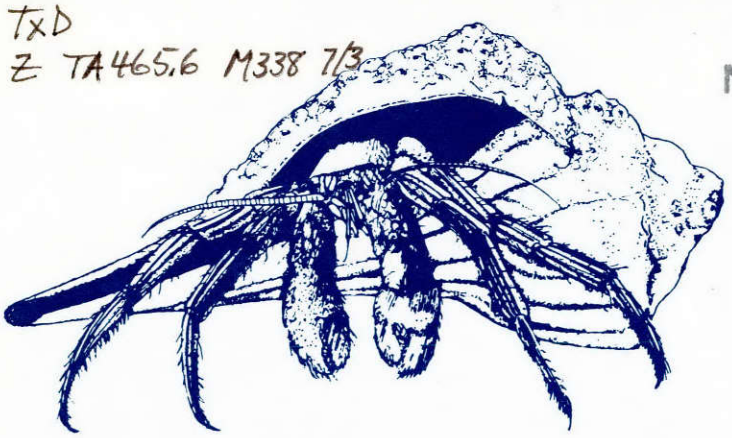

Marine Education

A COOPERATIVE EFFORT OF THE TEXAS A&M UNIVERSITY SEA GRANT COLLEGE PROGRAM AND DEPARTMENT OF EDUCATIONAL CURRICULUM AND INSTRUCTION

NSF reveals Science Week plans

The National Science Foundation has announced its third National Science and Technology Week for April 5-11, 1987. The Week will include nationwide programs and activities designed to get the general public, and particularly young people, interested and involved in science, mathematics, engineering and technology.

National Science and Technology Week '87 involves numerous corporations, professional associations, museums, libraries, research centers, community groups, schools and universities. Highlights of the week's events include:

° A launch of 200,000 balloons at the beginning of the week, with weather cards to be returned by the finder. Those interested in participating should contact Triangle Coalition, attention Dr. Livermore, National Science Teachers Association, 1742 Connecticut Ave., N.W., Washington, D.C. 20009.

° A traveling exhibit on biological diversity, produced by the National Science Foundation and the Smithsonian Institution. For further information on the exhibit, entitled *Diversity Endangered*, as well as showing dates and locations, write Smithsonian Institution, SITES, Washington, D.C. 20560.

° A national art competition for high school seniors, *The Art of Science*, that will culminate during the week. Contact Nan Smith or Wendy Jacobsen, National Science Foundation, 202/357-9838, for more information.

° Educational activity packets that will help students explore scientific concepts, to be distributed to elementary and middle/junior high schools in every state. These kits will include teaching activities with hands-on experiments, and are designed to help students explore important concepts in science and technology.

National Science and Technology Week coordinators also suggest that students assume the character of a famous scientist or engineer to re-create, or even anticipate, a great moment in science. Students also could produce a science-related video or radio broadcast, or a special newspaper with scientific games, puzzles and stories.

One suggestion for more advanced classes is to have members work with younger students on a topic, such as camouflage in nature, to create camouflage designs for various backgrounds.

The first two National Science and Technology Weeks, in 1985 and 1986, were held in May, but Week coordinator Mary Keeney said this was too

(See Science, page 7)

You don't have to be an Einstein to get involved in National Science and Technology Week–April 5-11, 1987

Vol. 7 No. 3 March 1987

CEE issues final cleanup report

The final report on the results of the 1986 Beach Buddy cleanup day sponsored by the Center for Environmental Education (CEE) last September was released prior to a press conference held Feb. 17 in Austin, Tex. CEE staff members from the national office discussed the findings during the conference, and Linda Maraniss, director of the Gulf Coast Regional office, announced that another cleanup day will be held Sept. 19, 1987. This will coincide with the beginning of the national Coast Weeks' observance.

According to the report, 2,772 Beach Buddies collected 140 tons of debris during a three-hour cleanup in September. Volunteers also collected information on the type and amount of debris. This information and input from members of the Texas Coastal Cleanup steering committee provided the basis for the report, which includes governmental and industry recommendations for reducing the beach debris crisis in Texas.

Approximately 171,479 items were collected statewide. Plastic items comprised 56 percent of the debris, with plastic bottles being the most commonly found item, followed by plastic bags.

Maraniss said it was often difficult to trace items to particular sources, and in many cases it was impossible to tell if certain items were on the beach as a result of offshore or on-shore littering. Some specific items were selected as "indicator" items, however, due to their known association with particular activities conducted in the Gulf. Sources of offshore-generated trash included cargo wastes (plastic sheeting, wooden pallets, crates and rope), galley-type wastes (egg cartons, milk jugs and vegetable sacks), operational goods (write-enable rings, hard hats, lightbulbs, gloves and drums), and fishing gear (nets, buoys, fishing line and light sticks). Detailed information about these items and percentages of each are discussed in the report.

One chart in the report lists all debris items recorded on the data cards. A sample of these numbers includes 398 diapers, 10,358 plastic six-pack holders, 1,435 fishing nets, 5,308 milk jugs, 11,837 glass bottles and 1,561 unbroken light bulbs.

Maraniss will coordinate the 1987 event and is already looking for interested volunteers to serve as zone captains. The 1986 cleanup extended from Boca Chica and South Padre Island in South Texas to Beaumont and McFadden Beach near the Texas-Louisiana border. Those interested in helping with the 1987 cleanup should contact Maraniss at 1201 West 24th Street, Austin, Tex. 78705, (512/477-6424).

Similar beach cleanup efforts are held in nearly every other coastal state as well as in Texas. Those interested in participating should contact the national CEE office (624 9th St., N.W., Washington, D.C. 20001) or the national coordinator for Coast Weeks, Barbara Fegan (Off West Road Box 545, South Wellfleet, Mass. 02663).

Photodegradable carriers now available

At least one company recognizes the environmental impact of plastic six-pack carriers. Hi-Cone, a division of Illinois Tool Works, Inc., of Itasca, Ill., is manufacturing photodegradable carriers that gradually break down when exposed to sunlight.

According to Hi-Cone, ultraviolet energy from sunlight breaks down the plastic material's complex long-chain molecules into shorter chains. As the material's moleculer chains are broken, the action of wind and rain causes the carrier to crumble into polyethylene dust. This method does not result in any toxic or harmful byproducts or inhibit normal degradation in a landfill.

The amount of time required for the plastic to degrade varies from one area of the country to another and also from season to season, depending on the amount and intensity of exposure to sunlight. The plastic becomes brittle and weak after as little as 30 days of average exposure.

Photodegradable carriers are identified by a small diamond embossed on the carrier in the area adjacent to the finger hole.

Tinnin plans two more workshops

Rick Tinnin, marine education coordinator at The University of Texas Marine Science Institute in Port Aransas, has two remaining weekend workshops scheduled, one April 10-12 and the other May 8-10. The topic for the April workshop has not been selected, but the May session will focus on Texas' coastal birds.

Each workshop is limited to the first 35 paid participants. The total cost is $45, which includes registration, dormitory space and all meals. Further information is available from Tinnin by writing Marine Education Services, Marine Science Institute, Port Aransas, Tex. 78373.

"There are some items that teachers should bring with them," Tinnin said. "Basically, these include a blanket and towels, collecting buckets with lids, air pumps if they want to transport live specimens back to the classroom, field clothes, tennis shoes, cotton gloves, suntan lotion, a hat, long-sleeved shirt and a camera."

Tinnin conducted two basic marine science workshops in January, a weekend event for elementary teachers and a day-long workshop for secondary teachers. Twenty-five attended the elementary workshop Jan. 16-18, which included a cruise aboard the R/V KATY. The secondary workshop, which attracted 30 participants, was held at the Coastal Science lab at South Padre Island.

(See Workshops, page 7)

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Marine Education is to inform elementary and secondary teachers about current research and activities in the marine environment. Amy Broussard, editor.

Marine Facts

Understanding the nitrogen cycle

by Gil Naizer and Randy Cooper*

Potential saltwater aquarists may be hesitant about keeping marine fish for fear that the fish may suddenly die. Many of the problems associated with marine aquaria can be avoided, however, with a better understanding of the tank's nitrogen cycle.

All organisms produce wastes containing compounds that can be toxic at high concentrations. The nitrogen wastes produced by fish are the most common obstacle to a healthy aquarium. These same waste products in the natural marine environment are diluted enough to pose no problem, but an aquarium is a closed system, and potentially toxic wastes can accumulate.

A properly designed aquarium will cycle waste products into relatively harmless compounds. This is accomplished by establishing bacteria colonies in the tank's filter bed. These bacteria are the essential elements of the nitrogen cycle and are supported by a properly prepared gravel filter.

The filter base is a perforated plastic plate that is placed on the bottom of the tank. These filter bases can be purchased in a variety of styles and sizes, or can be made by cutting narrow slits in a sheet of corrugated fiberglas. The filter base should cover the entire bottom of the aquarium, but must allow circulation.

The gravel in the filter system becomes the bacteria's habitat. The gravel should be 2 to 5 mm in size and have rough, angular edges. The most suitable types are crushed oyster shell, coral rock and dolomite, which all contain the essential calcium carbonate or magnesium carbonate. The gravel should be washed to remove fine particles before being added to the aquarium. A depth of approximately 7.5 cm (3 inches) provides adequate filtration.

Since purifying bacteria need oxygen to live and oxidize wastes, an air lift system is also essential for filtration. This system circulates the aquarium water, bringing the waste products to the bacteria in the filter bed.

The nitrogen cycle consists of three processes--ammonification, nitrification and denitrification. Ammonification is the breakdown of organic nitrogenous waste into toxic ammonia by heterotrophic bacteria. These bacteria will be the first to develop in a new (unconditioned) aquarium. They feed on waste products as they accumulate, and multiply on gravel surfaces and tank walls. The ammonia resulting from decomposition of organic compounds provides food for another group of bacteria.

Nitrifying bacteria use ammonia as a food source and convert it into less toxic substances. Since these bacteria obtain energy from inorganic sources, they are known as autotropic bacteria. The first group, *Nitrosomas*, converts ammonia into nitrites, which are less toxic than ammonia but can still cause problems in the tank. The second group of nitrifying bacteria, *Nitrobacter*, oxidize nitrite compounds into nitrates, which are even less toxic than other compounds, with lethal concentrations beginning near 200 ppm. Such toxic levels are rarely reached in an aquarium because of a third process, denitrification.

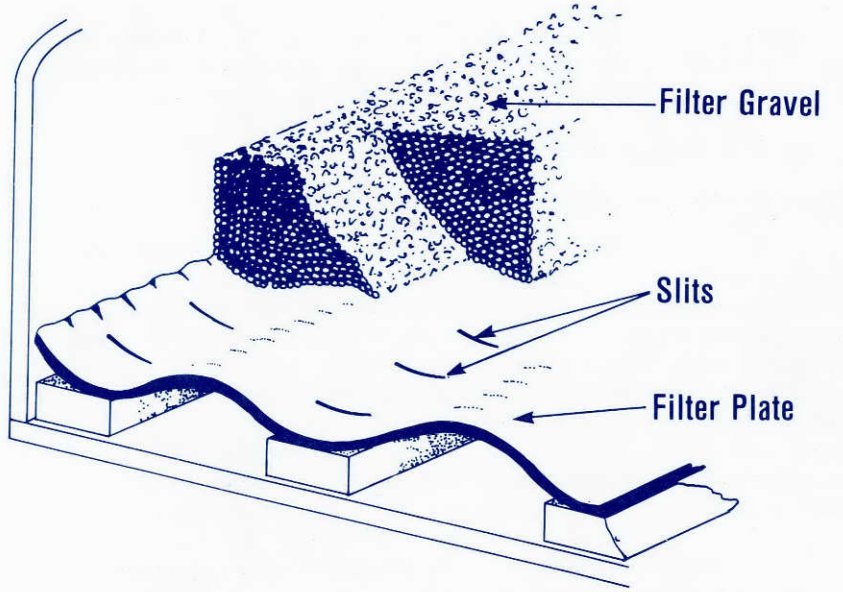
Denitrification is a process in which denitrifying bacteria reduce nitrate into nitrous oxide or nitrogen gas, which eventually escapes into the atmosphere, so nitrate levels rarely exceed 50 ppm. A 10- to 25-percent water change should be done monthly to help rid the system of excess nitrate.

The conditioning period for a new tank is approximately 30 to 60 days, and the system will be self-sustaining as long as conditions are favorable for the bacteria. Essentially, the bacterial colony represents the tank's "carrying capacity," equaling the number of animals that can be supported by the conditioning filter. If new animals are added suddenly, the equilibrium between animals and bacteria is offset, resulting in a buildup of toxic wastes. Equilibrium will be regained after the bacteria reproduce sufficiently to catch up with the increased animal load.

Only small numbers of hardy animals should be added to a tank during the conditioning period. Hermit crabs, killifish, damselfish and other resistant organisms are good to use. Estuarine or marsh animals tend to be more tolerant of changing conditions than those normally found in the open seas.

Once the tank has cycled, additional animals can be added every few days, allowing time for the bacteria to catch up with the additional waste load.

The initial animal load, amount of feeding and water temperature affect the length of a tank's conditioning per-



*Graduate research assistants in Marine Education.

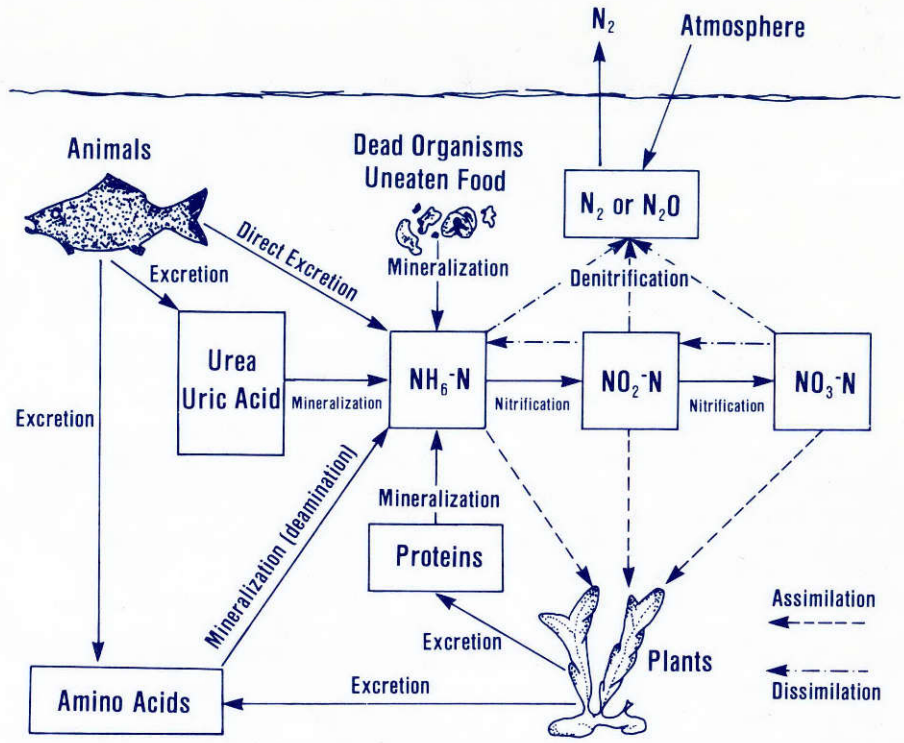
iod. Obviously, more animals result in more waste, and more feed yields more waste. At the same time, higher water temperatures increase bacterial growth, resulting in a shorter conditioning period. Nitrification is most efficient between 25° and 30°C.

Other water parameters that affect the conditioning period include pH, dissolved oxygen, salinity and surface area for microbial attachment. Normal salinity and pH levels are ideal for bacterial growth. Bacteria are aerobic, needing an adequate supply of dissolved oxygen, and proper filtration and aeration provide more than adequate dissolved oxygen. The surface area of the filter is an easily altered element. Larger surface areas support larger populations of bacteria, so a maximum filter area is preferable.

Conditioning can be accelerated by innoculating the new filter bed with acclimated bacteria (gravel) from a conditioned tank that is maintained at the same temperature and salinity. Another method is to increase the nutrient levels in the water, but care must be taken not to spoil the water with excessive organic material.

Periodic water changes commonly disrupt the nitrogen cycle. Monthly water changes should be at or near the temperature and salinity of the tank, with recommended variations no more than 2 degrees temperature or 2 ppm salinity. These narrow tolerances are important to sustaining microbial populations, since even a four-degree change in temperature can result in a 50 percent reduction of *Nitrosomas* and a 12 percent reduction in *Nitrobacter.*

Understanding the nitrogen cycle will not solve all possible problems in a marine aquarium, but start-up will be easier and more efficient by following these recommendations. Maintenance is not as difficult as most people think, and, with planning and forethought, the marine aquarium can be very productive in either an educational or home environment.



Nitrogen cycle of saltwater aquaria

Ideas for the classroom

Monitoring nitrogen cycles

1. As a long-term experiment, monitor the nitrogen cycle by using test kits that are available from a number of biological supply companies.
2. These kits enable students to observe different stages of the nitrogen cycle, including the rise in ammonia, decline in ammonia with an increase in nitrite, and the decrease in nitrite with an increase in nitrate.
3. Have students plot the levels of nitrogen compounds on a graph so that trends can be seen and stages established.
4. Have students predict the outcome of several variables on the system, such as a change in temperature, addition of animals, or decreased volume of water or gravel.
5. A microbiology unit can be incorporated, using nitrifying bacteria as an example. Test bacteria from the filter bed using standard techniques (gram stain, shape, autotrophic culture techniques).

References

King, M. and S. Spotte. 1974. **Marine Aquariums in the Research Lab**. Aquarium Systems, Inc., Eastlake, Ohio. 36 pp.

Spotte, S. 1973. **Marine Aquarium Keeping**. John Wiley & Sons, New York. 171 pp.

Spotte, S. 1979. **Seawater Aquariums**. John Wiley & Sons, New York.

Wickins, J.F. and M.M. Helm. 1981. *Sea water treatment* in A.D. Hawkins (ed.) **Aquarium Systems**. Academic Press, London.

Resources

Igelsrud, D. 1986. Aquaria. **The American Biology Teacher**. 48: 498-500.

King, John M. 1970. New culture systems - the "run-in." **Sea Scope**. 1(1): 6.

King, John M. 1971. Diseases in closed aquatic systems. **Sea Scope**. 2(1):7. *Reprinted in* ***Salt Water Aquarium****, 9(5):145.*

King, John M. 1972. Specific gravity-temperature relationships in sea salt solutions. **Salt Water Aquarium**. 9(5):7-8.

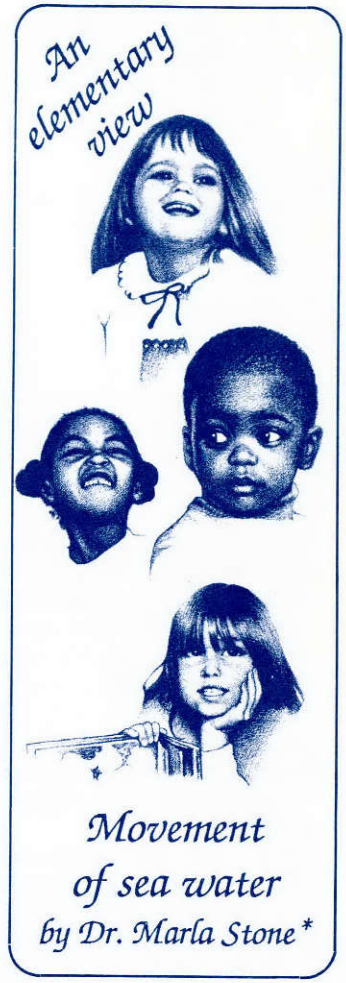
King, John M. 1973. The salt water aquarium...do it right the first time. **Pets/Supplies/Marketing**. 27(4):56-58.

King, John M. and William E. Kelley. 1971. Airlift pumps and the efficiency of undergravel filters. **Sea Scope**. 2(3):5-8.

King, John M. and William E. Kelley. 1973. **Salt water aquariums: principle and practice**. Aquarium Systems, Inc., Eastlake, Ohio. 28 pp.

Miklotsz, John C. 1971. Biological filtration. **The Marine Aquarist**. 1(5):22-29.

Roff, J. 1972. The nitrogen cycle in nature and culture. **Sea Scope**. 2(4):1, 7-8.



The ancient Incas of Peru were able to travel thousands of miles to the Easter Islands in the South Pacific. Spanish explorer Juan Ponce de Leon learned to sail quickly from American back to Spain. Benjamin Franklin charted a route to get ships from England to bring the mail to America much faster.

All were using a special movement of the ocean called **current**. A current is a moving or streaming body of water of air. The ocean has many streams of moving water, almost like "rivers" within the larger mass of water. Like rivers on land, ocean current flow along in essentially the same course.

Waves move **across** water, but currents move **in** water. They flow **through** the water around them. Some currents flow along the surface, some flow along the ocean bottom, and some currents flow up and down. All of this movement begins with energy from one source or another. Some of the sources will be identified in the activities that follow.

Activity 1

Half-fill a deep bowl with water. Drop 5 or 6 tiny pieces of paper on the water's surface. Set the basin on a lazy Susan tray or a rotating stool. Gently spin the tray or stool in a counterclockwise direction three times. Observe the water and papers in the bowl as you spin. Continue watching after the spinning has stopped.

Spin the tray or stool again in a counterclockwise direction, but spin 20 times as a constant speed. Observe the water and paper during and after the spins.

1. Is the movement of the water and paper any different while spinning 20 times than when spinning three times? (You should notice that the papers seem to stay in one spot during the three spins, while they begin to move with the spinning bowl at some time during the 20 spins.)
2. Was there any difference between the movement of the paper after the three spins ended than after the 20 spins? (You should notice the papers moving in a much faster circle following the 20 spins.)
3. What happens to the motion of the water if you spin the tray or stool in a clockwise direction? (You should see the water and papers moving in the opposite direction from the previous spins.)
4. Can you relate the spinning bowl and water to the earth and its oceans? (You may realize that the earth spins at a constant speed, moving the water with it. The rotating causes both wind and water currents. The Northern Hemisphere turns clockwise and the Southern Hemisphere turns counterclockwise.)

The energy of the spinning earth also causes the water on the earth's surface to spin. The earth rotates at a speed of about 1,600 kilometers (or 1,000 miles) per hour at the equator, but much slower at the Poles. This would be like watching a car tire spin. The lugs on the hub cap make a much smaller circle than the white label on the edge of the tire, so the lugs move more slowly in one spin. The water near the equator moves rapidly, creating huge currents deep in the ocean near the surface of the earth.

The currents do not flow in straight paths or circles, however, because of the continents and large islands. The currents are turned as they approach large land masses. Because the direction of the earth's rotation is clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere, the currents in the two hemispheres are turned in opposite directions. Smaller circles of currents result, as can be seen in the drawing.

Activity 2

Fill a square or oblong dishpan with water to 2 cm from the top. Set a fan 8 to 10 cm from one side of the pan so the fan's blades are parallel with the side. Drop a few tiny pieces of paper on the surface of the water and turn on the fan. You may also add a drop of food coloring to the water. Observe the movement of the paper, as well as the water. Stop the fan.

1. How does the movement of the current of water through the container compare with the movement of air flow from the fan? (You should notice that the water current moved in the same direction as the air current.)
2. What happened to the water and paper as they reached the opposite side of the pan? (The water changed direction and returned back toward the fan, making a circular pattern.)

Move the fan so that it blows along one side of the pan. After several seconds, observe the movement of the paper and water.

3. After the fan was moved to blow from a different direction, what happened to the water current? (You may have noticed the water's direction changed with the

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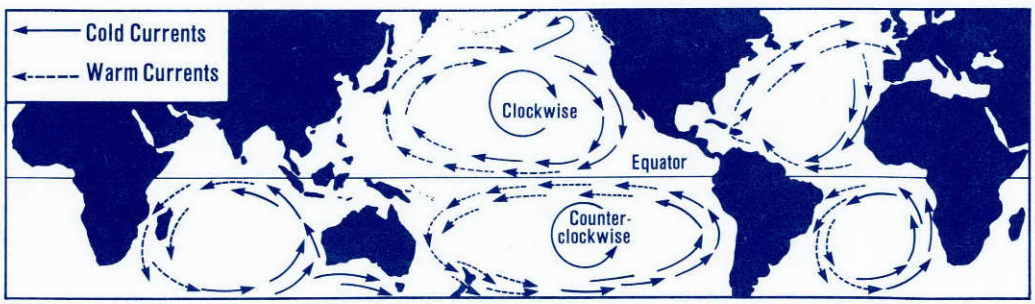


wind direction, creating currents that moved along the side of the container. Most of the water changed direction when it came to the corner of the container and returned back toward the fan.)

Compare the movement of the paper caused by the fan to another source of energy. Place a piece of cardboard or thin wood upright at one end of the pan. Move the cardboard with a flicking wrist action to produce waves. Watch the movement of the pieces of paper as you generate the waves.

4. How did the movement of the paper with the fan compare to the movement as you produced waves? (You should notice that the papers moved forward with the fan, but up and down in the waves.)

The wind causes **surface currents**, which seldom go deeper than a few meters in the water. The winds that create surface currents are called **prevailing winds**, and they move great distances over the globe. Winds near the equator blow mainly from east to west and are called **trade winds**. The **westerlies**, found at latitudes of about 40°, are prevailing winds from the west that affect weather in much of the United States. The **polar easterlies** are found in more northern latitudes.

Both air and water currents flowing from areas near the equator are warmer. Similarly, the currents coming from the polar regions bring colder air and water.

Activity 3

Fill a heat-resistant glass baking dish with water. Heat one end with a candle. After a minute or so, add two to three drops of food coloring to the cool side of the pan. Observe the movement of the food coloring.

1. Which way does the food coloring (cooler water) move? (You should notice that it moves toward the warmer side, then rises, moves away from the heated side, then sinks.)
2. What is the shape of the water movement? (It is circular or elliptical.)

Water from warmer areas of the earth (equator) moves to cooler areas (poles). The differences in water temperature start current movement. Cold water weighs a little more (is denser) than an equal volume of warm water, causing it to sink. As surface currents carry warm water toward the poles, the water cools and begins to sink. The sinking, colder water moves back toward the equator in a deep, cold **density current**, which flows the opposite direction as surface currents. As the water nears the equator, it warms up agan and rises to the surface. This up and down movement of currents is often caused by differences in water temperature.

Activity 4

Put equal amounts of water (approximately 200 ml) in two jars that are the same size and shape. Add a heaping teaspoon of salt and two to three drops of food coloring to jar A. Mix thoroughly. Both jars should be at room temperature. Place a test tube at a slant in an empty jar and half fill it with water from jar A (saltwater). Gently finish filling the test tube with water from jar B. Observe what happens.

1. What results do you see? (The salty water from jar A stays below the plain water from jar B. The food coloring helps distinguish the two.)
2. Which has greater density, saltwater or plain water? (Saltwater appears heavier, or denser, than plain water.)
3. A similar experiment using warm and cold plain water can be done. Which would sink to the bottom? (Cold water is denser and would sink.)

The amount of salt in water is called **salinity**. The more salt content, the greater the salinity, and the greater the density of water. Salinity can be affected by freshwater run-off near the mouths of rivers, or the melting of ice and snow, both of which decrease salinity. An increase in salinity occurs when water is evaporated, leaving salt behind. Differences in salinities will also cause density currents.

Four causes of currents have been discussed. The earth's rotation creates deep currents along the ocean bottom. Prevailing winds create shallow, surface currents. Both types of currents are changed in their directions by large land masses. Density currents that move water up and down are created when waters of different temperatures or salinities meet.

Extension

1. Relate Coriolis Effect, tides and convection to currents.
2. After examining a map of ocean currents, list at least three places you might expect to find a note in a bottle if you put the bottle in the ocean at a point nearest your home.
3. Why are the temperatures in London, England, generally milder than those in Maine even though London is at a more northern latitude?

References

Magnoli, M.A., L.S. Douglass and D.M. Ellis. 1985. **Experiences in Earth-Space Science**. River Forest, Ill.: Laidlaw. pp 349-352.

Magnoli, M.A., L.S. Douglass and D.M. Ellis. 1986. **Experiences in Earth-Space Science Resources**. River Forest, Ill.: Laidlaw. pp 109-110.

Oxenhorn, J.M. and B.I. Goldfeld. 1975. **Oceanography and Our Future**. New York: Globe Book Co. pp 55-64.

Winkler, A., L. Bernstein, M. Schachter and S. Wolfe. 1986. **Concepts and Challenges in Earth Science**. (2nd edition). New York: Globe Book Co. pp 182-183.

Flower Gardens move closer to sanctuary status

The East and West Flower Garden Banks, the northernmost shallow-water, tropical coral reef community in the Gulf of Mexico, moved a step closer to being declared a national marine sanctuary in November when a draft environmental impact statement and draft management plan were forwarded to the Gulf of Mexico Fishery Management Council for review.

Located 110 miles south-southeast of Galveston, on the outer edge of the continental shelf, the Banks are approximately 16 miles apart, and support the most ecologically complex and biologically productive reef communities on the Texas/Louisiana Outer Continental Shelf. They are isolated from other coral reef communities by more than 300 nautical miles.

Suggested regulations for the two reefs and the surrounding area include prohibiting damage to coral by the anchoring of large commercial vessels, prohibiting vessel discharges, and limiting fish capture to hook and line with the exception of spear fishing, which will be regulated in the future if deemed necessary.

The Flower Garden reefs have probably been forming since the Ice Age, perhaps for 10,000 to 15,000 years, and are now about 60 feet beneath the surface of the Gulf.

Commercial fishermen probably were the modern discoverers of the reefs. Local fishermen found bits of the multi-colored coral in their nets and, because of the colors, began calling the area the Flower Gardens.

As a marine resource, the reefs serve as a regional reservoir of shallow-water Caribbean reef fishes and invertebrates.

Workshops . . .

(Continued from page 2)

Teachers learned about constructing and maintaining saltwater aquaria, South Texas barrier island geology, and beach profiling and field collection techniques.

Tinnin will be developing a workshop schedule for 1987-1988 within the next few months. Specific topic requests or suggestions should be directed to his attention at the Port Aransas facility.

Texas A&M workshops set

The marine education program based at Texas A&M has two Super Ocean Saturday sessions scheduled, one for junior high teachers on March 14, and another for senior high instructors on April 4. Each seminar will be from 9 a.m. until 4 p.m. in the Analytical Services Building on the Texas A&M campus.

There is a $10 advanced registration fee. Participants will receive six hours of approved Career Ladder credit.

For each seminar, the morning session will stress the skills and procedures needed to establish and maintain a saltwater aquarium. Participants will learn how to build an aquarium, to test the chemical variables in water, and to combine a microscope with a video camera. The afternoon sessions will focus on state-of-the art technologies that make direct observation of the marine environment available in the classroom. Equipment demonstrations will include aerial and shuttle photographs, satellite receiving equipment and sonar simulation devices.

Science . . .

(Continued from page 1)

late in the academic year for many schools. The April date is expected to attract even more participants.

NSF, with corporate support, serves as the clearinghouse for activities throughout the United States. Corporate sponsors for 1987 include the Amoco Foundation, Atlantic Richfield Foundation, Cray Research Foundation, Dow Chemical Company Foundation, DuPont Company, EDS, Ford Motor Company, General Electric Foundation, IBM, Monsanto Company, Time, Inc. and *Discover* Magazine, and TRW. In addition, NSF maintains close ties with key scientific, professional and civic organizations, such as the State Academies of Sciences and State Science Supervisors, the American Association for the Advancement of Science, the National Science Teachers Association, the Association of Science and Technology Centers, the Triangle Coalition, the National Academy of Science, and the U.S. Chamber of Commerce.

Inquiries for more information on National Science and Technology Week should be directed to Mary Keeney, National Science Foundation, 1800 G Street, Washington, D.C., 20550.

Aquarium update

Construction of the Texas State Aquarium in Corpus Christi could begin sooner than expected because of momentum established in supporting the project in 1986 according to project officials.

"We can step up the time frame of the project if our 1987 fund raising achieves its goals," said John Dorn, president of the Texas State Aquarium Association, the non-profit group sponsoring the state's public aquarium.

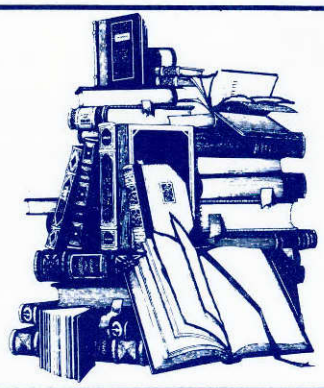
The original schedule called for breaking ground on the $20 million aquarium in 1988, but the Association has now moved that date to late 1987 and hopes to open the facility by late 1989.

Dorn said the aquarium is recognized as a centerpiece for tourism development along the Gulf coast, but that its research and education potential is now attracting attention. Professors, research scientists and students from several universities, including Texas A&M University, The University of Texas and Corpus Christi State University, have expressed interest in making use of the aquarium's facilities.

Highlights of 1986 include the purchase of six acres of waterfront property as the aquarium's site, retention of Joseph A. Wetzel and Associates, an exhibit design firm, to develop a story line and begin conceptual work on potential exhibits, and a fact-finding tour of aquariums in Japan and Hong Kong. The Association also had a touch tank display at Corpus Christi's annual Bayfest Festival, which attracted more than 250,000 visitors.

Texas State Aquarium™

Marine Education...7

books  & things

Texas A&M's Sea Grant Program has two new publications that may be of interest to teachers and counselors. The first, **Questions About Careers in Oceanography** by Aubrey L. Anderson, replaces an earlier brochure, **Careers in Oceanography**. Anderson provides concise, informative answers to such questions as *What is an oceanographer; where does one study oceanography; who hires oceanographers; who supports oceanographers; and where does one obtain information.*

Single copies are free by requesting publication TAMU-SG-87-401 from Marine Information Service, Sea Grant College Program, Texas A&M University, College Station, Tex. 77843-4115. A unit price of 28 cents will be charged for multiple copies.

Following the red tide outbreak off the Texas coast in 1986, there were many questions about this phenomenon, which is rare in Texas. **Red Tide in Texas--An explanation of the phenomenon** (TAMU-SG-87-502) was published in response to those questions. The four-page fact sheet explains the causes of the red tide bloom, when and where it occurs, its impacts on marine life and on humans, and the economic aspects of red tide.

Teachers looking for new ways to decorate their science classrooms might request a poster catalog from Osprey Books, P.O. Box 965, Huntington, N.Y. 11743. There also is a toll-free number, 1-800-843-5799.

Osprey publishes 22 different 27- x 39-inch, full-color posters that are printed on heavy art stock and laminated for protection. Poster topics include, among others, North American fish, shellfish, whales, butterflies, birds of the shore and sea, sharks, delicacies of the sea, and crabs and lobsters. Individual posters are $15.00 each, but there are special prices for sets of posters.

The Galveston chapter of the American Cetacean Society has a 32-page booklet on the marine mammals of the Galveston area, **Galveston's Dolphins**, available for $5.00. The booklet gives a brief introduction to the dolphins seen most frequently in the Galveston area, with particular emphasis on the bottlenose dolphin.

There is some taxonomic information, a discussion of the legal aspects of watching marine mammals and a Galveston area sighting map.

Copies are available by contacting the Galveston Chapter, American Cetacean Society, P.O. Box 2461, Galveston, Tex. 77553.

A more useful book for the classroom is the new **Discovery Book for the Texas Coast**, a Gulf beach activity book by A. Leland Parker and illustrated by Wayne Chandler. Although written specifically for the Gulf coast, this book could be used as an elementary introduction to coastal processes and marine animals anywhere. There is a good, if brief, description of the tide line, marshlands and estuaries, sea nurseries and the food chain.

The book also includes activities, such as sand casting, making a sea collage, fish printing and an adaptation of the food chain for people.

The book is available from South Coast Publishing, 4906 Eider, Corpus Christi, Tex. 78413, for $3.95, including postage.

It is not too early for teachers to make plans for summer courses, particularly when at least one institution, The University of Texas Marine Science Institute at Port Aransas, has a March 15 application deadline. Three advanced classes, open both to undergraduate and graduate students, will be offered each summer session.

The first session, June 3 through July 9, includes classes in marine invertebrates, comparative physiology of marine animals, and biological oceanography. Ecology of fishes, marine chemistry and topics in marine studies--marine macrophytes will be offered during the second session, July 10 through Aug. 15.

The Marine Science Institute is located on the northeast tip of Mustang Island, readily accessible to Aransas Bay Channel, an extensive bay and estuarine system, Laguna Madre, and the Gulf of Mexico. Facilities include classrooms, a library, research laboratories, experimental ponds and a pier lab. The 105-foot R/V LONGHORN and 57-foot R/V KATY are used for both research and summer teaching cruises.

Those interested in applying should contact Dr. Patrick Parker, Department of Marine Studies, Marine Science Institute, The University of Texas at Austin, Port Aransas, Tex. 78373.