Lesson III. Weedon Island – Sea

keywords: pollution, nitrogen, nitrate, nitrite, ammonia

Inhabitants of Weedon Island

Some of the fish that can be collected in a net at Weedon Island include anchovy, sheepshead, catfish, snook, blenny, stingray, and snapper. At the water's edge, an observer might see a fish jumping, a bird stalking a small fish, or a Cormorant duck lazily drifting in the current. As one might look further out into the deeper waters that surround the island, a dolphin playing or a manatee might be spotted.

The waters and the muddy flats are found on Weedon Island are great place to observe the local reptile families. Alligators, and turtles might be found floating at the surface of the water basking in the warm Florida sun, while others may be found in trees. Skinks, squirrel treefrogs, mangrove snakes, diamondback terrapin snakes, and rattlesnakes can all be found throughout the preserve.

The Nitrogen Cycle

adapted from an article written by Dr. Kent Fanning for the St. Petersburg Times, St. Petersburg, Fl

The element nitrogen, which forms up to 90% of the air that we breathe, is also important in seawater. It is the most abundant gas in the atmosphere, and necessary for all functions of life. The movement of nerve impulses, muscle contraction, photosynthesis, growth, digestion of food, vision and growth of hair, feathers, or scales are only a few of the processes that require nitrogen.

But nitrogen has a negative side. Processes inside healthy tissues produce a molecule in which nitrogen is joined to hydrogen atoms. This molecule is called ammonia, or ammonium. Ammonia is poisonous and if not removed, or contained in some way inside tissue, it causes death. All animals, including fish and people, must some how get rid of this poison that is a by-product of normal living. Fish **excrete ammonia (NH_4^+)** through their gills. Mammals excrete urea, birds excrete uric acid.

Ocean fish benefit from another process that recycles the excess nitrogen -- **phytoplankton!** These are microscopic algae and they are the basis of the food web for the entire ocean. They are nearly everywhere in the surface ocean. They are usually starved for nitrogen, and take ammonia out of seawater whenever they encounter it. Ammonia is their "favorite" fertilizer during photosynthesis.

Phytoplankton growing on ammonia "convert" a fish's waste ammonia

into plant tissue fish can then feed on.
At the same time, bacteria called nitrifying bacteria cause a reaction between ammonia and dissolved oxygen that makes forms of nitrogen called **nitrate (NO_3)** and **nitrite (NO_2^-).** Because of nitrifying bacteria, ocean water nearly always contains nitrate, nitrite or both. Harmful concentrations of ammonia almost never build up in the ocean because of the actions of phytoplankton and nitrifying bacteria.

Biological Filters

adapted from an article written by Dr. Kent Fanning for the St. Petersburg Times, St. Petersburg, Fl

How does an aquarium compare to a wetland or an ocean? An aquarium is a closed system, where as a wetland or an ocean is an open system. All stated ecosystems must have some way to remove ammonia, purify the waters around them, and convert ammonia to nitrate and nitrite. Let's illustrate these systems through example.

In any system aquarium, there are three processes that can protect the fish from their own waste ammonia and provide food. These are water flow, phytoplankton and bacteria, and removal of ammonia across the fishes gills. The fish have gills in their anatomy, but they can not do anything about the phytoplankton and the water flow. In an open system, the amount of seawater to receive their wastes is huge. Surrounding seawater dilutes the ammonia and harmful levels are rarely reached. In an aquarium, that is not the case. If there could be as great a flushing of old, ammonia-contaminated water, there would be little need to worry about an ammonia build up. However, a large source of clean seawater rarely exists near an aquarium, and pumping a lot of seawater from a natural environment would be horribly expensive. The most practical way to run the aquarium is the keep the same seawater in the tank.

If enough phytoplankton were present in the tank, they might be able to remove the ammonia that cannot be flushed away. But no one wants that much phytoplankton (or any kind of algae for that matter) in an aquarium. That would make the waters murky, and the fish difficult to observe. Therefore the consumption of ammonia by phytoplankton, so important to the cycling of nitrogen in the oceanic realm is absent from the tank by any design.

The aquaria replace phytoplankton with nutrients. Although there are not any phytoplankton in the tank, there are nitrifying bacteria found in the sand filter that the water cycles through. The filter is the second stage of the purification of the water found in the aquarium. The bacteria do the same job inside the filter that they do in the ocean: convert ammonia to nitrate and nitrite. The last step of the purification system is to replace the oxygen and remove the carbon dioxide in the water. An

aquarium uses a pump to supply a constant stream of air.
In the closed system of the aquarium, nitrite and nitrate are not converted to plant tissue by phytoplankton. They are simply allowed to build up in the tank, and are eventually diluted when some of the old seawater is removed and replaced by new seawater. The aquarium is a closed system where life is manually sustained. In an open system, like Weedon Island, or any environment found naturally, life is sustained on its own. The organisms of Weedon Island all work together to ensure that Weedon Island will be able to sustain life. The waters flow, the organisms eat, plants live and die, the water dilutes ammonia, and brings the necessary materials to the waters edge, and the sun provides energy for photosynthesis.

Pollution Sources

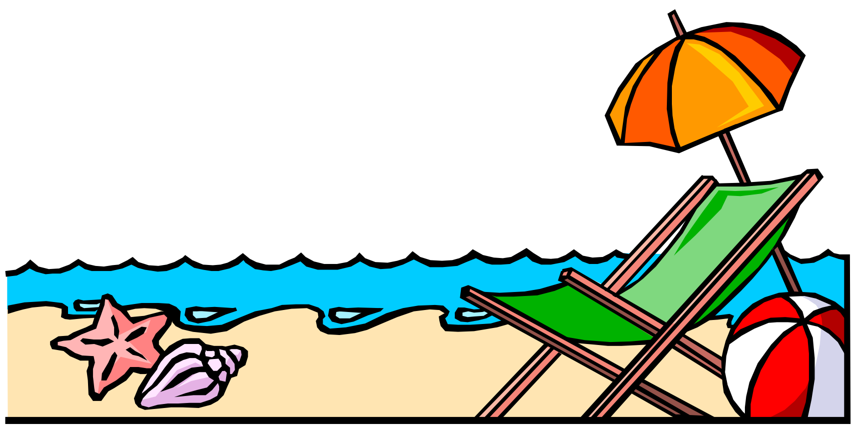
Land-based marine pollution can either be from a "**point source**" or a "**nonpoint source**." Point source pollution originates from a specific place such as an oil refinery or a paper mill. Nonpoint source pollution, on the other hand, is contaminated runoff originating from an indefinite or undefined place, often a variety of places (e.g., farms, acid rain and airborne contaminants, and poor land development). The soot, dust, oil, animal wastes, litter (debris), sand, salt, and chemicals that constitute nonpoint source pollution often come from everyday activities such as fertilizing lawns, walking pets, changing motor oil, and driving. With each rainfall, pollutants from these activities are washed from lawns and streets into storm water drains that often lead directly to nearby bodies of water such as streams, rivers, and oceans.

While rarely visible, nonpoint source pollution is a chronic and ubiquitous form of coastal water contamination. The U.S. Environmental Protection Agency estimates that the primary cause of the pollutants in the oceans is not from point sources, but from various forms of runoff. Mitigating nonpoint source pollution is difficult, even if the multiple sources can be identified and located. Often solutions entail major changes in land-use practices at the local level and expensive methods to minimize runoff. However, nonpoint source pollution does offer individual citizens an ideal opportunity to combat marine pollution. By changing everyday actions, individuals can help reduce the cumulative impact of nonpoint source pollution.

One way to help with pollution in the oceans and the waterways, is to participate in the International Coastal Cleanup held every year in the late summer. In 1997, there were 2,176,826 pieces of trash picked up in Florida alone. Worldwide, an estimated 100,000 people that joined forces to help clean up our waterways. Litter in the marine and aquatic environment can lead to loss of habitat, death of animals, and starvation. Let's all be better stewards of our waterways and keep litter in its place!

Salinity

Salinity is a measure of the dissolved salts in water. Salinity in water, varies worldwide. Freshwater has salinity near zero, and seawater has an average salinity of 35. In waters influenced by both rivers and oceans, the salinity varies between these two values because they are mixtures of freshwater and seawater. Weedon Island is a wetland that has brackish water. On an average, brackish water usually has a salinity of approximately 8 parts per thousand to 21 parts per thousand at the high end. Brackish water has less salt than the ocean, but more salt than freshwater. Brackish water environments are unique in that they may serve as nursery grounds for organisms that spend part of their lives in freshwater and part in saltwater.



Did you know?

The International Coastal Cleanup sponsored by the Center for Marine Conservation represents the largest, single diving event in the world!

Polluted runoff is the number one source of water pollution today.

The U.S. “Exclusive Economic Zone” (EEZ), which reaches 200 miles from the coast into the oceans, is estimated to contain about one-fifth of the world’s harvestable seafood.

Approximately 8 out of 10 molecules that enter our lungs are nitrogen, and only 2 out of 10 molecules are oxygen!

Weedon Island is a brackish water system, and helps to sustain life in both fresh and saltwater environments.

Activity III-3A. Waterfront Property

Objective: Students will learn to distinguish the difference between point and non-point source pollution. The students will recognize that everyone contributes to the water quality in an aquatic environment. This activity will help the students to understand management of bay strategies.

Materials:

Large piece of poster board, or newsprint works well

Blue marker or paint to draw a river or stream on it. Divide the stream down the middle and across all sections of the board. Each section must have a piece of stream, and blank space to allow room for students to draw on their plot of ‘land’. The number of sections should correspond with the number of students or groups of students working together. Number the sections on one side of the river in order, and repeat for the other side. Cut the sections of stream.

Drawing pens and pencils

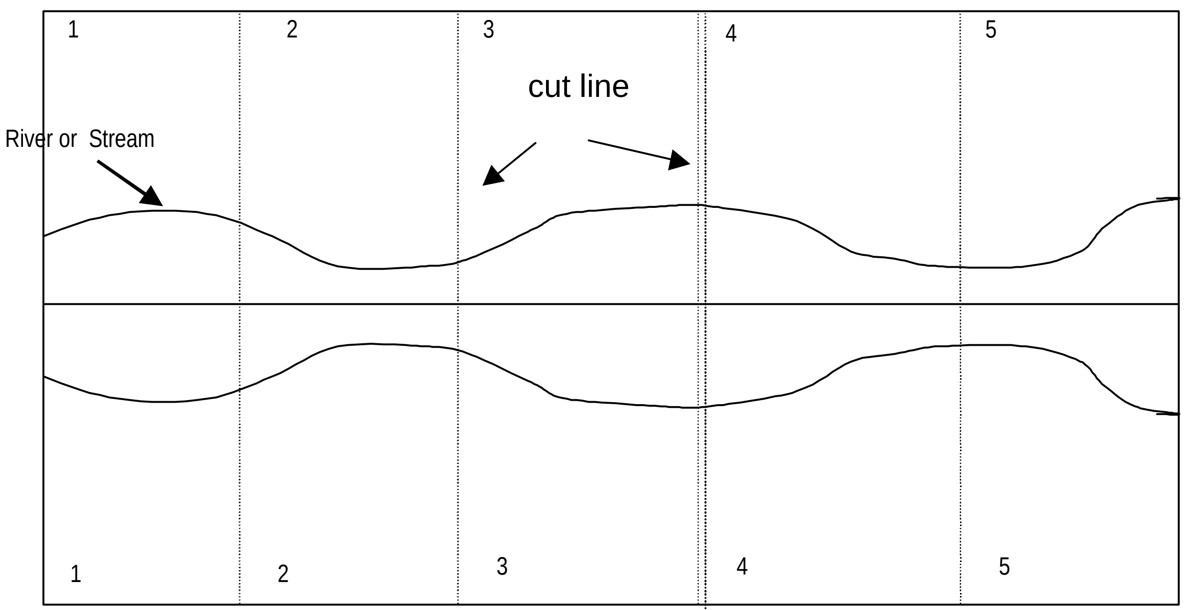
Items from students desk (pens, paper clips, etc)

Background:

The quality of watering a river (or lake) is a reflection of land uses and natural factors that surround it. If the land is stable, and has enough vegetation cover, erosion is kept in check. When humans settle an area, and begin to break up the ground cover, water quality is impacted.

Watershed investigations are conducted for many reasons. Some of reasons include water quality, changes in water flow, changes in water path, detection of contaminants, protection of nurseries, and to determination of the best methods to protect lakes or rivers from pollutants. Also, watershed investigations provide important information for policymakers and water managers when determining how best to spend money for improvements.

When watershed managers investigate land use practices that might affect the quality of water, they are concerned with two general sources of pollutants: Point and Non-point.



Procedure:

1. Determine the student knowledge about watersheds by asking them to name several major American Rivers. Where do these rivers originate and end? How many states does each cross or touch?
2. Discuss some of the types of land usage found along one river as it flows through one state. Do the students think that these practices could effect the river?
3. Tell each student, or group of students that they have just inherited a piece of waterfront property, and one million dollars to develop that piece of land.
4. Pass out the pieces of 'land'. Explain that the water is blue, and the blank space is the parcel of land they own. They can develop their land as they wish. (Ranch, farm, build a house, factories, parks, log, mine – whatever they would like to do.)
5. After the students have completed their drawing, explain to them that their property is actually a piece of a puzzle.
6. Have the students re-assemble the location of land beginning with piece number one. They will construct the stream pathway and adjacent land area in order.
7. Have the students describe their land and how they used it. Have students represent each of their contributions to the watershed with an item from their desks.
8. Tell students to take their items and line up in the same order as their pieces of riverfront property. They are going to pass their pollution pieces downstream. Have them announce what kind of pollutant they are holding before they pass it on. The ones will pass their items to the twos, the twos will pass everything to the threes, and so on, until the last students are holding all items.

Discussion:

1. Could a student downstream be effected by the actions of a student upstream?
2. How did the students at the middle or end of the river feel?

3. Tell the students to reclaim their items. Explain that the items easily identifiable as their own simulate point source pollution. Other items may be more difficult to claim, because these kinds of pollutants originated from multiple sources. Tell students these represent non-point source pollution.

Follow up: Have each student write one paragraph detailing ways to reduce the amount of pollution he or she contributed.

Activity III-3B. Water Quality Station

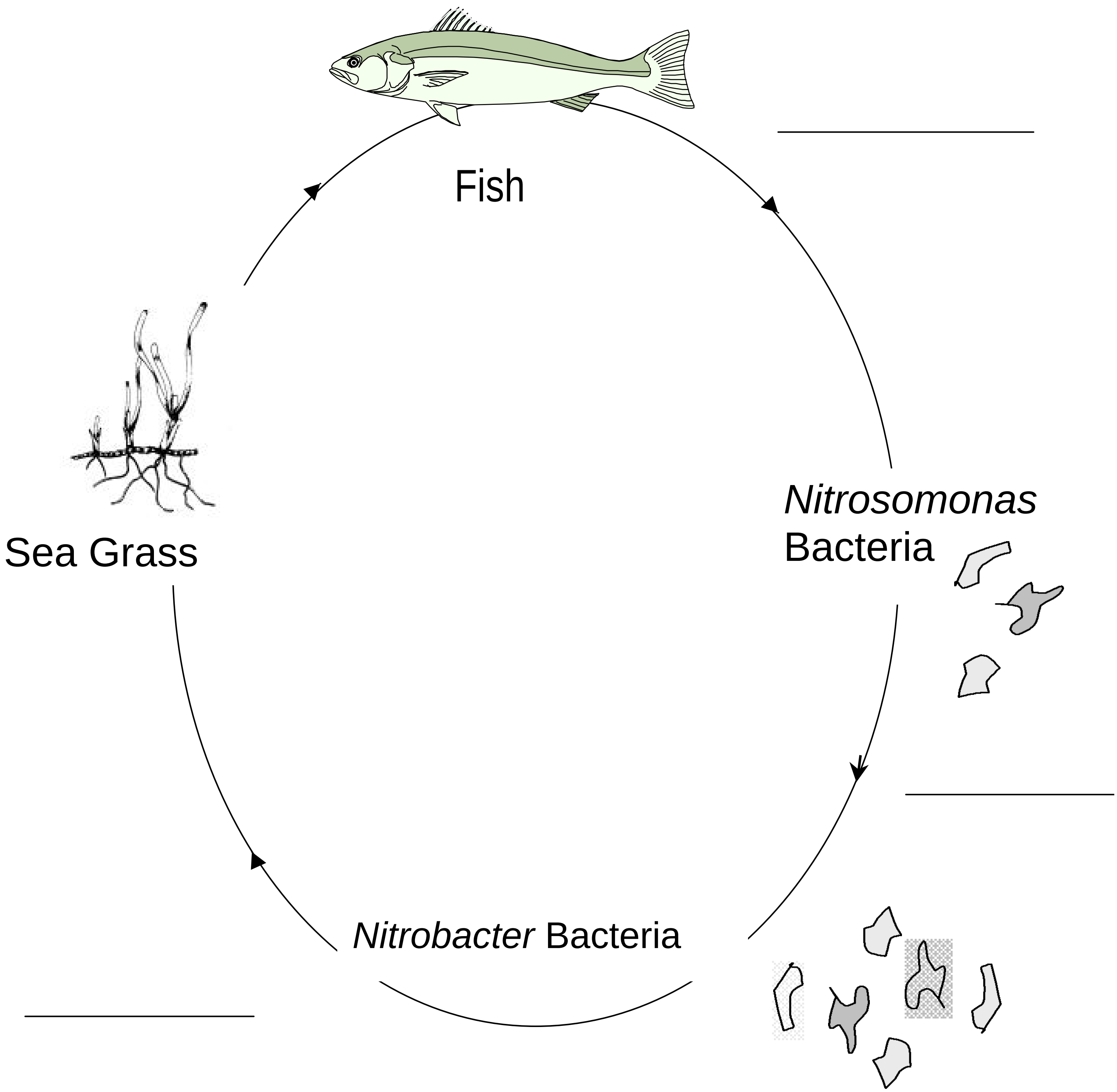
Part 1. Key terms and definitions. Have the students draw a line to match each term with the appropriate description.

Nitrification	Phytoplankton bloom
Nutrients	Ranges from 1 – 14
Salinity	Breakdown of fish waste
pH	Abundant plant life
Oligotrophic	Dissolved Salts
Eutrophic	Clear Blue Water

Part 2. Fill in the blanks with the appropriate nitrogen compound.

NO_3 → nitrate
NH_4^+ → ammonia
NO_2^- → nitrate

NITROGEN CYCLE



Student Information Sheet III. Weedon Island – Sea

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If you find any interesting facts, or have any questions that you would like to share with the staff at Project Oceanography, please feel free to call us at: 1-800-51-OCEAN or e-mail us at: pjocean@marine.usf.edu We will answer you either via e-mail or on the air during a broadcast. Visit our website at http://www.marine.usf.edu/pjocean/index.html