

TRADING BOOKS FOR BOATS



ANSWER KEY

ACAP HUMBER ARM

HOW TO USE THIS WORKBOOK

This workbook contains 5 major sections:

Boat Station

To be completed by students on-board the boat using the nautical chart.

Learning Stations

To be completed by students based on the activities and/or observations at the learning stations.

Presentation

To be completed by students based on the notes provided to you in this workbook and the powerpoint presentation. A copy of the presentation was supplied to your teacher.

Homework

To be completed by students at home or at school using materials supplied to your teacher.

Glossary

To assist students with terms that they may not be familiar with.

STUDENTS - where do I find the answers?

The information needed to answer the questions contained in this workbook can be obtained by:

- Listening to the power point presentation. The PowerPoint presentation has been supplied to your teacher.
- Studying the displays and posters.
- Participating in the activities during the boat trip.

TEACHER'S - learner outcomes / evaluation

This workbook and all supporting material have been developed to directly fulfill the prescribed curriculum as outlined in the table on the following pages.

The workbook is meant to be used by teachers as an evaluation tool.

Trading Books for Boats Topics	Science Grade 8 Curriculum
Water Cycle	1.1 Describe major interactions among the hydrosphere, lithosphere and atmosphere (332-3) 1.2 Define water cycle 1.3 Demonstrate the importance of choosing words that are scientifically appropriate by using these words in context. Include: (i) hydrologist (ii) oceanographer (109-13) 1.4 Sketch and label a diagram of the water cycle
Ocean Currents	1.26 Carry out procedures in order to investigate how temperature differences cause deep water currents. (209-1)
Ocean Waves	1.32 Explain how waves and tides are generated. (311-10a) 1.33 Define wave 1.34 Identify that waves on the surface of water are the result of a transfer of energy from moving air to the water. 1.35 Define and illustrate the following wave features: (i) wave length (ii) wave height (iii) crest (iv) trough 1.36 Distinguish between ocean waves, swells, and breakers 1.37 Identify that as waves approach a shoreline the wave length decreases and wave height increases 1.38 Define tsunami
Tides	1.39 Define tide 1.40 Explain and illustrate how tides are generated by the gravitational pull of the moon. 1.41 Define tidal range 1.42 Distinguish between spring tides and neap tides
Interactions at Shoreline	1.43 Identify that wave and tide interactions with shorelines depend on: (i) shape of the shoreline (ii) slope of the shoreline (iii) type of rock material (iv) wave energy 1.45 Define headlands and bays 1.46 Explain how waves affect headlands and bays differently 1.47 Investigate how shoreline slope and rock type determine the type of interaction between waves and shorelines 1.48 Research information, from various print and electronic sources, on the processes of erosion and deposition that result from wave action and water flow. (209-5, 311-11) Include: (i) beaches

	<ul style="list-style-type: none"> (ii) shoal (iii) sand bars (iv) sea caves (v) sea arches (vi) sea stacks <p>1.49 Provide examples of various technologies designed to contain damage due to waves and tides. (112-3)</p> <p>1.50 Investigate, using print and electronic media, recent and past events (storms or tides) that have affected local shorelines creating damage to property and the environment.</p> <p>1.51 Research technologies used to prevent or reduce wave action along shorelines where human development is occurring. Include:</p> <ul style="list-style-type: none"> (i) breakwaters (ii) jetties/wharves (iii) vegetation
<p>Marine Species</p>	<p>1.60 Describe species found in saltwater environments. Include:</p> <ul style="list-style-type: none"> (i) pelagic zone (ii) benthic zone <p>1.61 Select appropriate methods and tools for collecting data and information and for solving problems (208-8)</p> <p>1.62 Interpret patterns and trends in data, and infer and explain relationships among the variables (210-6)</p> <p>1.63 Prepare a presentation or report on the effect of abiotic factors on the distribution of species in freshwater and marine environments and evaluate processes used in planning and completing the task. (211-2, 211-4)</p> <p>1.64 Identify the effects of abiotic factors on plant and animal distributions in marine and freshwater ecosystems. (208 2, 306-3)</p> <p>Include:</p> <ul style="list-style-type: none"> (i) temperature (ii) dissolved oxygen (iii) phosphates (iv) pH (v) turbidity (vi) pollution (vii) upwelling (marine) (viii) salinity (marine) (ix) ocean currents (marine)
<p>Humans and Oceans</p>	<p>1.66 Describe some positive and negative effects of marine technologies on ocean species. (113-2)</p> <p>1.67 Discuss how new technologies have contributed to over-fishing</p> <p>1.68 Discuss how the offshore oil industry impacts marine environments</p> <p>1.69 Discuss potential impacts aquaculture technologies have on marine environments</p>

BOAT STATION

To be completed by students on-board the boat using the nautical chart.

1. What are the 3 inlets of the Bay of Islands (Humber Arm, Middle Arm & North Arm) described as?

Flooded glacial fjords

2. How long and wide is the Humber Arm?

24km long and 2km wide

3. What is the name of the largest river flowing into the Humber Arm?

Humber River

4. What is the maximum depth measured in the Bay of Islands?

300m

5. Why is the inner Humber Arm much shallower than the rest of the Humber Arm?

Sediment accumulation from the Humber River

6. What is the surface temperature ranges for the Humber Arm and the Bay of Islands in the winter and summer?

	Humber Arm	Bay of Islands
Winter	-1.8 to 5° C	-1.0 to 3° C
Summer	17 to 25° C	15 to 18° C

7. How many tidal cycles occur in the Bay of Islands everyday?

2

8. Name 3 types of groundfish in the Bay of Islands:

Atlantic Cod, Winter Flounder, Red Fish, Haddock, Halibut, Lumpfish

9. Name 3 types of shellfish in the Bay of Islands:

Blue Mussel, Lobster, Snow Crab, Atlantic Jack Knife Clam, , Atlantic Surf Clam, Green Sea Urchin, Scallop, Squid, Periwinkle

10. Name 3 types of marine birds found in the Bay of Islands:

Bald Eagle, Black Duck, Black Guillemot, Black Legged Kittiwake, Common Tern, Double-crested Cormorant, Great Black-backed Gull, Greater Yellow Legs Sandpiper, Herring Gull, Merganser, Spotted Sandpiper

11. Name 5 coastal activities taking place in the Bay of Islands:

Fish harvesting and processing, industry, marine transportation, marine tourism, recreation, research

LEARNING STATIONS

To be completed by students based on the activities and/or observations at the learning stations.

Station 1: Industrial Effluent Treatment

Carefully study the display and answer the following questions:

1. List 4 industries in the Bay of Islands whose effluents might affect the water quality of the Bay of Islands.

Larfarge Gypsum Plant,

Corner Brook Pulp and Paper,

Barry's Limited Fish Plant,

Oil Tanker Docking in the Humber Arm,

Oil Storage Facility

2. Sludge is the solid material found in the pulp and paper industry's effluent. Look carefully at the sludge sample. What do you think the sludge is?

Wood fibres and pulp

3. Look at the sample taken from the aeration basin. What do you see? What process is being used to break down the effluent from the mill?

A biological treatment of mico-organisms and oxygen

4. Look at the diagram of the effluent treatment system. What does Corner Brook Pulp and Paper do with the sludge?

Send it to the boiler and burn it as fuel

5. Sludge consists of wood fibre and an excess of micro organisms. Can you think of other ways the sludge can be used?

Compost, firelogs, etc. (answers will vary)

6. What do you think other industries do with their effluents and what affect may it have on the water quality?

They dispose of their effluent in the Humber Arm. This can pollute the water system, negatively impact water quality, and be hazardous to the health of marine species.

Station 2: Oil Spill Prevention and Remediation



Preventing Oil and Fuel Spills

Diesel, gas and petroleum lubricants are deadly to marine life. Boat engines, automatic bilge pumps, fuel handling facilities and accidents can be responsible for releasing harmful materials into the environment. If spilled, a quart of oil can cover an area of water the equivalent of nearly 3 football fields. Oil residue can remain for as long as 2 years.

To reduce the risk of spills:

- Wipe up all spills immediately with absorbent material
- Prevent oil from entering your bilge by keeping your engine tuned
 - Do not pump contaminated water overboard
- Place an oil-absorbant sponge in your bilge to remove oil from bilge water
- Use one cloth for the filler and one for the fuel tank vent. Pay attention!
- If possible, fill fuel tanks ashore where spills are less likely to occur
- If you have fixed or built-in tanks, know the capacity of your fuel tank
- Have an accurate fuel gauge
- Material used to absorb oil or fuel should be treated as hazardous waste and disposed of accordingly

In case of an Environmental Emergency Contact
The Canadian Coast Guard
1.800.563.9089

 **ACAP**
Harmful Algal Bloom Environmental
Assessment Inc.

 **ecoACTION2000**
Helping communities create a healthy environment.
Aider les collectivités à créer un environnement sain.

1. Using the display, name 5 potential sources of oil pollution in the Bay of Islands.

Oil storage facilities, oil tankers and extraction rigs, shipping and cruise vessels, recreational boaters, ballast water from ships, land based spills.

2. After the “oil spill effects” demonstration with the instructor, what happens to a bird’s feather once it comes into contact with oil?

The barbules get clogged with oil and their feathers become full of “holes”. Afterwards they no longer have a water resistant coat.

3. Briefly describe 3 ways of cleaning up a small oil spill.

a. Sorb soxs: filled with oclansorb, a highly absorbent peat moss

b. Oclansorb: a highly absorbant peat moss

c. Spillows: resemble giant paper towels

4. Name an area of Newfoundland's west coast where a spill occurred. What type of spill was it?

The spill occured in the eastern arm of Bonne Bay in Gros Morne National Park. It was a land based spill where a tanker truck overturned.

Station 3: Municipal Wastewater Treatment

1. What is municipal wastewater?

A combination of liquid and solid material removed from residential, commercial, and institutional establishments

2. Describe primary wastewater treatment:

The first level of treatment where floating and suspended materials are removed by a filter or settling tank. This is a physical process which reduces the amount of solid material in the effluent

3. Describe secondary wastewater treatment:

The second level of treatment which breaks down the waste by using oxygen and bacteria. This is a biological process

4. Describe tertiary wastewater treatment:

The third and final level of treatment where chemicals are added to remove nitrates, phosphates, and any remaining suspended particles. This is a chemical process which should leave the water free of odors, suspended solids and objectionable bacteria

5. How many sewage outfalls empty into the Bay of Islands?

32

6. What types of environmental impacts do you think may be caused by sewage outfalls?

Sewage can cause the growth of fecal coliform which can destroy habitats and marine life

7. How do sewage outfalls impact the local economy?

It prevents many industries and businesses to operate because the water quality is so poor. (answers will vary)

8. Sewage outfalls also affect interactions between local communities and their environments; can you identify how?

Local communities cannot harvest fish or any marine species. Sewage outfalls also prevent people for using the water for recreational purposes. (answers will vary)

9. There are 3 methods that are used to treat sewage that runs into the Humber River and the Bay of Islands: septic tanks, Biogreen Systems, and lagoons.

List 2 advantages of a lagoon system and a septic tank system?

Lagoon

- i. Effluent can be used for irrigation because of its high nutrient, low pathogen content.
- ii. Lasts for lifetime (30 years)
- iii. Good for smaller communities
- iv. Cost effective to build
- v. Requires less energy than most other wastewater treatment systems

Septic Tank

- i. Solid material is removed
- ii. Requires minimal maintenance
- iii. Good for single family residents
- iv. Important for rural areas

List 2 disadvantages of a lagoon system and a septic tank system.

Lagoon

- i. Not a permanent solution
- ii. Requires a lot of land area
- iii. Produces massive amounts of nutrients
- iv. Many factors to consider: soil type, land available, climate, amount of sunlight, and wind.
- v. Not effective for removing heavy metals
- vi. May require additional treatment

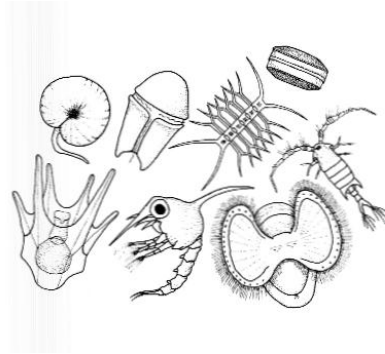
Septic Tank

- i. Needs to be pumped out every 3-5 years
- ii. Requires soil with good absorption properties
- iii. Primary treatment only
- iv. Solid waste still must be dealt with

Station 4: Species

1. Define plankton and describe the 2 types of plankton.

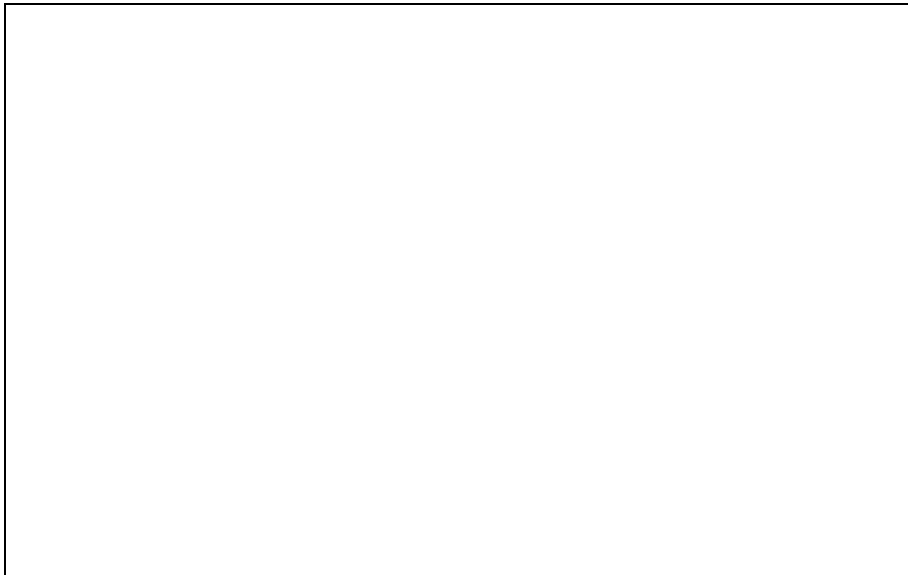
Plankton are microscopic organisms. There are two types: phytoplankton and zooplankton.



2. Describe the role that plankton plays in the environment.

They are primary producers and the basis for the food chain.

3. On the boat you conducted (or will conduct) plankton tows and collected a sample from the tow. Look at some of the specimens under the microscope and sketch what you see. What type of plankton could it be?



4. What type of plankton did you just sketch?

Zooplankton and/or phytoplankton

5. List the 4 most common species harvested through aquaculture in Newfoundland.

Atlantic Cod, Atlantic Salmon, Blue mussels, Steelhead

6. List the 2 major aquaculture areas in Newfoundland.

Twillingate and St. Albans

PRESENTATION

To be completed by students based on the notes provided to you in this workbook and the powerpoint presentation. A copy of the presentation was supplied to your teacher.

1: 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 oxides, carbon oxides, and sulfur oxides are being released into the atmosphere by automobile exhaust and by 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.

1. What are the effects of low pH on aquatic organisms?

They will not survive or have very low productivity

2. What are some causes of low pH in aquatic ecosystems?

2: Temperature

Temperature is important for growth in any ecosystem. Oxygen gas is less soluble in water at higher temperatures than at lower temperatures. An increase in water temperature can encourage biological and chemical activity, affecting oxygen levels in the system.

The source of water in a stream can determine its temperature. For example, water coming from a glacier or from a spring will be cold. Many factors along a stream's course can affect its temperature. Natural warming occurs when air temperatures are high from direct sunlight. Human activities such as the removal or the destruction of shading vegetation along the stream's edge can also raise water temperature by exposing the stream to the heat of direct sunlight. As well, water slowed by dams or other obstructions will warm near the surface, though deeper water may remain very cold.

Ponds, being generally small and shallow, will warm uniformly throughout. In contrast, the larger lake systems show characteristic temperature patterns as the seasons change. During spring, temperature patterns, water density, and the level of dissolved oxygen within a lake are fairly consistent. As summer approaches, the sun heats the lake system, causing internal changes. The less dense top layers of the lake warm first, and stay 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 of depth of more than 12 meters, while shallow water bodies are usually warmed uniformly and completely.

This layering has consequences for dissolved oxygen levels. The warmer upper layer at the surface circulates, thus maintaining contact with the air, whereas, the deeper, cooler layer is cut off from the surface by the thermocline. This reduces oxygen in deeper waters, and limits productivity in this layer.

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, forming ice at

the lake surface, while water with temperatures of 4°C or greater remain at lower depths.

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.

1. What is the average water temperature in the Bay of Islands?

Summer: 15 to 18°C

Winter: -1 to 3°C

2. How do changes in water temperature affect living organisms?

Many animals prefer stable temperatures and generally move to stay within a certain range. These temperature preferences are critical for feeding, reproduction, and migration.

3: Dissolved Oxygen

Aquatic organisms depend on the level of oxygen dissolved in water. Even if water is saturated with oxygen, (containing as much O₂ as it is capable of holding), it may contain less than 5% oxygen. The air we breathe 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 (moving) water. Moving water (water flowing 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 its capacity to hold oxygen, but as water slows and gets heated in an open area, this oxygen holding capacity again decreases.

Organic Matter - The quantity of organic matter in water also affects the amount of dissolved oxygen in the system. In a natural environment that has not been disturbed by humans, the organic matter present in a stream will originate from dead aquatic plants, 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 (waste) 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. At night, 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 replenishment of dissolved oxygen by photosynthesis. This oxygen depletion often results in a winter kill of aquatic organisms including fish.

1. What human activities affect dissolved oxygen levels?

Input of effluent and organic matter such as logging debris from homes and industries

2. What is the effect of reduced dissolved oxygen levels to aquatic organisms?

Oxygen depletion often results in a winter kill of aquatic organisms including fish.

4: Phosphates

Phosphates contain the element phosphorus which is important in many organic chemicals, especially those involved in energy storage. Much of the excess phosphorous enters the water through detergents that are being flushed down our drains. Too much phosphorus contributes to algal blooms which leads to choked water systems.

1. What are the possible sources of phosphates?

Detergents

5: Turbidity

The sun is the source of light and heat energy in freshwater 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 lower down in the water column, thereby still allowing photosynthesis to take place.

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 colors. Not all colors 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 color water and affect the clarity, and thus the penetration of light through the depths. 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 measurement by itself, however, does not indicate water quality even though the clarity of water can give an indication of the health of an aquatic system. Clear water may be good for light penetration, but the water may be clear due to a high level of acidity (low pH), and water organisms may have been killed by this acidity. While turbid (cloudy) water may prevent light penetration, the turbidity may be caused by plankton, which indicate the presence of abundant nutrients. A Secchi disc reading alone should not be the only indicator of water quality.

1. What factors might affect turbidity in the Bay of Islands?

Plankton and dissolved and suspended materials such as tannins and sediments

6: Salinity

The salt in the ocean was initially derived from gases expelled from volcanoes when the earth's crust was being formed; now rivers, streams and groundwater flowing over land, pick up minerals and deposit them into the ocean. These break down or dissolve, contributing to the salinity of the seas. The average of total amount of salt dissolved in the ocean is approximately 35ppt. This means that there is roughly 35 grams of salt in every 1000 grams of seawater.

Salinity is not constant throughout the water column. Salinity of the top layer of the ocean is closely linked with precipitation and evaporation. Evaporation leaves behind dissolved salts increasing salinity, while precipitation "freshens" the top ocean layers (reducing salinity). Salinity levels are high in mid-latitudes where evaporation is high and precipitation is low, whereas salinity is low near the equator because precipitation is so high. Very high latitudes can also see decreases in salinity where sea ice melts and "freshens" the water.

The oceans are naturally salty. This saline environment has quite an effect on life in the oceans-- most creatures that live in the ocean could not live in fresh water. 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 adapted to a mixture of fresh and salt water. The alteration of fresh water systems, ground waters, or soils by human actions that cause an increase in the salinity of these areas, can have a devastating effect on the organisms within the affected ecosystems. 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.

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

Answers will vary per class

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

The salinity would decrease, particularly when sampling surface waters

HOMEWORK

To be completed by students at home or at school using materials supplied to your teacher.

1. What is Marine Debris?

Any material found in the marine or coastal environment that does not naturally occur in that environment.



2. List 4 examples of marine debris.

Plastic, rubber, glass, styrofoam, metal, paper, wood

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

a. Entanglement: When marine animals get tangled in marine debris which can prevent them from moving, breathing, and/or eating. Also, animals can lose fins or cut themselves while struggling to get free.

b. Ingestion: Organism often mistakes marine debris for food and swallows the materials, especially plastic. Animal digestive systems cannot breakdown plastic.

4. What is the most common type of marine debris?

Plastics, styrofoam, metals, wood, glass

5. List the 3 types of marine debris that take the longest to decompose.

Plastic, metal, glass, fishing line

6. Explain a possible scenario of how small pieces of garbage from around your school could end up in the Bay of Islands.

Answer will vary

GLOSSARY

BIOLOGICAL 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, causing the freshwater and seawater to be mixed.

HOLOPLANKTON: an organism that remains a zooplankton for their entire life (i.e. copepods).

KRILL: (known as euphausiids); are small shrimp-like crustaceans, which are a major food source for a variety of marine life.

MEROPLANKTON: an organism that is a zooplankton only when it is young/juvenile (i.e. starfish).

PHOSPHORUS: An important nutrient for algae; responsible for 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 (THERMOCLINE): formation of layer(s) based on temperature.

TURBIDITY: clarity of water caused by 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.

THANK YOU
FOR TAKING PART IN
TRADING BOOKS FOR BOATS 2011