BIO 1200, 2030,106MC, PHS109AACC Name_____
Professor Billeter SS#_____
Check your college: College? ❑Charles (LaP., St.M., Cal.) ❑Anne Arundel ❑Montgomery

revised 1/99

"OCEAN PLANET"

A SMITHSONIAN INSTITUTION TRAVELING EXHIBITION

SELF-GUIDED VIRTUAL FIELD TRIP

http://seawifs.gsfc.nasa.gov/ocean_planet.html

READ THIS PAGE BEFORE YOU "GO"

1. All field trips are optional activities. YOU ARE **NOT** REQUIRED to participate in any field trip and your grade will not be lowered if you do not participate.... But, if you do choose to participate in this field trip, you may add as many as 5 points to your final course average AND you will learn things that will help you understand course material better and help you earn better grades on your exams.

2. If you have never used the World Wide Web, shame on you. It's about time you learned and this is a good opportunity to do so while earning some extra credit in Oceanography or Marine Biology.

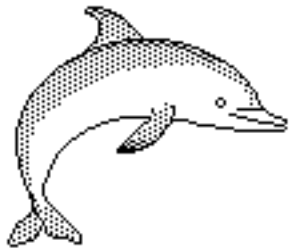
   This exhibit is a traveling display of topics and issue of contemporary ocean science. When I first viewed the exhibit (in real life) it was at the Smithsonian in D.C., when I wrote this worksheet the exhibit was at the Bishop Museum in Honolulu, Hawaii and the last time I revised it it was in Chicago. Through the efforts of the Smithsonian, the support of NASA, and the technology of the "Web" the exhibit is available to anyone in the world who has access to the Internet. The exhibit is "located" at:

http://seawifs.gsfc.nasa.gov/ocean_planet.html

   If you don't know what this means ask a friend who knows how to use the Web or go to the college library or an open computer lab and ask for help. DO NOT BE INTIMIDATED!!, the Web is friendly and you will catch on quickly. The monstrosity in the box above is simply an address. We call a World Wide Web address a "URL" (Uniform Resource Locator.) The "http;//" part (hypertext transfer protocol) links YOUR computer into the World Wide Web; the "seawifs" part is the name of a server computer at NASA that will "serve up" the info to the computer YOU are using (which would then be the "client" computer of the seawifs "server" computer) and, the "ocean_planet.html" part is the name of the file on "seawifs" that holds this field trip's text, images, and sounds. Most people who use the Web will be glad to show you how to "get on" and "navigate around." JUST ASK.

3. The hours of operation of the World Wide Web are: **24-7-365 !!!!**

4. **Admission: FREE!!!!!**



I. When you get to the Ocean Planet Home Page, ☞**click on** "ENTER THE EXHIBITION HERE" to go to the exhibit floor plan map. Enter (click) the "Ocean Science" Room. ☞**Click on** HERE to go to the room floor plan. Go to the following exhibits and answer the questions. When you want to move to another part of this room click on "Back" (upper left of page) to return to the previous page, in this case this room's floor plan. When you need to go back to the Exhibit Floor Plan (from the room floor plan), ☞**click on** the tuna fish at the bottom of any page.

A. How Cold... The vast majority of the oceans are characterized by constant cold temperature, complete absence of sunlight, and, compared to sea level, enormous pressure.

1. What is the temperature of most of the ocean's water? ____ºC or ____ºF.

2. Even in the clearest ocean water at high noon the intensity of surface illumination at a depth of 1600 ft (_____meters) is reduced to one-_____ of its surface value. A mile is 5280 feet so 1600 ft is 1600/5280 or about 0.3 miles. The average depth of the ocean is about 3800 meters and the deepest part of the ocean is the _____ Trench which is _____ft (=_____ m) deep.

3. Most of the ocean is under pressures of _____ p.s.i. which is about _____ times greater than the pressure in automobile tires.

☞**CLICK on Back**

B. HOW DEEP can they go? Click on the snorkler with the green swim suit: What is the record free-dive by a human?_____ ft. Who?_____

Click on this symbol: **§** What is its function on these web pages?_____

_____

The deepest recorded dive of a sperm whale is _____ ft. Link from this page to "Whales and Dolphins (Jay Calkins) List 5 species of baleen whales: _____ _____. ☞**Click Back twice**. Give depths of the following:

1. SCUBA diver: _____ Who?_____
2. Elephant Seal: _____ 3. Algae:_____
4. The Titanic: _____ Give the lattitude and longitude_____
5. DSV Alvin: _____ maximum speed_____ dive duration_____
6. Sponge: _____ 7: Jason robotic submarine _____
8. Deepest recorded fish: _____ 9. Which has gone deepest, ❒Trieste or ❒Kaiko?

Go back up to the surface. Find the USA research vessel **named** the *R.V.Aquarius:*

Where is the *Aquarius* moored?_____

☞**CLICK on Back** to the Ocean Science Room

C. Up There...Sunlit surface waters teem with microscopic algae called: _____
LINK TO :sea-surface color: CLICK ON Life in the Oceans: According to this page a "better" place from which to study the oceans is _____ .☞**Click Back** and **LINK TO** Carbon: Photosynthesis by phytoplankton allows the oceans to absorb more CO_2 (carbon dioxide) ❒true ❒false CO_2 levels in the atmosphere are important to ❒ozone depletion ❒acid rain ❒global warming☞**CLICK on Back**

LINK TO Activities: #4 List the two types of satellites used to study the environment. _____
_____ . Which of these is better for tracking hurricanes and why? hint: link to Answers! (right red arrow)_____
_____

☞**CLICK on** **Back** to the Ocean Science Room floor plan and ☞**click on** "Undersea Flyby": Attempt to play these movies (you'll need a pretty fast multimedia computer to do this because you have to download mpeg digital video files. Download and play at least the smallest of these video files, Journey through the Trench and watch the video.

☞**CLICK on** **Back** to the Ocean Science Room floor plan and click on "Plunge":
A. The mid ocean ridge is an undersea mountain range _____ miles long.
B. Where is the Mariana Trench located?_____ and
C. How deep is it?_____
D. The average depth of the oceans is:_____ miles or _____km or _____ meters
E. Where is the tallest waterfall on land?_____ and where is the tallest undersea water cascade?_____. Compare these two._____
F. Mauna Kea Volcano is located in _____. Mauna Kea is _____ feet tall.
G. Calculate how many MILES tall Mauna Kea is. (hint: there are 5,280 feet per mile) _____ miles.
H. Compare the Mount Everest to Mauna Kea. _____
Mauna Kea's height is measured from the sea floor. It's peak is about 14,000 feet above sea level.

☞**CLICK on** **Back** to the Ocean Science Room floor plan and click on "Studying Oceans":

A. Collecting scientific data using electronic instruments suspended from buoys or collecting data about the oceans from satellites is called REMOTE SENSING (as compared to going to a place on or in the ocean with a ship or submarine.) The ocean color data shown in this satellite photograph of the ocean around the large Australian island of Tasmania, was collected by the cameras on the satellite in ___ minutes.An oceanographic research ship traveling at ____ knots would take ____ years to coleect the same amount of data!!!!

B. Go to the CSIRO Marine Laboratory in Australia. Write the mailing address of the lab below:

C.GO TO the Division of Marine Research. What is today's date?___/____/___. What is the date and title of the most recent press release from CSIRO's WHAT'S NEW list?
_____

D. What does CAAB stand for?_____
What is the CAAB # for the great white shark, *Carcharodon carcharias*, a member of the mackerel shark family, the **LAMNIDAE**. __ __ __ __ __ __ __ __

☞**CLICK on** **Back** (welcome home to the USA!) to the "Sensing" page (the one with the spinning globe and sattelite image of Tasmania):

A Now GO TO the Rosensteil School of Marine and Atmospheric Science, link to Environmental Observations; and to Satellite Imagery. Click "Cuba/Nova Scotia/U.S. East Coast." Find the Chesapeake Bay on the satellite image. What is today's date?__ __ __ What is the date and exact time of the satellite image on your computer right now?__ __ __ __ __ __ (dd mm yy hh mm ss)
What color was the Chesapeake Bay that day?_____ What was the temp?___^{o}C
What was the ocean temperature at Martha's Vinyard MA (42North,71West) _____^{o}C

☞**CLICK on** **Back** to the Ocean Science Room floor plan and click on "El Nino":
A. What is the "El Nino" phenomenon? (copy the 2nd paragraph starting with the word "every")
_____
_____
_____
_____

_____
_____
_____
_____
B. What does the Spanish term *El Nino* mean?_____
C. Why did the Peruvians name this ocean/atmosphere phenomenon with this name?_____
_____
D. List the effects of the 1982-83 El Nino on the following places:

1. Australia-_____
2. Indonesia, Philippines-_____
3. India, Sri Lanka-_____
4. Tahiti-(place#6) _____
5. South America-_____
6. Across the Pacific-_____
7. Colorado River basin-_____
8. Gulf states-_____
10. Southern Africa-_____+_

II. Scroll down and ☞**click on** the tuna fish to return to the floor plan. Enter the Sea People Room

A. Where is Sri Lanka?_____☞**Click on Back**

B. ☞**CLICK ON "Community,"** then enlarge the photo of the room by clicking anywhere inside the photo (with the t-shirts). Click on the lobster buoys (near botton with green stripe) then scroll down and find your way to the Lobster Institute at the University of Maine. Navigate via "lobster goodies'" to the lobster quiz and take the quiz. "Submit" your quiz for grading and write down your score here._____. Click back to the Lobster Institute Home Page and go to the Lobster Library, GO TO the October 1997 issue of the "Lobster Bulletin" and explain here why "berried" lobsters (females carrying eggs) get "V-notched." (i.e. why do the fishermen cut a little V into the flipper of a berried lobster when they catch one in their lobster traps)

_____
_____

C. What is your visitor # _____.Sign the lobster guestbook with your name. Type "Oceanus Telecourse" in the Company Box and, in the Comments Box type your college (Charles CCC or Montgomery College, or Anne Arundel CC), todays date (mm/dd/yy), your visitor number, and any thing else you'd like to say to .

D. Go back to the Sea People Room (t-shirts) and ☞**CLICK ON** the photograph to the far right in the lower panel (under the t-shirts). If you do not get the photo of the room but rather "People" page with the photo of the stilt fisherman, click on the word "Community" (wait a second for the photo to appear, the text will come up before the photo.) and then click anywhere on the room photo to enlarge it. INSIDE the photo of the exhibit room, click on the bottom right panel photo again to go to the "Working Women" page.

Read the letter by Lorelei Stevens.

1. What newspaper is this letter from?_____
2. What is the writer's point ?_____

_____

3. What's your opinion ?_____

_____

4. Bonus Question, the answer is not found in this exhibit! Why is "Lorelei" an interesting name for the author of this letter ? Who is the mythical Lorelei ?_____

_____

_____

III. ☞**Click on** the tuna fish to go back to the main exhibit hall. GO TO the SEA STORE Room.
A. GO TO SEAcrets, click on the bar code icon, go to "entire list" For each of the following chemicals give the a) source b) three products that contain this chemical and the effect of this chemical on the product.

1. **SEAcret ingredient:** Alginate

a. **Source:** _____

i. product and Effect _____

_____

ii. product and Effect _____

_____

iii. product and Effect _____

_____

2. **SEAcret ingredient:** Carrageenan

a. **Source:** _____

i. product and Effect _____

_____

ii. product and Effect _____

_____

iii. product and Effect _____

_____

3. **SEAcret ingredient:** Chitosan

a. **Source:** _____

i. product and Effect _____

_____

ii. product and Effect _____

_____

iii. product and Effect _____

_____

☞**CLICK on Back to SEA Store**

B. ☞**GO TO PharmaSEA "Drugs, Dressings, Diagnostics"** and answer the following questions:

Many medications and diagnostic agents are derived from proteins, hormones, and other chemical compounds in marine plants and animals. In a few cases, parts of the organisms themselves are used therapeutically.

PHYCOBILIPROTEINS for research are made from SEAWEED. These naturally _____ proteins are used to separate and analyze _____ cells and to identify some types of _____ cells.

CALCITONIN for treating _____ disorders was modeled after a protein from _____ _____. This hormone, also secreted by _____ but in a much less potent form, slows bone breakdown.

TETRODOTOXIN for neuroscience research is collected from _____ and other marine organisms. It's a useful tool because it is a very potent _____ inhibitor.

ADHESIVE for immobilizing cells and tissues for research is made from _____ byssal fibers--the anchors that mussels secrete to fasten themselves to rocks. The _____"glue" has many biotechnological uses.

ABSORBABLE SUTURES contain chitosan, made from shells of _____ and CRABS. In addition to _____ that speed healing after surgery, chitosan has dozens of uses in food, cosmetics, drugs, farm products, and water treatment.

ARA-C, an _____ drug, was modeled on compounds taken from Caribbean _____. It was one of the _____ drugs marketed in the U.S. that had an ocean connection.
BONE SUBSTITUTE for speeding regrowth of bone grafts is available from _____. Coral _____ structure is remarkably similar to human _____.

C. ☞**GO TO *SEA* foods**: List the top ten: 1)_____ 2)_____
3)_____ 4)_____ 5)_____ 6)_____
7)_____ 8)_____ 9)_____ 10)_____

D. ☞**GO TO *SEA ways:***
By far, our most important economic use of the oceans is for shipping. Worldwide each year, tankers, liners, and freighters import and export _____ of tons of products valued at over _____. Shipping lanes are oceanic _____

When steamships replaced sailing ships late in the _____ century, prevailing _____ no longer determined routes. Shipping lanes were gradually adopted, based simply on the fact that a great _____ is the shortest distance between two ports. Ships detour only to miss _____, _____ masses, _____ weather, or each other. The major routes have remained largely the same for a _____.

LIST World's Top Four:
These four cargoes represent well over _____ the total weight of products shipped around the world.

1) _____ _____ metric tons
2) _____ _____ metric tons
3) _____ _____ metric tons
4) _____ _____ metric tons

CLICK on Back

E. **GO TO SIGHT***SEA* **SEEING** and click on sport fishing and the click on National Marine Fisheries Service. Click on the Year of the Ocean "Get Into It" icon and then on the Free Stuff button. What phone number do you call to get the free poster? _____.
Click on the Ocean Facts button and then click on the Marine Mammal button and answer the following:

Marine Mammals: Some of the ocean's most skilled divers are marine mammals. Sperm whales and elephant seals can stay underwater for almost ___ hours. Sperm whales have been recorded at depths of more than _____ feet and elephant seals at depths greater than _____ feet.

_____ is the most important sense to many marine mammals. In fact, most whales and dolphins rely on clicks, whistles, or songs to communicate with each other.

Two of the world's most endangered species of marine mammals live in U.S. waters. There are as few as _____ northern _____ remaining off the U.S. East Coast, and only _____ Hawaiian _____ live and breed at a few locations in the Hawaiian Islands.

In _____, the _____ whale became the only marine mammal species to be removed from the _____ Species Act list. Almost driven to extinction by commercial whaling in the late_____, the gray whale's recovery is a true environmental success story.

☞**CLICK on Back**

☞**Click on the Sustaining Marine Resources** button and answer the following:
In 1996, commercial landings by U.S. fishermen were _____pounds, valued at $_____billion, making the U.S. the world's _____largest seafood harvester.

In 1996, approximately 17 million recreational fishers (are you ❒male or ❒female? would you rather be called a ❒fisherman ❒fisherwoman ❒fisherperson or ❒fisher? Check only one, Prof B. is doing a survey) spent more than $___ billion on fishing and related activities.

U.S. consumers spent an estimated $___ billion for seafood and fish products in 1996.

Many of our important fish species in the United States are overfished and in need of rebuilding, including _____, _____ and _____.

Use the ☞**'BACK'** button to the **SEASTORE** page and go to **SEASERVICES**

Where rivers meet oceans, the young of many species find ideal _____. These transition zones between fresh and salt water are called _____. They are rich in river-deposited and recycled _____, and sea _____ provide good hiding places for the young.
Many commercially useful fish feed in _____ when young. Shrimps, crabs, oysters, cockles, and mussels are caught in _____.
Treasures on Tap: One _____ of the world's _____ and gas come from the sea floor, tapped by _____ _____ or deep-sea drilling. Oceans offer other _____sources. In tropical areas, the difference in _____ between _____ surface water and _____, deep water can be converted into _____. Experimental projects are showing that _____ _____ _____ _____(_____) could be renewable, available round the clock, and easy on the _____ . _____ and _____ energy can also be used to generate electricity.

☞**Click back** to the **SEA STORE** page and then click on the **Smart *SEA* Shopping** link. Scroll down to the heading **"Coastal Zone"** and answer the following:

_____ _____ _____ grant exclusive rights over resources within _____ nautical miles of a nation's shores. The U.S. has the _____ __ __ __.
The surface area of the U.S.'s _____ Exclusive Economic Zone is _____% larger than U.S. land

area. More than _____ the world's_____ people live within _____ miles (96 km) of a _____.
There are _____miles of coastline in the world; _____ with _____% has most of it.
☞**Click on the tuna fish to return to the main exhibit.**

IV. GO TO "Oceans in Peril" room. ☞**CLICK HERE**. Then ☞**CLICK "photo murals"**
A. CLICK "**Coral Reefs**" Coral Reefs are in _____ _____ whereever they are in contact with _____ _____. About ___-___% of coral reefs have already been _____ worldwide.

☞**CLICK on Back**.
☞**CLICK Mangroves.**

Mangroves nurture young _____ and _____, and control _____ and water quality. To date, nearly _____ of the world's mangrove forests and salt marshes have been cleared, drained, diked, or filled.

☞**CLICK on Back**

Click **Polar ecosystems** Polar Ecosystems are no longer beyond the reach of _____ activity. _____, commercial fishing, and _____ are putting pressure on populations of penguins, _____, _____, and_____.

☞**CLICK on Back**
☞**Click on Kelp Forests**
Kelp forests shelter many kinds of _____ in _____ coastal waters of the Americas, Europe, and Asia, but these habitats are _____ to declining _____ _____, over-_____ of _____ and _____, and fluctuations in water _____.

☞**CLICK on Back**

click on **Intertidal Zones** Intertidal zones may support as many as two _____ species, but these _____ between _____ and _____ are in jeopardy from coastal _____, _____-based _____, and ocean _____.

☞**CLICK on Back to Oceans in Peril Room.**

☞**Click on Marine Pollution I Buoy**
☞**Click on OIL POLLUTION** When it comes to mixing _____ and _____, oceans suffer from far more than an occasional_____ _____. Disasters make headlines, but hundreds of _____ of _____ of _____ quietly end up in the seas every year, mostly from non-accidental sources.

Look at the graph that shows how many millions of gallons of oil each source puts into the oceans worldwide each year.
1. Down the Drain: _____ Million Gallons
1. Routine Maintenance: _____ Million Gallons
1. Up in Smoke: _____ Million Gallons
1. Natural Seeps: _____ Million Gallons
1. Big Spills: _____ Million Gallons
1. Offshore Drilling: _____ Million Gallons

Used _____ oil can end up in waterways. An average oil change uses _____ _____; one change can contaminate a _____ gallons of fresh water. Much oil in runoff from land and municipal and industrial wastes ends up in the _____. 363 million gallons
Road runoff adds up. Every year _____ road runoff from a city of ____ million could contain as much oil as one large _____ _____.

Routine Maintenance: 137 Million Gallons
Every year, _____ cleaning and other _____ _____ release millions of gallons of oil into navigable waters, in _____ of discharges of just a few gallons each. 137 million gallons.

Up in Smoke: 92 Million Gallons
_____ pollution, mainly from _____ and industry, places hundreds of _____ of hydrocarbons into the oceans each year. Particles settle, and _____ washes hydrocarbons from the air into the oceans.

Natural Seeps: 62 Million Gallons
Some ocean oil "_____" is _____. Seepage from the _____ bottom and eroding _____ rocks releases oil.

Big Spills: 37 Million Gallons
Only about ____ percent of oil pollution in oceans is due to major _____ accidents, but one big spill can disrupt sea and shore life for miles.

Accidents
Spills and slicks sicken and kill
Large spills--even though a relatively _____ source of ocean oil pollution--can be devastating. The same amount of oil can do _____ damage in some areas than others. _____ reefs and mangroves are more sensitive to oil than _____ beaches or_____-_____ beds; intertidal zones are the _____ sensitive. _____ oil is most likely to cause problems.

Dead oiled otter a victim of the Exxon Valdez spill Prince William Sound, 1989
Oil-covered _____ or _____ can't insulate marine _____ and diving _____ from cold water, and when an animal cleans itself, it also _____ oil.

Even if oil exposure isn't immediately _____ it can cause _____-term harm. Bottom-dwelling fish exposed to compounds released after oil spills may develop _____ disease and _____ and growth problems.

Mangroves stand in oil from a ruptured refinery tank, Panama, 1986

Smithsonian Institution scientists monitored effects of this 1986 spill, one of the largest in _____ North America. Five years later,mangrove _____ still held fairly _____, _____ oil. It may take the mangroves _____ years to recover fully.

Cleanups
Treaty treats pollution problems

International _____ has greatly reduced accidental and operational oil discharges from tankers. MARPOL (for _____ _____) is shorthand for a _____ Nations treaty (the Convention for the Prevention of Pollution from Ships) that became effective in _____. MARPOL is largely credited for reducing oil pollution from shipping by about _____ percent worldwide during the 1980s.

More do-it-yourselfers are doing it right.
More than _____ of all Americans change their own _____, but only about _____ _____ of the used oil from do-it-yourself oil changes is collected and _____. Government and industry-sponsored oil collection and recycling programs in many _____ are increasing awareness of the hazards of _____ used oil and the benefits of reusing it.

☞**CLICK on Back to "Oceans in Peril"**
☞**Marine Pollution Two**
☞**CROSS-COUNTRY SOURCES**

Side effects spread from land to sea
Identifying a water polluter is a snap when you spot a _____ _____ spewing wastes. It's not so _____ when you consider that the line-up includes nearly _____ we do on land. It all contributes to _____ _____ _____--polluted runoff that enters surface, _____ water, and the _____ from widespread and distant activities. It can lead to _____ and _____-bed closings, and spoiled _____ for fish and other aquatic life.

- **Agriculture and Livestock**

Runoff from _____, _____, and _____ contributes nutrients from _____ and _____, as well as _____ and eroded soil .

- **Urban Runoff**

Urban _____ from buildings and _____ surfaces carries _____, _____, _____, trace metals, chemicals, road _____, _____ droppings, and litter.

- **Automobiles**

- **Land Clearing**

Construction, _____ land, and _____ often lead to _____ erosion, putting more sediment in rivers and coastal waters. Filling in _____ takes away vast natural _____ that can break down many common _____ before they reach other water bodies.

- **Sewage**

_____, leached from faulty _____ _____, or dumped directly _____ instead of emptied at boat pumpout stations, contributes _____ and _____-causing _____.

- **Air Pollution**

_____ pollutants, chiefly from _____ and _____, are responsible for almost a _____ of all contaminants and _____ entering marine waters (note from prof B: hi, hope you're having fun surfing the web. In case you haven't noticed I keep making you write down the word "nutrients" over and over. Do you know what we mean by that? Well, you'd better!!--NUTRIENTS refer to "plant nutrients" by which we mostly mean the elements nitrogen(N) and phosphorus(P). N and P come in many forms, the two most popular are forms where they are combined with oxygen atoms to make "nitrate" (NO_3) and "phosphate" (PO_4.) This is basically the fertilizer that farmers put on crops and you put on your lawn. In the water, these chemicals can upset ecosystems by making aquatic plants, seaweeds, algaes, and phytoplankton grow too rapidly. This could affect the penetration of light, the balance of oxygen and carbon dioxide and in many and more subtle ways perturb aquatic ecosystems. TOO MUCH NUTRIENTS IN THE WATER IS CALLED "EUTROPHICATION": IT IS PRETTY MUCH ALMOST ALWAYS "BAD".

Warning Signs (see, I told you so. Check this out.)

Too many nutrients lead to too little oxygen

Too much _____ (from _____ _____ _____ or _____), or too much _____ (from the same sources, as well as _____ or water-treatment chemicals), can set off _____ _____ of _____ and aquatic plants. As the overpopulated plants and _____ _____ _____, _____ can deplete _____ from the water as they _____ the dead plants. Lack of _____ kills _____ and other animals.

Pond after nutrient build-up. ☞ **Click on** Harp's thumbnail photo of the Ches. Bay to enlarge it. (Gross 'eh?)

☞**CLICK on Back**

Gulf bottom-dwellers die in the "_____ _____ " The Mississippi River drains nearly _____ of the continental U.S., carrying excess _____ into the Gulf of Mexico. During the _____ ,

_____ of the resulting _____ _____ consumes _____ and kills some animals and drives away others in a _____ -_____ - _____ bottom area (10,360 sq km) off the coast of Louisiana and Texas.

A "_____ " occurs in the Gulf of Mexico each _____ as _____ build-up leads to drastic reductions in oxygen in bottom waters._____ and _____ catches virtually _____.

First Aid...
The Chesapeake Bay depends on the kindness of many strangers

The Chesapeake Bay's watershed covers _____ _____ and the District of Columbia, and drains _____ rivers and streams--an enormous catch-all for_____ , _____ , and _____ pollution. A landmark _____ government agreement launched efforts to clean up the bay. Successes include reducing _____ pollution from farming and livestock, _____ on _____ detergents and _____ _____ boat _____ ,and legal protection for environmentally sensitive shorelines .

☞**CLICK on Back**
☞**CLICK on RAW SEWAGE**

Around the world, untreated _____ flows into coastal waters, carrying _____ _____ and nutrients that can lead to _____ _____, as well as disease-causing _____ and _____ that require closing beaches and shellfish beds.

As human _____ grows, so will the volume of _____ _____ pouring into the oceans.

Overloaded Systems

Much untreated sewage enters waterways when _____ _____ combined storm-water and sewage systems. In the U.S.,frequent sewer _____ restrict shellfish harvests and _____ _____.

No Systems At All

Most _____ _____ lack sewage collection and treatment facilities, but some developed countries also release untreated sewage. _____ _____ has led to outbreaks of _____ ___ and _____ throughout the world.

Distress Signals
Swim at your own risk (of disease)

_____ water and seafood can carry _____ _____, _____, _____ fever, and a range of _____ and intestinal _____. In 1993, beaches were temporarily closed, or advisories against swimming were issued, over 2400 times in the U.S., usually because of high levels of bacteria. There are no U.S. federal requirements for notifying the public when water-quality standards are violated, and some coastal states don't monitor water at beaches. The problem is greater in other countries, however.

Overfeeding chokes off marine life

In many _____ and bays, excessive amounts of _____ and _____ result in _____ of plants and _____. When the plants and algae_____, _____ _____remove o_____ from the water, killing fish and other marine life. _____ is a major cause of _____ _____ in American estuaries.

Fish kill caused by nutrient build-up, Nanticoke River, Chesapeake Bay, 1992
photo © David W. Harp

☞ **Click on** this thumbnail photo to enlarge it. About how many dead fish are in this picture? (yeah, count 'em) _____ dead fish in this little picture alone!!!

To the Rescue
The Clean Water Act kicks in

The _____ _____ _____ (CWA) was enacted in _____ to make America's water safe for _____ and _____. CWA programs have provided _____ of dollars of federal aid to build or upgrade _____ _____ _____ _____, other _____ _____ _____ controls, and national _____ programs. The act also limits _____ industrial _____ into public sewers, streams, and _____.

☞ **Click on** this thumbnail photo to enlarge it. Blue Plains Sewage Treatment Plant Washington, D.C. photo © Hedrich-Blessing. This is the major sewage treatment plant for the D.C metropolitan area, perhaps you've smelled it? Note the famous Woodrow Wilson Bridge in the background. That's the Potomac River.

The Clean Water Act provided the _____ tools and _____ to build this state-of-the-art plant that treats more than _____ _____ _____ of sewage per day. Along with a _____ on _____ _____ the plant has helped to drastically cut the level of _____ entering the _____ River and _____ Bay.

☞**CLICK on Back**

☞ **Click on Alien species**

Biological Roulette

For centuries, people have _____ locally native marine species to _____ areas. In some cases the introductions are _____: animals are imported for _____ _____. Most introductions are _____ and _____. In their new homes, _____ and stowaways often turn into _____.

_____ _____ brings unwanted passengers aboard. Ships take on _____ water to _____ their _____ in the water or to improve maneuverability and _____. When ships _____ ballast water, plants and animals picked up elsewhere may survive and move into new territory.

Click on the roulette wheel to see how some alien species were introduced, and what happened. Spin the wheel until you find at least <u>four</u> different species. Fill in their information below

Species: _____
From:_____
To: _____
Effect: _____
How introduced: _____

Species: _____
From:_____
To: _____
Effect: _____
How introduced: _____

Species: _____
From:_____
To: _____
Effect: _____
How introduced: _____

Species: _____
From:_____
To: _____
Effect: _____
How introduced: _____

Zebra mussels muscle in in the Great Lakes
The most famous or infamous ballast-water stowaway is the_____ _____. Originally from _____, it now flourishes, to say the least, in the _____ _____: _____ zebra mussels may occupy only ___ cubic yard. Mussel damage to industries, public utilities, navigation, boating, and sport fishing could total $__ _____ by the year 2000.

Asian clams take the advantage in San Francisco Bay
In 1986, just after a flood lowered populations of native San Francisco Bay clams and mussels, the _____ _____, *Potamocorbula amurensis*, arrived in ballast water. Within two years, there were more than _____ Asian clams per _____ _____ in some areas. Now the Asian clam population, along with _____ other introduced species, could alter the bay's entire food web.

Precautions
Guidelines get rid of stowaways
In 1991, the _____ _____ Organization (a United Nations agency) developed voluntary _____ for ballast water. _____ participating major and medium-sized shipping nations will take measures to control the spread of alien species. §

☞ **CLICK on Back**

☞**CLICK on America's Watersheds**

More than _____-_____ of ocean pollution comes from land.
Most of it flows into the oceans from the mouths of _____.

Tributary _____ and streams pick up _____, _____, fertilizers, _____, toxic chemicals, _____ _____, _____, decaying organic matter, and litter from the surrounding land that they drain.

By the time a _____ reaches the ocean, it's carrying the runoff load from a _____ that may drain _____ of _____ _____ .

Reducing watershed pollution is complicated. It requires managing diverse activities including lawn care and gardening, farming, land clearing, _____, treating _____ and waste-water, handling and disposing of trash, and limiting _____ and _____ air pollution §.

What's your watershed address?
You're always in a watershed. To find out which one, **trace** the drainage path from **your home** to the ocean. What stream, river, lake, aquifer, reservoir, or coast does the land around your home drain to?
I live in the town/city of _____ which is in _____ county. Try to trace the path of land runoff from your house to the ocean. List as best you can, the streams and rivers etc from your house to the ocean.

_____
_____

☞ **CLICK on Back** to the **Oceans in Peril** floorplan and click on the **Fishing Buoy**
☞ **CLICK on Overfishing...**
Too many people chase too few fish

Fish catch has _____ _____ since the late _____.

In many places, heavy fishing pressure and environmental problems have forced governments to limit or halt fishing until fish _____ can recover. _____ transforms marine ecosystems and also costs people jobs and _____ .

Reel in the facts on commercial catches

Most of the world's _____ _____ fish species are fished to _____ or _____. Valuable fishes that once furnished the _____ of fishermen worldwide are nearly gone, replaced by species of much _____ commercial value. The United Nations Food and Agriculture Organization issues status reports based on the past 25 years of fisheries statistics. Choose any four organisms from the drawings and give name, location, and status of each.

Name: _____
Location: _____
Status: _____

Name: _____
Location: _____
Status: _____

Name: _____
Location: _____
Status: _____

Name: _____
Location: _____
Status: _____

Name: _____
Location: _____
Status: _____

On the Brink
Bluefins are going the way of the buffalo

_____ tuna is one of the most _____ _____ and exploited fish in the sea. A single bluefin can bring as much as $_____ at U.S. docks. The number of adult bluefins in the Western Atlantic is estimated to have dropped almost ____% since 1970.

Bluefin tuna are _____ and among the _____ and _____ marinefish. An adult may weigh _____ pounds (_____) and can swim in spurts of up to _____ miles per hour (_____).

Frozen tuna, Tsukiji fish market, Tokyo, Japan, 1993 Bluefin tuna is a highly prized delicacy in exclusive Japanese _____ restaurants.

Under Control

Fish farmers raise their own catch

Raising saltwater _____, _____, _____, and _____ is a growing business. Marine _____ provides more than ____% of total fish production worldwide.

Coast Guard cutters patrol the coasts

Under the _____ _____ _____ _____ _____ Act, U.S. Coast Guard crews may board _____ and _____ vessels in U.S. coastal waters to enforce _____ _____. Violators can be _____, and their _____ and _____ seized. The Coast Guard checks on sizes of fish and lobsters caught, gear and _____ _____ size, use of _____ _____ _____ on shrimp nets, and other activities.

CLICK on Back, then CLICK on Chain Reaction.

What happens when people catch too many fish?

Fishermen lose their _____; other animals may starve. Entire marine _____ react to the _____ of heavy _____ _____.

Where have all the codfish gone?

In 1992, the Canadian government closed fishing for Atlantic cod off of Newfoundland, and more than _____ people lost _____ §. Several problems contributed to the decline in Atlantic cod: heavy _____ _____, changes in water _____, and decline in the cod's _____, a fish called _____.

Short seasons make fishermen play beat the clock

One way to try to _____ _____ pressure is to _____ _____ _____ during which fish can be caught. By 1992, the entire U.S. commercial fishing season for _____ _____ off _____ had been pared to ___ ___ _____ _____ per year. For two days, fishermen worked round the clock, often in bad weather, risking life and limb to catch as many halibut as humanly possible.

Regardless of weather and exhaustion, fishermen race against time and each other in the dangerous halibut "derby," Alaska, 1993 Most halibut hooked weigh between ____ and _____ pounds (9.1-45.4 kg), but when a _____-pounder is on the line, the whole crew must help land it. In 1992, fishermen landed about 60 million pounds (27.2 million kg) during the 48-hour halibut season. _____ _____ may be _____ for fish, fishermen, and fish consumers.

Under the new _____ _____ _____, a certain _____ of halibut _____ are given _____ to a _____ _____. This system could eliminate the "races" in open-season fishing, give more time to handle non-target catch safely, make working conditions safer, let fishermen decide when to fish, bring fishermen higher prices, and bring consumers better, fresher fish.

With fewer fish to eat, sea lions suffer

Like some birds and other fish-eating mammals in the Bering Sea and northern Gulf of Alaska, _____ _____ lions are _____ in number. Biologists think that food _____ due to _____ fishing may be one of the major causes of the sea lions' _____ decreases.

Skates and sharks take over after overfishing

Even the richest fishing grounds can run out of fish. _____, _____, and yellowtail _____ were once common catches in the waters above _____ Bank, a vast _____ off New England and Nova Scotia. Now, after _____ decades of _____ _____, ineffective management, and environmental changes, _____ are _____ of less valuable _____ and spiny dogfish, a small bottom-dwelling _____ .

A landmark agreement controls fishing to conserve an ecosystem

_____, _____, and _____ hunting in past years depleted many species in the _____ _____ around _____. When interest grew in harvesting the _____ that many antarctic birds, mammals, and fish eat, it prompted world leaders to negotiate a new approach to fisheries management. CCAMLR (the _____ for the _____ of Antarctic Marine Living _____), a treaty enacted in 1980, requires that regulations managing all Southern Ocean fisheries consider potential effects on the _____ antarctic _____.

_____, a _____ _____ in the antarctic food web. In 1991 a _____ was set on krill _____ after CCAMLR evaluated the impact of the krill harvest not only on the krill population but also on other species that depend on these _____ _____ **-**_____ _____ for food.

☞ **CLICK on Back**
☞ **CLICK on Terrible Tackle**

Bombs, poison, and scrapers damage habitats

_____ **Poisoning** wouldn't seem an ideal way to catch fish (and it's generally _____), but many tropical _____ fish are captured after being stunned with _____ _____.

Cyanide helps collectors catch fish, but it also _____ coral reef _____ and other plants and animals. As fish populations continue to decline, fishermen begin cyanide collecting in _____ areas and destroy even more habitat.

Cyanide fishing, Luzon, Philippines

Fishermen _____ sodium cyanide into reef _____ where fish hide. Almost ___% of the marine _____ fish sold internationally come from the _____, many caught by cyanide fishing.

Although the practice has been _____, and many importers refuse cyanide-tainted fish, _____ _____ use of cyanide _____.

Bombs

_____ _____ catches food fish in a flash, but it's dangerous to fishermen, devastating to fishes and coral reefs, and even though _____ in most countries, still used on coral reefs in Asia, Africa, the South Pacific, and the Caribbean. A _____ _____ can destroy _____ of years of _____ _____.

Blast fishing is also common in _____, Indonesia, _____, Thailand, and _____. Blasting has caused reef damage in _____ of the countries in the _____ _____. A _____-bottle-sized _____ exploding near the bottom will shatter all stony corals in a circle ___ _____ (3 m) wide. A _____-sized bomb takes out an area about ____ feet (10 m) in diameter.

Scrapers

_____ a _____ along the sea floor is one of the most common forms of fishing around the world. _____ _____ catches fish and shrimp easily, but it _____ the complex _____ of plants and animals, many of them very small or hidden in the _____, that live on sandy and muddy sea floors.

Helping Hands

Say No to cyanide; Yes to hand nets

The International Marine Life Alliance, a private conservation organization, has been training fishermen in the Philippines in the use of _____ _____. Nets are _____ to use than _____

Local fishermen help shattered reefs

In the mid-_____s the economy of the _____ region on Negros in the _____ was collapsing because of overfishing and blast- fishing damage to reefs and _____--vital fish _____. Local fishermen have _____ over 100,000 _____ _____ and built over a thousand _____ _____ of _____, _____, and _____.

More Information

☞ **CLICK on: International Marinelife Alliance**: An organization dedicated to the protection of marinelife forms and the conservation of their habitat.
☞ **CLICK on "Coastal Clean-up** and find out how many participants there were in the clean-up project in 1997 _____ and the number of kilograms of trash collected in 1997, So... use these two numbers to calculate the average number of kilograms of trash each participant picked up in 1997. _____. A kilogram is 2.2 pounds!
☞ **CLICK on Back to the FISHING page and CLICK on BY-CATCH.**

By-catch
_____ are not always _____: some _____ ____ _____ in their paths--the _____ catch, as well as many _____-_____ species (the ____-catch). Unwanted or undersized animals culled from a catch are _____--thrown back into the sea, _____ or dying.

A shrimping crew culls the by-catch, Gulf of Mexico Commercial marine fisheries in the U.S. alone _____ _____ up to ____ _____ pounds of by-catch each year--_____ the _____ and _____ catch _____.

Sorting catch and by-catch on a shrimpboat deck, Georgia, 1986 Shrimpers tow nets that collect shrimp, and many other animals in their path. Red snapper, croaker, mackerel, sea trout, spot, drum, and other fishes--up to _____ _____ _____ than the shrimp catch--are _____ _____, already dead or dying.

Banned

Driftnets drowned by-catch

With nearly _____ _____ _____, enormous _____ (used in the open ocean) catch and hold fish by the _____. Driftnets also _____ and _____ _____, sharks, _____, and _____. The by- catch problem was so dire that the United Nations _____ large- scale _____ on the high seas in _____, prompted by widespread _____ from governments and conservation groups around the world. Smaller driftnets are still being used in coastal waters, including those of the U.S.

Driftnetting in the North Pacific, August 1990 When strung together, _____ could sweep almost ____ _____ (60 km).

Drowned white-sided dolphin, North Pacific, 1990 During the peak years of _____ in the late _____s, more than _____ _____dolphins and _____ and _____ of _____ were killed annually.

Safety Caps

_____ let sea turtles take the easy way out

A _____ _____, trapped in a _____ _____ and unable to surface for _____, can _____ in ____ minutes. But since May 1990, many U.S. shrimp trawls in the Atlantic and Gulf of Mexico have been _____ to use _____ _____ _____--TEDs. Many Central American countries now also require TEDs in the _____ _____, and western Atlantic. TEDs reduce shrimping- related sea turtle _____ by about ____%.

TED (turtle excluder device)☞ **CLICK on the thumbnail diagram to see how a TED works.** Sea turtles hit a grid before entering the main part of the net. Shrimp slip through the grid into the net, but turtles slide along the bars and out a webbed flap. Illustration © Bonnie Branner

Nordmore _____ gives finfish a break
Named for the Norway county where it was developed, the _____ grate was designed to eliminate ___- _____ of small fish in shrimp nets. Since 1992, _____ shrimpers in the Gulf of _____ have used the grate to _____ stocks of _____, cod, and _____.

☞ **CLICK on the thumbnail diagram to see how a Nordmore grate works.**Nordmore grate Mesh funnels shrimp and fish to the bottom of the net. Shrimp go through the grate; almost all fish escape through an opening in the net above the grate.

More Information:
☞ **Link to Green Sea Turtles nesting** Smithsonian Photographer Laurie Minor-Penland's personal account of her trip to photograph Green Sea Turtles nesting on the beach at Tortugeuro, Costa Rica. Choose **The nesting Green Sea turtles** from her table of contents.

The _____ _____ _____ *Chelonia mydas* only nests on the beach at _____. As she crawls out of the ocean, if she sees any _____ or _____ on the _____ , she will turn around and return to the sea _____ nesting. This is one of the reasons why the species is _____. _____ of our _____ has left the sea turtles with very _____ nesting grounds. ...Read the rest of this page and then...

☞ **CLICK on Back all the way to the Ocean Perils Floor Plan.**
☞ **CLICK on the HABITATS Buoy**
☞ **CLICK on Lost Wetlands**

Coastal _____ stretch inland from estuaries and beaches. In _____ climates, they're _____ _____ and grassy fresh marsh and tidal flats. In _____ areas, they include swampy _____ of _____. Draining, _____, and _____ wetlands, as well as _____ _____ _____, are _____ coastal wetlands _____.

What's to lose?

There's more to swamps and marshes than meets the eye. _____ with _____ and plant debris, coastal wetlands are _____ _____ for _____, shrimps, and _____, and _____ sites for _____ . Not only do wetlands crawl with wildlife, they also _____ _____ pollutants, _____ inland areas from _____, wave, and _____ damage, and support _____ _____ for _____.

Red and black mangroves, Belize

Thickets of _____ roots are perfect _____ for wild shrimp and fishes. An added bonus, the roots protect coasts from wind and wave _____. Most _____ countries have _____ more than _____ of their mangrove forests to _____, urban development, or _____ to _____ fields, cropland, or _____ - _____ ponds.

Other Resources:
☞ **Link to: National Estuary Program**
☞ **CLICK on "About Estuaries"**
About Estuaries
What is an Estuary?
An _____ is a _____-_____ body of water formed where _____ from rivers and streams flows into the _____, mixing with the _____ sea water. Estuaries and the lands surrounding them are places of _____ from land to sea, and from fresh to salt water. Although influenced by the _____, estuaries are _____ from the full force of ocean waves, _____, and storms by the _____, _____ _____, or fingers of land, mud, or sand that define an estuary's seaward boundary.

Estuaries come in all _____ and _____ and go by many different names, often known as _____, lagoons, harbors, inlets, or _____. (Note _____ all water bodies by those names are necessarily estuaries. The _____ _____ of an estuary is the _____ of _____ and _____ water, not the name.) Some familiar examples of estuaries include San _____ Bay, _____ Sound, _____ Bay, Boston Harbor, and Tampa Bay.

The tidal, sheltered waters of estuaries support unique communities of plants and animals, specially adapted for life at the margin of the sea. Estuarine environments are among the _____ _____ on earth, creating more _____ _____ each year than comparably-sized areas of forest, _____, or _____ land. Many different habitat types are found in and around estuaries, including shallow open waters, freshwater and salt marshes, sandy beaches, mud and sand flats, rocky shores, oyster reefs, mangrove forests, river deltas, tidal pools, sea grass and kelp beds, and wooded swamps.

Why are Estuaries Important?

Estuaries are _____ for the _____ of many species. Tens of thousands of birds, mammals, fish, and other wildlife _____ ___ estuarine habitats as places to _____, feed, and _____. Estuaries provide ideal spots for migratory birds to rest and refuel uring their journeys. And many species of _____ and _____ rely on the sheltered waters of estuaries as protected places to _____, giving them the nickname "_____" of the sea." Hundreds of marine organisms, including _____ _____ _____ fish species, _____ on estuaries at some point during their development.

Besides serving as important habitat for wildlife, the wetlands that fringe many estuaries also perform _____ _____ _____. Water draining from the uplands carrie _____, _____, and other _____. As the water flows through fresh and salt marshes, much of the sediments and _____ are _____ out. This filtration process creates _____ and clearer water, which benefits both people and marine life.

☞**CLICK on Back**
☞ **CLICK on <u>DAMS AND DIVERSIONS</u>**

Pluses
There are over _____ dams in the United States, and more are planned. Why? We _____ _____ water to meet household needs, _____ fields, supply factories, control _____, generate _____, permit barge traffic deep inland, and make lakes for boating and fishing.

Minuses
Dams _____ the natural _____ from watersheds. Less _____ washes downstream to _____ coastal wetlands and beaches. Salt levels _____ at river mouths, as less fresh water flows out. Dams _____ with migration routes and _____ grounds, and water released after long periods behind dams is often _____- poor and _____.

Before the ____ _____ River dams were built for irrigation and _____ power, ___ million wild _____ swam upriver each year. Today, streams and tributaries yield only ____ million salmon, most bred in hatcheries.

What lowered water levels do

More than a hundred dams and water-diversion systems built to provide irrigation and reclaim cropland have transformed the watersheds that feed San Francisco Bay. Water withdrawals have depleted the San Joaquin River's flow by up to ___%.

Salinity has spread into the delta. Combined _____ of _____, _____ bass, _____, and other estuarine fisheries have exceeded $__ _____. Control structures have been built to reduce the amount of _____ water entering the delta.

Remedies
Water savers save water for wildlife
Conserving water frees up more water for wildlife. Water- efficient _____, shower heads, and _____ reduce domestic water consumption--a good thing, since _____, bathing, and hand-washing use more than three-_____ of the water in a typical American home.

Traditional toilets turned in under a rebate program, Los Angeles, 1993
Although Los _____ County spent $_____ for each _____-___ toilet, the state will save millions of gallons of water as residents switch to _____-_____ toilets that use less than ___ gallons per flush.

☞ **CLICK on Back to "Oceans in Peril" Floorplan**
☞ **CLICK on the "Planet-wide Perils" Buoy**
☞ **CLICK on "CLIMATE CHANGE"**

CLIMATE CHANGE
Through <u>computer models</u>, scientists are working to understand how increases in _____ _____ and other "_____" gases in the atmosphere _____ change the earth's climate. But so far, complex interactions between oceans, atmosphere, land, and the sun have made precise climatic predictions _____

What ___ ___ _____ is that human activities--_____ fossil fuels and _____--have put

a greater _____ of greenhouse gases into the atmosphere, and have put all of us into a _____ _____ with an unknown outcome.

_____ are crucial in shaping _____ because they _____ and _____ heat around the planet, and they're a major _____ and _____ for _____ (such as carbon dioxide) that affect climate.
It's _____ fully _____ how much carbon dioxide the oceans can _____ and _____.

What if climate change warms the oceans?
Storms might rage
If oceans grow _____, more and stronger _____ and _____ could hit coastal North America and the Far East--but most _____ are that the greatest warming would occur in _____ _____, outside the hurricane belt.

Shores might be submerged
Sea _____ would _____ if the oceans warmed, because water _____ as it heats up. If polar _____ _____ melted, sea level would _____ further. A rise of even a few _____ would _____ low-lying islands and coastal cities.

Coral reefs might die back
Coral's _____ (and some of their _____) come from algae living within coral tissue. Too much _____ causes coral to _____ the _____. Although _____ could cause coral "_____" in some areas, it _____ also _____ areas of warm water that corals need to _____.

Weather Advisory
More greenhouse gases could be too much of a good thing

Life is possible because water vapor, carbon dioxide and other gases trap heat radiating from the earth's surface. _____ these natural atmospheric gases, the planet's average _____ would be far _____ _____.

Burning _____, _____, and _____ (and forests and grasslands) releases carbon _____. The volume of this and other _____-_____ _____ in the atmosphere has grown ___% since the _____ _____, around _____. It's _____ that increases in greenhouse gases could lead to regional and global climate changes.

Climate savers work on many fronts
Scientists are studying the oceans' role in climate and weather, while cooperation between governments, industries, and consumers already leading to energy conservation that will cut greenhouse-gas emissions.

Several _____ research programs on interactions between the ocean and atmosphere began gathering extensive _____ on the oceans in the _____s, using _____, research _____, _____ and research _____.

☞ **LINK to "World Ocean Circulation Experiment (WOCE)"**
General WOCE Information
☞ **LINK to Introduction to WOCE**
The Purpose of WOCE

The _____ _____ _____ Experiment (WOCE) is an unprecedented effort during _____-_____by scientists from more than ____ nations to study the large-scale circulation of the ocean. WOCE will employ several _____, dozens of _____, and thousands of instruments to obtain a basic description of the physical properties and circulation of the global ocean during a limited period.

Why WOCE is Important
Determining how _____ activities and _____ forces are influencing climate--and foreseeing the consequences involved--is one of the greatest _____ to _____ today. Understanding climate change depends on _____ scientific _____ of the ocean and the atmosphere.
☞**Click Back twice:**
Joint Global Ocean Flux Study (JGOFS) _____ the role of marine _____ and _____ to better understand how oceans and the atmosphere _____ carbon _____, and how carbon is _____ to the _____ _____.

SCROLL DOWN TO: "More Information"
☞ **LINK to TOGA-TAO:** Observing Array in the Tropical Pacific from NOAA

Find a definition of La Nina and write it here:
_____
_____
_____

☞ **CLICK on Back to "Planet-wide Perils" page**
☞ **CLICK on "OZONE HOLE"**

OZONE HOLE
The _____ "hole" is really a _____ in concentrations of ozone high above the earth in the _____. Even normally, there's not much ozone--only _____% of all atmospheric gases

--but it's vital because it shields us from harmful _____ radiation.

Each _____ the amount of ozone in the stratosphere over _____ drops by about half, exposing the Southern Ocean to more UV-B radiation .

Too much could harm or kill microscopic _____ and _____ the ocean's ability to remove carbon _____ from the atmosphere--contributing to _____ change .

Hazards Ahead
CFCs are ozone eaters
Rising levels of some manufactured chemicals _____ stratospheric ozone.
CFCs (_____) have been widely used as _____, aerosol propellants, cleaning solvents, and _____ agents for chemicals.

CFCs are _____ _____ and can remain in the atmosphere for up to _____ years.

Krill under ice
Are CFCs _____ killers? Reactions set off by _____ _____ radiation in the Antarctic could move up the food chain, from _____ to small animals that krill eat, with far-reaching results in a _____ _____ that includes _____ species of finfish, ____ species of seabirds, ____ species of seals, and ___ species of whales and dolphins--not to mention _____.

Life Savers
International cooperation phases out CFCs
An _____ signed in _____, Canada, in 1987 by 47 countries established an international framework for _____ the ozone layer by phasing out the use of _____-depleting substances. More than ____ countries have now agreed to abide by the treaty.

Manufacturers phase in CFC alternatives
As the _____ _____ takes effect, alternatives less harmful to ozone, such as HFCs (hydrofluorocarbons), are replacing CFCs as coolants in automobiles and other products. §

☞ **CLICK on Back**

☞ **CLICK on GROWING PAINS**

The world's population is expected to reach ___ _____ by the year _____.

- Already, _____ _____ _____ the world's population-- over _____ billion people--live within ____ miles (100 km) of a _____.
- Rapid _____, especially in developing countries, will lead to more coastal _____ cities with ____ _____ or more people .
- As coastal zones become more densely populated, coastal water quality will suffer, wildlife will be _____, and shorelines will _____.

By _____, ___ out of ___ of the world's largest cities will lie on or near _____:

1 _____, Japan	27,956,000
2 Mexico City, Mexico	_____
3 _____, Brazil	22,558,000
4 Bombay, India	18,142,000
5 Shanghai, China	17,407,000
6 _____ U.S.A.	_____
7 Beijing, China	14,366,000
8 Lagos, _____	13,480,000
9 _____ Indonesia	13,380,000
10 Los Angeles, U.S.A.	_____
11 Seoul, _____	12,949,000
12 Buenos Aires, Argentina	12,822,000
13 _____, India	12,675,000
14 Manila, _____	12,582,000
15 Tianjin, China	12,508,000

Who consumes more?

With only ____% of world population, _____ use about _____ of the world's processed _____ resources, and about _____ of the world's _____ _____ energy sources, like _____ and _____.

Compared to a person from India, a typical American uses:

_____ times more aluminum
_____ times more natural gas
_____ times more petroleum
_____ times more pulp wood (for paper)

******* THE END *******