Trading Books For Boats In Bonne Bay

Student Workbook 2008

Name:_____

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Note to Students

The information in this workbook and the answers to the questions will serve as YOUR notes for this unit of study. You can find the answers to the questions by:

- Viewing the power point presentation (your teacher will be given a hard copy to bring back to school). This presentation is also available at www.bonnebay.ca for your review.
- Studying the displays and posters.
- Participating in the activities during the boat trip.

Learner Outcomes: Water Quality

Trading Books For Boats in Bonne Bay has been designed to fulfill the following outcomes:

1. Humans have had a major effect on environmental quality.
A. Describe changes in the environment (local, regional, and global) that are the direct and indirect result of human actions.
2. Environmental quality can be determined by an assessment of the living and non-living factors.
A. Describe the following factors as indicators of water quality: - pH levels - dissolved oxygen levels - phosphate levels - turbidity - temperature - biological indication - toxicity levels
B. Investigate the water quality in the local area.
C. Prepare a report based on the results of the investigation.
D. Propose suggestions and recommendations for restoring and/or maintaining a high level of water quality in the local area.
E. Communicate the findings and recommendations of your investigation.

Water Quality

NOTE TO STUDENTS - This section will be completed based on the notes provided to you in this workbook and the presentation that will be given to you (your teacher will be given a hard copy). If you wish to review the presentation again go to www.bonnebay.mun.ca

pH

Each molecule of water is made up of one oxygen and two hydrogen atoms. It also contains some ions of free hydrogen atoms (H+) that have a positive charge, and some ions of oxygen and single hydrogen atoms (OH-) that have a negative charge. These ions are very unstable and will attempt to combine with other elements. The measure of the ratio that exists between these two ions in a sample of water is called its pH. The pH scale ranges from 0 to 14.

Pure water is neutral and has a pH of 7. It contains the same number of negative and positive ions. If water contains more H+ ions, it is considered acidic and will have a pH lower than 7. If it contains more OH- ions than H+ ions, it is basic and will have a pH value greater than 7.

Fish need water that is near the middle of the pH scale to survive. For example, salmon need water with a pH between 6.5 and 8.0 for full productivity.

Increased amounts of nitrogen oxide and sulfur dioxide are being placed into the atmosphere by automobile exhaust and the burning of fossil fuels. These emissions are converted to acids in the atmosphere and fall as acid rain or acid snow. Periods of high water caused by melting acidic snow may rapidly decrease the pH in streams.

pH Questions:

What are the effects of low pH on aquatic organisms?

What are some causes of low pH in aquatic ecosystems?

Temperature

There are many natural factors which affect water temperature. These include:

- season;
- size of water body and **bathymetry**
- water source;
- water velocity;
- latitude and climate;
- water chemistry;
- water circulation and currents

In the coastal zone all three types of aquatic environment are present – freshwater, **estuary** and marine. Water temperature and range are different in all three environments.

Water temperature in lake systems varies as the seasons change. During spring, temperature patterns within a lake are fairly constant, as are water density and the amount of dissolved oxygen. As summer approaches, the sun heats the lake system, causing internal changes. The top layers of the lake warm first, and because it is slightly less dense, the warmer water does not circulate but stays at the surface. Thus, two distinct layers form: a warmer, upper layer and a cooler, lower layer. This layering is called **thermal stratification.** By midsummer there will be three layers: the warm upper layer, a transition layer from warm to cold called the **thermocline,** and the cool deeper layer. These layers generally form in lakes deeper than 12 metres, while shallow water bodies are usually warmed uniformly.

When winter arrives, the water cools. The layering disappears and temperatures become uniform again. As air temperatures continue to fall, the surface waters of the lake cool further, become denser and sink to the bottom. This pattern continues until the water temperature reaches 4°C, the temperature of maximum density for water. Water colder than 4°C is lighter, remains near the surface, and freezes. Thus, ice forms at the lake surface, and in the depths the temperature is 4°C.

A similar phenomenon exists in the ocean, however the **thermal stratification** (layers) exist throughout the year. There are many factors that impact water

temperature in the ocean including: oceanic currents, tides, wind, physical geography and freshwater input. The influence of these factors on seawater temperature increases the complexity of the temperature structure in the ocean. In Bonne Bay, for example, glacial formation, local water circulation and lack of deep water mixing in the Eastern Arm play an important role in determining water temperature. The open ocean however, is affected more by ocean currents, wind patterns and latitude.

In an **estuary**, freshwater flows into salt water creating two layers – an upper layer of fresh, low-density layer, and a lower layer of dense salty water. Some mixing occurs at the meeting point of these two layers. Estuarine environments are very dynamic and water temperatures are influenced by many factors.

While plants are adapted to these temperature variations, many animals prefer more stable temperatures and generally move to stay within a certain range. These temperature preferences are critical for feeding, reproduction, and migration. In particular, temperatures are critical for the survival of young.

Temperature also influences the amount of **dissolved oxygen** available in the aquatic environment. Cold water contains more dissolved oxygen than warmer water. In the oceans cold, dense, oxygen rich water masses form at the surface of the earths poles and then sink. The colder water is pushed by oceanic currents from the Poles into mid-latitude waters. **Upwelling** occurs in specific areas of the oceans, bringing oxygen rich waters up from the bottom.

Temperature Questions:

What is the average water temperature in Bonne Bay?

How do changes in water temperature effect living organisms?

Dissolved Oxygen

Aquatic organisms depend on oxygen dissolved in water. Even if water is saturated with oxygen, that is, holding as much as it is capable of holding, it may contain less than 5% oxygen. Air by comparison contains 21% oxygen. Many factors can affect the oxygen content of water. **Turbulence**, temperature, organic matter and plant growth all influence daily and seasonal oxygen levels.

Turbulence

Dissolved oxygen content is increased by water movement. Generally, standing or stagnant water contains less dissolved oxygen than turbulent water. Water that flows over a waterfall, or through shallow riffles, mixes with air thus increasing the opportunity for oxygen to become absorbed.

Temperature

Temperature also influences oxygen concentrations. Generally cold water contains more dissolved oxygen than warm water. Water running through a cool shaded area can increase in its capacity to hold oxygen, but in an open area where it is heated by the sun, its oxygen holding capacity decreases.

Organic Matter

The quantity of organic matter in water also affects the amount of dissolved oxygen. In a natural environment that has not been disturbed by humans, the organic matter present in a stream will originate from dead aquatic plants, from leaves shed by stream side vegetation, or from animals that have died in or near the water. Other sources of organic matter in water are the result of human activity. These include logging debris and effluent from homes and industries.

Decomposition of organic matter by micro-organisms such as bacteria and fungi requires oxygen. Therefore, water with a high organic content will use up available oxygen quickly. High **biological oxygen demand** (BOD) can cause oxygen levels to become too low to sustain most aquatic organisms.

Plant Growth

Plant growth also affects dissolved oxygen levels. During summer months, when plants receive light from the sun, they can produce large amounts of oxygen during the day through **photosynthesis**. However, at night when it is not occurring, their respiration uses up some of that oxygen. In locations where aquatic vegetation is dense, dissolved oxygen levels can fluctuate considerably from day to night. Dead aquatic vegetation can cause serious problems in winter as it decomposes under a layer of ice. This decomposition increases the BOD, but there is little chance to restore oxygen levels as they are depleted. The ice barrier separates the water from the air, preventing atmospheric oxygen from reaching and dissolving into the water. The barrier created by ice and snow also blocks or diffuses what little light there is, preventing photosynthesis from taking place and replenishing the dissolved oxygen. Depleted oxygen often results in a winter kill of aquatic organisms including fish.

Dissolved Oxygen Questions:

What human activities affect dissolved oxygen levels?

What is the effect of reduced dissolved oxygen levels on aquatic organisms?

Phosphates

Phosphates contain phosphorus is an important nutrient in many organic processes, especially those involved in energy storage. Phosphorus occurs in the water naturally through decomposition of organisms. However, Phosphorus is present in household cleaners and fertilizers, and can enter aquatic systems through municipal wastewater and runoff. An excess of phosphorus increases the nutrient supply for plankton growth, contributing to algal blooms that can lead to choked water systems.

Phosphates Question:

What are the possible sources of phosphates?

Turbidity

The sun is the source of light and energy in ecosystems. All plant life (plankton, algae, and macro-plants) need light for photosynthesis, the basis for all energy flow in the environment. Water must be clear if light is to reach organisms low in the water column.

The depth of light penetration in water is determined by the nature of light and water's ability to filter out specific wavelengths. Light is made up of different wavelengths that we perceive as different colours. Not all colours are equally transmitted through water. Red wavelengths are filtered out in the upper layers while the blues reach farthest into the depths.

Dissolved and suspended material such as tannins and sediments colour water and affect its clarity, and consequently the penetration of light. Measuring the clarity of water gives an indication of the health of an aquatic system. If water is cloudy, it will reduce light penetration and is said to be **turbid**.

Clarity is determined using a Secchi Disc, which indicates the depth to which light can penetrate. This by itself, however, does not indicate water quality. Clear water may be good for light penetration, but water organisms may be killed by acidity. Turbid water may prevent light penetration, but the turbidity may be caused by plankton, which indicates abundant nutrients. A Secchi disc reading alone should not be the only indicator of water quality.

Turbidity Question:

What factors might affect turbidity in Bonne Bay?

Salinity

Ocean water is about 3.5% salt. Ocean salts were originally dissolved from the earth's volcanic crust when the world was still young. Salinity now remains constant because of the balance between salt input from rivers, streams and groundwater discharges and salt extraction into the seabed. Oceanic salinity varies between 30 ppt (parts per thousand) in the Arctic Ocean and Labrador Sea to 37 ppt in the Mediterranean Sea, with average salinity of the oceans being 35 ppt. Salinity of the top layer of the ocean is closely linked with precipitation and evaporation. Evaporation leaves behind dissolved salts increasing salinity and precipitation "freshens" the top ocean layers. Very high latitudes can also see decreases in salinity where sea ice melts and "freshens" the water.

The oceans are naturally salty. The saline environment has quite an effect on life in the oceans. Most creatures that live in the ocean could not live in fresh water, and visa versa. However, when the highly saline waters of the ocean meet fresh water, an estuary is formed. This is a special environment where some creatures have learned to adapt to a mixture of fresh and salt water. When fresh water, ground water and soils are altered by human actions and salinity greatly increases, it can have an extreme detrimental effect on life there. Changes in salinity brought about by human residential, commercial and industrial activity can kill plant life, aquatic life, and animal life in a given area.

Salinity Questions:

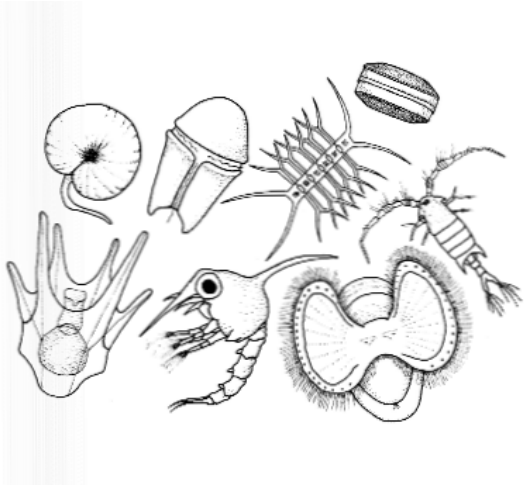
On the boat a salinity meter is used to measure the amount of salt present in the sea water that you collected. What was that measurement and how does it compare with average salinity levels (35 ppt)?

Explain what would happen to that salinity measurement if several icebergs began to melt in Bonne Bay (note: icebergs are made of freshwater)?

LEARNING STATIONS

NOTE TO STUDENTS - The following section will be completed based on the activities you conduct and observations you make at the five learning stations

Station 1: Plankton



Observe the display and plankton under the microscopes and answer the following questions:

What is plankton?

Define Phytoplankton

Define Zooplankton

What is the importance of plankton in the marine environment.

Draw arrows below connecting the organisms that form food chains. Use a different colour for each chain and see what food web develops. **Use the information on the back of the organism cards provided to help you make the food chain connections and remember to <u>start</u> with plankton.**

Man

Tern

Seals

Adult Cod

Herring

PLANKTON

Capelin

Humpback Whale

Mussels/Clams/Scallops

Jellyfish/Sea Anemones

Lobster/Crab

Wolffish

Sea star

Leatherback Sea Turtle

Identify, and list below, 3 organisms in our touch tank that feed directly on plankton.

1.

2.

3.

What is an 'algal bloom'? Describe a healthy algal bloom and a harmful algal bloom.

Station 2: Oil Spill Prevention and Remediation

Carefully study the display and answer the following questions:

List 3 potential sources of oil pollution in the Bonne Bay and Gulf of St. Lawrence. Think about today's activities as well as activities that may occur over the next 10-20 years!

1.

2.

3.

List 2 marine organisms that might be affected by oil pollution.

1.

2.

Outline one way of cleaning up a small oil spill.

List 3 things you might be asked if you were reporting an oil spill.

1.

2.

3.

Answer the following questions with reference to the diesel fuel spill in Gros Morne National Park in 1999.

What was the initial response to stop the spilled oil from spreading into the environment?

What was the purpose of building a rock berm?

Read the display information on Eelgrass. Examine the eelgrass on display and go into the aquarium and examine the eelgrass growing in tank # 4

How was eelgrass used to help restore the marine habitat in the area of the spill?

Station 3: Marine Debris

What is Marine Debris?

List 4 examples of marine debris.

1.

2.

3.

4.

Give two examples of how marine debris can be harmful to marine life.

1.

2.

Following the instructions at the display, identify marine debris and estimate how much time it would take to decompose (decomposition time) in the table below. Compare your estimate with others in your group and the information on the poster provided.

Debris Name	Your Estimated Decomposition Time	Known Decomposition Time

Observe the poster of ocean currents in the Gulf of St. Lawrence. Suggest where a plastic bottle might end up if it were dropped into the ocean at the location indicated on the poster.

List three things that you can do to reduce marine debris in the world's oceans.

1.

2.

3.

Station 4: Municipal Wastewater Treatment

What is municipal wastewater?

Look at the maps provided. Does your community treat its wastewater?

What percentage of our province's population treats wastewater?

Define primary wastewater treatment

Define secondary wastewater treatment

Define tertiary wastewater treatment

What is a Biological Indicator of water quality?

Identify one marine organism and one freshwater organism that may be used to indicate the health of an environment?

Marine:

Freshwater:

Station 5: Coastal Activities in Bonne Bay and the Gulf of St. Lawrence

Read the display information and answer the following questions.

Choose 3 coastal activities and list possible harmful effects these activities may have on our marine environment. Suggest how we can reduce these negative effects (***if you cannot think of ways pay attention to the wrap up session and refer to the presentation we have given your teacher).***

Coastal Activity # 1: _____

Potential Harmful Effects: _____

_____

_____

_____

_____

Ways to reduce negative impacts: _____

_____

_____

_____

Coastal Activity # 2: _____

Potential Harmful Effects: _____

_____

_____

_____

Ways to reduce negative impacts:

Coastal Activity # 3:

Potential Harmful Effects:

Ways to reduce negative impacts:

GLOSSARY

BATHYMETRY:	the measure of water depth at various locations in a body of water.
BIOLOGICIAL INDICATOR:	organisms whose presence or absence, or health, can be used to indicate how polluted an environment is.
BIOLOGICIAL OXYGEN:	oxygen that is dissolved in water.
BIOLOGICAL OXYGEN DEMAND:	amount of oxygen required by organisms to decompose organic matter in water.
ESTUARY:	the point at which the mouth of a river/stream enters the sea and freshwater and seawater are mixed.
KRILL:	scientific name are euphausiids, are small shrimp-like crustaceans. A major food source for a variety of marine life.
PHOSPHORUS:	An important nutrient for algae primary production.
PHOTIC ZONE:	the top layer of the ocean that sunlight is able to reach/penetrate.
PHOTOSYNTHESIS:	process by which plants produce their own food and release oxygen as a byproduct. Carbon dioxide is combined with hydrogen from the water using solar energy.
PHYTOPLANKTON:	plant plankton, they conduct photosynthesis.
PLANKTON:	organisms that drift in the sea, they can not actively swim against it.
TANNINS:	phenolic compound from plants that dyes or colors.
THERMAL STRATIFICATION:	formation of layer(s) based on temperature.
THERMOCLINE	a transition layer from warm to cold water
TURBIDITY:	state of reduced clarity in water caused by the presence

	of suspended matter.
TURBULENCE:	the unstable flow of a liquid or gas.
UPWELLING:	upward motion of cold nutrient rich ocean waters.
ZOOPLANKTON:	animal plankton.

Trading Books for Boats

Data Sheet – Fall 2005

School Name: _____

Student Name: _____

Sampling Site # _____

GPS Location: _____N _____W

Date: _____ Time:_____

DATA COLLECTION

Cloud Cover (check one): clear___ scattered___ broken___ overcast___

Sea State (using Beaufort's Wind Scale 0 – 12): _____

Turbidity a = length of rope where disk disappears _____cm
b = length of rope where disk is at surface_____cm
Turbidity depth (a-b)_____cm

Water Sample #	**1**	**2**	**3**
Water Sampler:			
Depth of Sample:			
Salinity of Sample:			
D Oxygen of Sample:			
Temperature of Sample:			

Plankton Tow Yes_____ No_____

Tide Information Time of High Tide:_____(hours & mins)
Time of Low Tide:_____(hours & mins)

Beaufort Wind Scale

In 1806, Admiral Sir Francis Beaufort devised a simple scale that coastal observers could use to report the state of the sea to the Admiralty. It was officially adopted in 1838.

Beaufort Number	Speed			Name	Conditions at Sea
	knots	km/h	mi/h		
0	< 1	< 2	< 1	Calm	Sea like a mirror.
1	1-3	1-5	1-4	Light air	Ripples only.
2	4-6	6-11	5-7	Light breeze	Small wavelets (0.2 m). Crests have a glassy appearance.
3	7-10	12-19	8-11	Gentle breeze	Large wavelets (0.6 m), crests begin to break.
4	11-16	20-29	12-18	Moderate breeze	Small waves (1 m), some whitecaps.
5	17-21	30-39	19-24	Fresh breeze	Moderate waves (1.8 m), many whitecaps.
6	22-27	40-50	25-31	Strong breeze	Large waves (3 m), probably some spray.
7	28-33	51-61	32-38	Near gale	Mounting sea (4 m) with foam blown in streaks downwind.
8	34-40	62-74	39-46	Gale	Moderately high waves (5.5 m), crests break into spindrift.
9	41-47	76-87	47-54	Strong gale	High waves (7 m), dense foam, visibility affected.
10	48-55	88-102	55-63	Storm	Very high waves (9 m), heavy sea roll, visibility impaired. Surface generally white.
11	56-63	103-118	64-73	Violent storm	Exceptionally high waves (11 m), visibility poor.
12	64+	119+	74+	Hurricane	14 m waves, air filled with foam and spray, visibility bad.