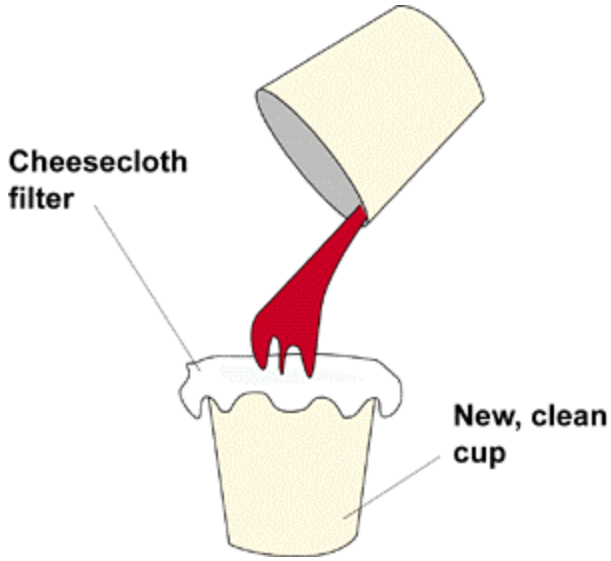
4. Add a few drops of liquid dish washing detergent—this will aid in the breaking down of the cell membranes, along with the salt. The salt also helps to bring the DNA together in order to precipitate out of solution.

5. Filter this mixture through several layers of cheesecloth into a plastic cup.

6. Measure the liquid (use a graduated cylinder or a measuring cup) and double the volume by adding the 91% isopropyl rubbing alcohol.

7. Spool the DNA on the glass rod or "swizzle stick". It will spool as you slowly stir the solution.

8. Remember, this is a very simple process and any cellular components that are not alcohol soluble are still included. To further purify this extract would require hazardous chemicals that are not necessary for our purposes here.



Questions for Students:

1. Do textbook or Internet research and determine the "building blocks" of the DNA molecule.

2. Draw a diagram of the DNA molecule and label its components (you will need your text book or the Internet as a resource).

3. Describe the chemical reaction you observed (that is, describe what you saw occurring) when you began to spool the DNA.

4. If time permits, try this experiment again with a different type of plant material and work on refining your lab skills to produce the best possible extraction of the DNA.

Notes to the Teacher:

Goggles should be worn while working with the isopropyl alcohol. This activity is a great way to introduce the topic of protein synthesis.

Grade 8 Activity: Making a Fish Print to Study External Morphology Characteristics

Numerous species of fish exist in the tropical rain forests. Fish, like all of the rain forest species, are a vital link in the complex ecological web of this threatened biome.

This activity is designed to be done prior to a standard laboratory fish dissection. It could also be done as an integration with art. The object is to gain an appreciation and understanding of the external characteristics of the fish (whatever species you decide to dissect—perch is the most commonly used in the lab). This activity also serves the purpose of creating a permanent record of the fish's external morphology.

Materials:

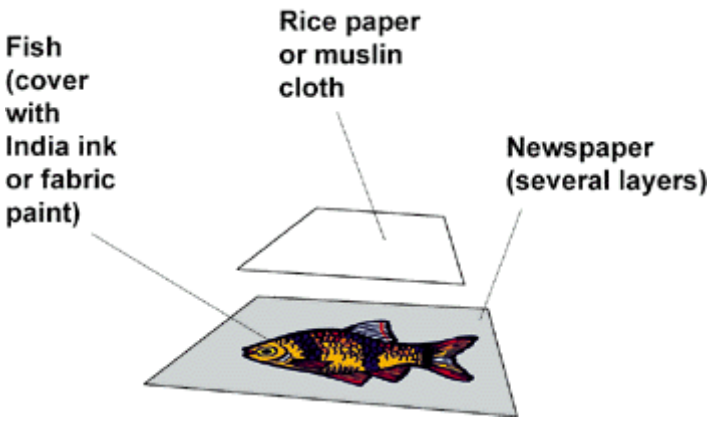
Fish (from scientific supply house or supermarket seafood counter), rice paper or muslin cloth (cut in 8 ´ 10 inch squares, or large enough to accommodate the fish being printed), India ink, or fabric paint, paint brush. All of these materials are available from the craft store, with the exception of the muslin cloth, which can be purchased from a fabric store.

Procedure:

1. Lay the freshly rinsed fish on several sheets of newspaper and pat it dry with paper toweling.

2. You can choose to do the following procedure by using rice paper and India ink or muslin fabric and fabric paint. Paint the fish with either ink or fabric paint (most craft paints work well). Apply a sheet of rice paper (if you are using ink, fabric paint if you are using muslin cloth) to the fish and gently press, without smearing.

3. Gently pull the rice paper or fabric away from the fish and let dry.



Questions for Students:

1. How many fins does your fish have? What do suppose the function of each fin is in terms of aiding the fish to maneuver efficiently in the water?

2. Do the scales of the fish appear to grow from the head toward the tail, or from the tail toward the head? Why do the scales grow in the direction you described?

3. Make a simple sketch of your fish. Measure the length, the width (at the widest point), and the distance from the mouth opening to the dorsal, pectoral, and side fins. Now calculate the percentages of these distances compared to the total length of the fish. Example: If the fish is 24 cm long and the dorsal fin begins at 10 cm from the mouth opening, the dorsal fin begins at 42% of the fish's total length.

Notes to the Teacher:

Remind students to wash their hands well after handling the fish. If you are using preserved fish from a scientific supply house, make the certain that the room is well ventilated due to the odor of the formalin preservative.

Grade 8 Demonstration: Buoyant Forces and Stratification in Rain Forest Lakes

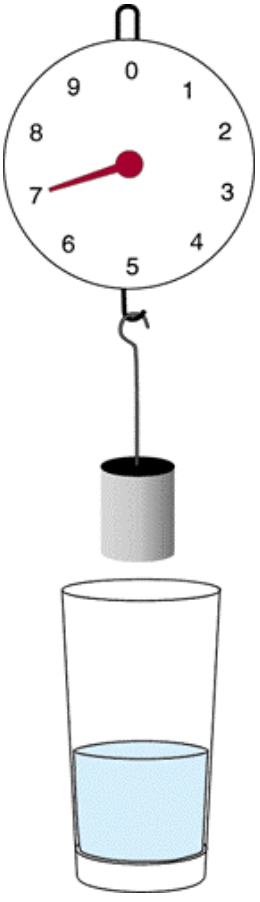
One of the most puzzling events of recent years was the sudden release of carbon dioxide gas from Lake Manoun in 1984 and Lake Nyos in 1986. Both lakes are located in the rain forest country of Cameroon, Africa. Over 1700 Cameroonians died in these events. Several questions can be addressed for scientific investigation of the cause of these events:

- No such other event has been recorded, yet two different lakes exhibited this event only two years apart—Why?
- Both events occurred in August—Why?
- Death from the event occurred up to 26 km away from the lakes—What was the mechanism for these deaths?
- Why did the lakes hold large amounts of carbon dioxide?
- Could this happen in other lakes?

One of the most important concepts for understanding the Cameroon disasters is that of the buoyant force, which we will investigate in this group of demonstrations.

Part 1—Observing the Buoyant Force

This first demonstration will show students direct evidence of the buoyant force. As a mass hanging from a spring scale is dipped into water, the reading on the scale decreases. The upward buoyant force from the water on the mass results in a smaller force from the spring. Be sure to stress the importance of the relative density of the object and the water in a discussion of floating and sinking.



Materials:

Hanging spring scale, metal object with hook, transparent glass or cup, water.

Procedure:

1. Fill the cup with water to a level such that it will not overflow when the metal object is immersed in the water.

2. Hang the metal object from the spring scale.

3. Face the spring scale toward students, and slowly dip the object into the water.

4. Have the students watch the spring scale reading as the object sinks deeper into the water.

Questions for Students:

1. Imagine that the cup is sitting on a second spring scale while the object is lowered into the water. What would happen to the reading on this spring scale?

2. Does the object become completely submerged? Why? Explain what would happen in this demonstration if the object were made of wood.

3. Suppose the demonstration were repeated with an object of a different metal. Which would be the same for the two metals—the difference between the initial and final scale readings, or the ratio of the initial and final scale readings?

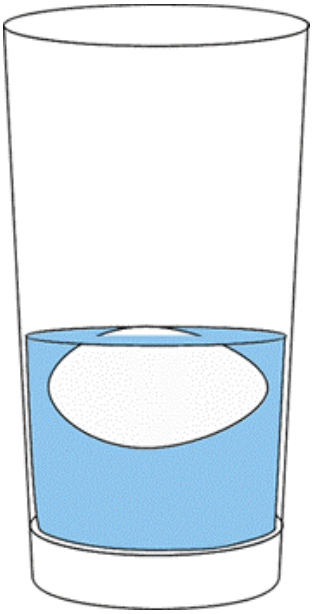
Part 2—Stratification in Water

One of the major contributions to the Cameroon disasters was the steady-state stratification of water in the lakes. This demonstration shows one result of stratification in water.

Materials:

Egg, distilled water, salt, clear drinking glass.

Procedure:



1. Fill the glass half full with distilled water. Add salt to the water and stir. Keep adding salt until no more salt will be dissolved, and salt begins collecting on the bottom of the glass.

2. Lower the egg into the salt water. It should float.

3. Gently add some fresh water on top of the salt water until the glass is full. You might want to pour the fresh water over the back of a spoon so that the fresh water sprinkles down gently onto the salt water. The important consideration is that the fresh and salt water mix as little as possible. You should be able to create a layer of salt water and a layer of fresh water above it, with the egg floating at the interface between the two layers. You can add a drop or two of food color to the fresh water before adding it to the cup in order to make the appearance of the stratification more dramatic.

Questions for Students:

1. What physical quantity is different in the water above and below the egg?
2. Would it make a difference if the egg were boiled?
3. What would happen if the glass were allowed to sit for a long time? Why?

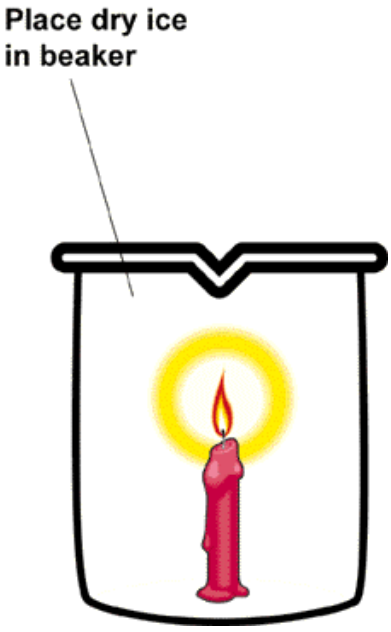
Part 3—Does Carbon Dioxide Float on Air?

Once the carbon dioxide was released from the lakes in Cameroon, it stayed close to the ground rather than rising into the atmosphere. This is what killed the individuals and animals near the lakes—they suffocated from lack of oxygen. This demonstration shows this effect, which is due to the fact that carbon dioxide is denser than air. It stresses the fact that the buoyant force is a consideration for gases as well as solids and liquids.

Materials:

Beaker, candle, dry ice.

Procedure:



1. Fasten a candle to the bottom of a beaker and light the candle.
2. Drop a few pieces of dry ice into the bottom of the beaker. The candle will go out in a few moments.

Questions for Students:

1. Why did the candle go out? Is this because of the drop in temperature?
2. How tall would the candle have to be relative to the beaker for it not to be extinguished?
3. What if a helium balloon were allowed to leak into the beaker—would the candle go out?
4. Why is the air warmer near the ceiling of a room than near the floor? Why are ceiling fans operated in the winter if you are trying to warm up the air?
5. How does this demonstration explain why so many Cameroonians died in the Lake Manoun and Lake Nyos disasters?

With the understanding from these demonstrations, we can now answer some of the questions about the Cameroon disasters. In a lake located in a temperate zone such as the United States, there are significant temperature variations during the day and during the entire year. For example, imagine the sun going down in the evening. As the temperature of the surface water drops, because of the absence of sunlight, the water contracts and becomes denser. This denser water sinks, and the warmer, less dense water below rises to the top. Thus, there is a process, based on the buoyant force, which tends to mix the upper and lower layers of water.

Lakes Monoun and Nyos have two characteristics that contributed significantly to the disasters. First, they are very deep, so that it is difficult to mix the various layers of water over such a large vertical distance. This factor also results in a very large pressure at the bottom of the lake so that a large amount of carbon dioxide can be dissolved into the water from local rocks and deep springs. Second, both lakes are located in an equatorial rain forest region where the temperature variation is much smaller than in the temperate zones. This results in little driving force to mix the layers of waters in the lakes. The result is major stratification of the water. The water that is near the bottom of the lake stays there for a long time and collects a large amount of dissolved carbon dioxide. Without a mixing process, this carbon dioxide cannot be brought to the surface with the water and released safely. It simply continues to increase in concentration.

The situation described is explosive. If the carbon-dioxide-laden water were to be brought to the surface where the pressure is much lower, the gas will expand and come out of solution rapidly. This is what happened in 1984 and 1986, although the exact cause of the breakdown in the stratification is not known. The stability of the situation is weak. Once there is any small breakdown in the stratification and carbon dioxide comes out of solution, the bubbles will rise through the water and cause more mixing of layers.

If there were a temperature decrease of the surface water, this water would become denser and will sink, possibly triggering the release of carbon dioxide and the beginning of the explosive situation described above. The monsoon season in Cameroon is in August. Monsoon clouds block the sunlight, resulting in lower surface water temperatures—this may be the reason that the disasters occurred in August. Climate data for Cameroon show lower than normal temperatures and higher than normal rainfall in the mid-1980s. The resulting decrease in surface temperature could explain why these events occurred in 1984 and 1986. The exact reasons for the sudden release are not known and remain an area of active research.

Finally, once the carbon dioxide was released from the lakes, it stayed near the ground because it is denser than air, as seen in the third part of the demonstration. Thus, a layer of carbon dioxide gas spread out over the land around the lake, representing a deadly suffocating gas for all organisms requiring oxygen in its path.