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Code 5911

low cost ESTUARY & MARINE monitoring kit

Earth Force, a national 501(c)(3) organization that works to engage young people as active citizens who improve the environment and their communities now and in the future. Through Earth Force and its network of diverse partners, young people get hands-on, real-world opportunities to practice civic skills, acquire a deep understanding of the environment, and develop the skills and motivation to become life-long leaders in addressing community issues.

The Global Rivers Environmental Education Network (GREEN) is an Earth Force program focused on engaging young people in the research, analysis and protection of our important water resources. GREEN began in 1984, when a biology class at Huron High School in Ann Arbor, Michigan became concerned about the water quality of the nearby Huron River. The students and their science teacher presented these concerns to Professor Bill Stapp at the University of Michigan. Together, Dr. Stapp and the students tested the water of the Huron River, revealing increases in the river's fecal coliform levels following rainstorms. The students, armed with their data, went to city and county officials and were instrumental in encouraging local authorities to upgrade sewage facilities.

Learn more about Earth Force programs at www.earthforce.org

WARNING! This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision

other sources of information

Now that you have used your monitoring kit to make a preliminary assessment of the health of your estuary it is time to check with other sources about what you have learned. Your local health department, environmental agency or conservation group may be able to tell you more about your estuary. You can also visit the Earth Force website (www.earthforce.org) to learn more about your specific test results. By clearly identifying the issues or problems surrounding your estuary, you have taken the first step toward taking action and improving water quality in your community.

Test Factor	Result	Ranking	Score (from ranking)
pH	4 5 6 7 8 9 10	1 (poor) 1 (poor) 3 (good) 4 (excellent) 3 (good) 1 (poor) 1 (poor)	
Phosphate	1 ppm 2 ppm 4 ppm	4 (excellent) 3 (good) 2 (fair)	
Salinity	0 ppt 14 ppt 35 ppt	3 (good) 3 (good) 3 (good)	
Temperature Change	0 - 2 °C 3 - 5 °C 6 - 10 °C 10 °C	4(excellent) 3 (good) 2 (fair) 1 (poor)	
Turbidity	0 Between 0 & 40 JTU Between 40 & 100 JTU >100 JTU	4 (excellent) 3 (good) 2 (fair) 1 (poor)	

introduction to the low cost estuary & marine monitoring kit

The Low Cost Estuary & Marine Monitoring Kit is a tool to help you assess the water quality of an estuary. An estuary is a partially enclosed body of water formed where freshwater from rivers and streams flows into the ocean, mixing with salty seawater.

This kit was designed to provide a simple, affordable and non-hazardous method of testing water for nine basic water quality parameters: coliform bacteria, salinity, dissolved oxygen, biochemical oxygen demand, nitrate, pH, phosphate, temperature and turbidity. Step-by-step, diagrammed instructions easily guide you through each test.

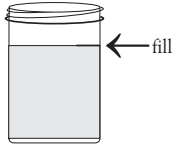
Remember that monitoring the water quality of your estuary is not enough. Once you have identified a problem in your local body of water it is time to determine what policies and practices have led to this situation and begin to address those issues. The health of our local water resources is everyone's responsibility.

This kit is an introduction to Earth Force's GREEN program or any water quality monitoring effort. As you conduct your tests or take action to solve environmental problems, you can find answers to your questions by using the Earth Force website: www.earthforce.org, or by contacting Earth Force at 703-519-6877.

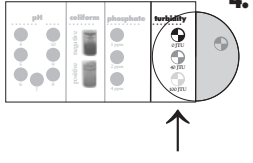
ranking test results

While standards of healthy water vary by location and conditions, ranking the results can often give you a good introduction to water quality monitoring and indicate relative quality of the water.

Test Factor	Result	Ranking	Score (from ranking)
Coliform Bacteria	Negative Positive	3 (good) 1 (poor)	
Dissolved Oxygen Saturation	91-110% Saturation 71-90% Saturation 51-70% Saturation <50% Saturation	4 (excellent) 3 (good) 2 (fair) 1 (poor)	
Biochemical Oxygen Demand	0 ppm 4 ppm 8 ppm	4 (excellent) 3 (good) 2 (fair)	
Nitrate	5 ppm 20 ppm 40 ppm	2 (fair) 1 (poor) 1 (poor)	



3. Fill the jar to the turbidity fill line located on the outside kit label.



4. Hold the Turbidity Chart on the top edge of the jar. Looking down into the jar, compare the appearance of the secchi disk icon in the jar to the chart. Record the result as turbidity in JTU.

NOTE: Allow jar to dry thoroughly before replacing kit contents for storage.

For more information on turbidity, including more extensive tests that you can perform and potential causes of high turbidity, visit the turbidity page on the Earth Force website at:

www.earthforce.org/green

The GREEN Program

Step One: understanding your estuary

Construct a map of the area you are interested in studying. You may want to obtain a map from a local tourism agency, county or city planners, or your state environmental agency. There are a number of ways you can determine the land uses in your area:

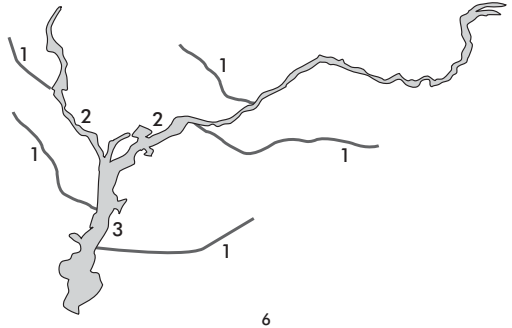
- Take a tour of the area in question. Mark the land uses on the map as you identify them.
- Access information on your area on the EPA's Surf Your Watershed website (www.epa.gov/surf). This website can give you detailed information on the land-uses and their effects on your watershed.
- Work with a local estuary or watershed organization. Local organizations can provide a wealth of information concerning your estuary and the ways that human beings are using it.

Mark your map with a colored pen or map pin. Mark each area that is being used primarily for industrial, agricultural and residential uses, and indicate natural areas.

Use your map as a reference, reflecting on the potential impact that each land use has on the estuary. (For more information on the impact of specific land uses, please see the *Field Manual for Water Quality Monitoring.*)

It is now time to gather data from others who are monitoring water quality in your area. This data will serve as the basis for the action you may decide to pursue later on. There are three primary sources for data about your estuary:

- Local estuary or watershed monitoring organizations
- Local & national government organizations (EPA, Department of Natural Resources)
- EPA Surf Your Watershed (www.epa.gov/surf)

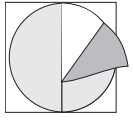


turbidity

Turbidity is the measure of the relative clarity of water. Turbid water is caused by suspended and colloidal matter such as clay, silt, organic and inorganic matter and microscopic organisms. Turbidity should not be confused with color, since darkly colored water can still be clear and not turbid. Turbid water may be the result of soil erosion, urban runoff, algal blooms and bottom sediment disturbances which can be caused by boat traffic and abundant bottom feeders.

Turbidity procedure

The water testing kit container is used to perform the turbidity test. If possible, adhere the Secchi disk icon sticker to the jar 8-24 hours before use to allow the adhesive to cure.



1. Remove the backing from the secchi disk icon sticker.

2. Adhere sticker on the inside bottom of the large white jar (kit container). Position the sticker slightly off center.

4. The difference between the temperature upstream and the temperature at the sampling site is the change in temperature.

For more information on temperature, including more extensive tests that you can perform and potential causes of pollution, visit the temperature page on the Earth Force website at:

www.earthforce.org/green

Step Two: develop a hypothesis

Develop a hypothesis using the information that other monitors have collected. The hypothesis should be a concise statement that predicts the condition of your estuary and reflects the water quality measurements provided in this kit (dissolved oxygen, biochemical oxygen demand, pH, salinity, temperature, coliform bacteria, nitrate, phosphate and turbidity). Your hypothesis should flow from the information that you gathered in step one.

hypothesis
a tentative assumption made in order to test a logical consequence.

Step Three: identify causes

Now that you have created a hypothesis concerning the status of your estuary, it is time to identify the policies and practices that led to the current situation. In the case of an estuary there may be a number of policies and practices that combine to create a specific situation.

For instance, the use of nitrogen-based fertilizer in residential areas would be a practice. The planned application of nitrogen-based fertilizer by an agricultural company or a farm would be a policy.

Using the information you gathered from local experts and other sources, identify the answers to the following questions:

- What problems have you identified?
- What are the potential causes of these problems?
- What personal or community practices contribute to these problems?
- What business practices or polices contribute to these problems?
- What public policies contribute to these problems?

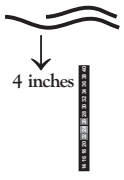
a policy

is a law, regulation or corporate procedure that creates a particular situation.

a practice

is a method that is commonly used by members of a community.

temperature procedure



1. Wear protective gloves. At each site, place the thermometer four inches below the water surface for one minute.

2. Remove the thermometer from the water, read the temperature and record the temperature as degrees Celsius.

3. Repeat the test approximately 1 km upstream as soon as possible.

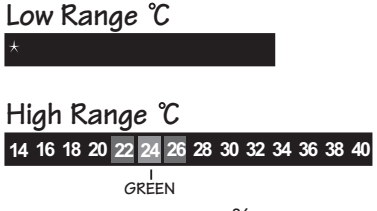
temperature

Temperature is very important to water quality. Temperature affects the amount of dissolved oxygen in the water, the rate of photosynthesis by aquatic plants, and the sensitivity of organisms to toxic wastes, parasites and disease. Thermal pollution, the discharge of heated water from industrial operations, for example, can cause temperature changes that threaten the balance of aquatic systems.

use of the thermometer

The two thermometers have an adhesive back. Adhere them to the kit container or another object to make grasping them easier.

The temperature is indicated by a liquid crystal number on the Low Range thermometer and a ***green*** display on the High Range thermometer.



Step Four: water quality testing

Use the Low Cost Estuary Monitoring Kit to test a water sample from your estuary. Next, combine all of the data that you have collected using the data sheets provided in this manual. Keep in mind that you may only be testing one water sample from your estuary and that to fully understand the impact that particular land use is having, you need the additional data gathered in step one.

Step Five: take action

Now that you have identified the impact of land uses on your estuary, it is time to take action. The first thing you should do is select one specific problem you want to address and review the potential cause of the problem.

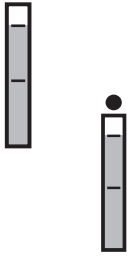
- Which cause do you think is most relevant to your area?
- Which cause are you able to address?
- How can you make an impact on the geographic area?
- Where will you make a significant difference?

To help you prepare for your activity, write an action plan. This step is a great way to organize your thoughts and your time. A good action plan includes a written description of:

- The problem
- A policy or practice you want to change
- The course of action (Your course of action consists of your goal and the strategies you will use to reach your goal)

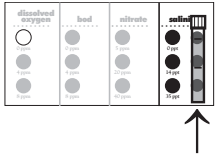
For each strategy you should write a detailed plan that includes tasks, timeline, assignments, resources, allies, obstacles and evaluation.

Now you are ready to take action! Using your plan, work with your group to address the problem you have identified.



3. Fill the test tube (0106) to the 10 mL line with the diluted sample from Step 2.

4. Add one Chloride TesTab (3885A). Cap tube and gently mix until the tablet has disintegrated.



5. Place the tube over the right-hand column of black circles on the color chart.

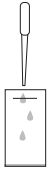
6. Compare the appearance of the circles through the tube to the circles in the left-hand column.

7. Record the result as ppt salinity.

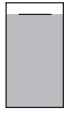
salinity

Salinity is the total of all salts dissolved in water. The salt content of water affects the distribution of plant and animal life in an aquatic system, based on the amount of salt they can tolerate. Variable salinity is the most characteristic feature of estuaries. Salinity at one place changes daily with the tides and tidal excursions. Salinity also changes dramatically during the seasons. The head of an estuary may experience almost full-strength seawater in the summer, while in the winter floods of fresh water may reach the mouth of an estuary. Salinity can also increase during major storms and hurricanes. In many cases, major storms can affect salinity levels for years.

salinity procedure

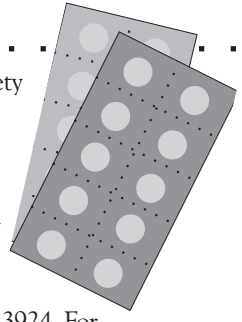


1. Use the pipet (0364) to add 5 drops of the sample water to the large round tube (0788).



2. Fill the tube to the 100 mL line with distilled or deionized water.

test kit safety



The TesTab® reagents used in this kit are designed with safety in mind. The single-unit, foil packaged TesTabs are easy to dispense. Store TesTabs in a cool, dry place and only open the foil when ready to use the tablet. A single tablet, either alone or reacted with a sample, is not a health hazard. However, TesTabs should not be ingested. To view Material Safety Date Sheets (MSDS) to to www.lamotte.com. Additional information for all LaMotte reagents is available in the United States, Canada, Puerto Rico, and the US Virgin Islands from Chem-Tel by calling 1-800-255-3924. For other areas, call 813-248-0585 collect to contact Chem-Tel's International access number. Each reagent can be identified by the four digit number listed on the upper left corner of the reagent label, in the contents list and in the test procedures.

The numbers in paretheses in the test procedures are reorder numbers for LaMotte TesTabs. The numbers printed on the foil are insignificant. Look for the name of the test on the foil package to determine which TesTab to use for each test. For example: DO is printed on the foil of the TesTab used for the dissolved oxygen test.

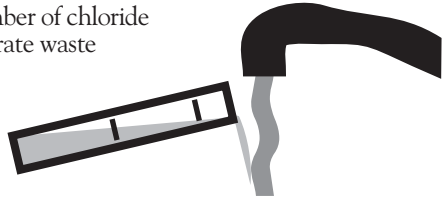
WARNING: Reagents marked with an * are considered to be potential health hazards. To view or print a Material Safety Data Sheet (MSDS) for these reagents

go to www.lamotte.com. To obtain a printed copy, contact LaMotte by email, phone, or fax. Call LaMotte Company 410-344-3100 or Earth Force 703-519-6877.

safety note: Wear eye protection during experiments. Wash hands after performing experiments. Follow all safety rules and guidelines provided by your school or organization regarding laboratory and outdoor activities.

after testing

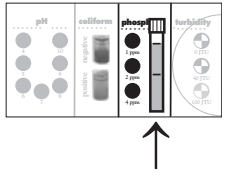
All reacted test samples, except coliform bacteria and sometimes salinity, can be disposed of by flushing down the drain with excess water. While in the field, reacted samples can be poured together into a waste container for later disposal. The Chloride TesTabs (3885A) contain silver which is considered to be an EPA characterisitic waste in large quantities. Waste solutions containing no more than 2 Chloride TesTabs per liter can be flushed down the drain with excess water. If a large number of chloride tests are to be performed, keep a separate waste container for the chloride test waste and dispose of it as hazardous waste. See the coliform bacteria procedure for coliform test disposal.



3. Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.

4. Wait 5 minutes for the blue color to develop.

NOTE: If the sample does not develop a blue color (sample is colorless), record the result as 0 ppm.



5. Compare the color of the sample to the phosphate color chart. Record the result as ppm phosphate.

For more information on phosphate, including more extensive tests that you can perform and potential causes of high phosphate levels, visit the phosphate page on the Earth Force website at:

www.earthforce.org/green

phosphate

Phosphate is a nutrient needed for plant and animal growth and is also a fundamental element in metabolic reactions. High levels of this nutrient can lead to overgrowth of plants, increased bacterial activity, and decreased dissolved oxygen levels.

Phosphate comes from several sources including human and animal waste, industrial pollution, and agricultural runoff.

phosphate procedure

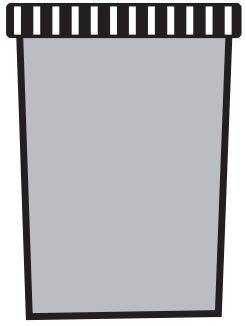
1. Fill the test tube (0106) to the 10 mL line with the water sample.

2. Add one Phosphorus TesTab (5422A).

collecting a water sample

Collect the water sample in a sterile, wide mouthed jar or container (approximately 1 liter) that has a cap. If possible, boil the sample container and cap for several minutes to sterilize and avoid touching the inside of the container or the cap with your hands. The container should be filled completely with your water sample and capped to prevent the loss of dissolved gases.

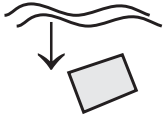
Test each sample as soon as possible or within one hour of collection. When possible, perform dissolved oxygen and BOD procedures at the monitoring site immediately after collecting the water sample.



collection procedure: estuary site testing

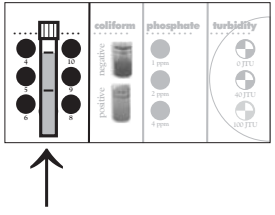
1. Remove the cap of the sampling container.

2. Wear protective gloves. Rinse the bottle 2-3 times with the water.



3. Hold the container near the bottom and plunge it (opening downward) below the water surface.

3. Cap and mix by inverting until the tablet has disintegrated. Bits of material may remain in the sample.



4. Compare the color of the sample to the pH color chart. Record the result as pH.

For more information on pH, including more extensive tests that you can perform and potential causes of imbalanced pH levels, visit the pH page on the Earth Force website at:

www.earthforce.org/green

pH

pH is a measurement of the acidic or basic quality of water. The pH scale ranges from a value of 0 (very acidic) to 14 (very basic), with 7 being neutral. The pH of natural water is usually between 6.5 and 8.2. Most aquatic organisms are adapted to a specific pH level and may die if the pH of the water changes even slightly.

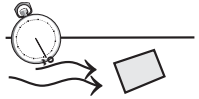
pH can be affected by industrial waste, agricultural runoff, or drainage from improperly run mining operations.

pH procedure

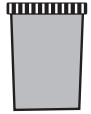
1. Fill the test tube (0106) to the 10 mL line with the water sample.

2. Add one pH Wide Range TesTab (6459A).

4. Turn the submerged container into the current and away from you.



5. Allow the water to flow into the container for 30 seconds.



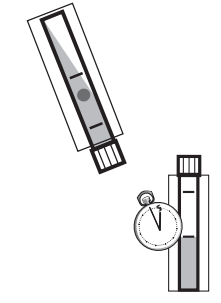
6. Cap the full container while it is still submerged. Remove it from the water immediately.

coliform bacteria

Fecal coliform bacteria are naturally present in the human digestive tract but are rare or absent in unpolluted waters. Coliform bacteria should not be found in well water or other sources of drinking water. Their presence in water serves as a reliable indication of sewage or fecal contamination. Although coliform bacteria themselves are not pathogenic, they occur with intestinal pathogens that are dangerous to human health. This presence or absence total coliform test detects all coliform bacteria strains and may indicate fecal contamination.

The coliform test in this kit will indicate if you have above or below 20 coliform colonies per 100 mL of well or river water. **Even if the result of the coliform test for your well water is negative, this is not proof that your water is safe to drink. You should always have a professional lab test your drinking water for the presence of coliform bacteria.**

See chart for significant levels.



3. Cap the tube and mix for two minutes to disintegrate the tablet. Bits of material may remain in the sample.

4. Wait 5 minutes for the red color to develop. Remove the tube from the Protective Sleeve.

NOTE: Nitrate Wide Range CTA TesTabs (3703A) are sensitive to UV light. The Protective Sleeve (0106-FP) will protect the reaction from UV light. If testing indoors, there is no need to use the Protective Sleeve in this procedure.

5. Compare the color of the sample to the nitrate color chart. Record the result as ppm nitrate.

For more information on nitrate, including more extensive tests that you can perform and potential causes of high nitrate levels, visit the nitrate page on the Earth Force website at:

www.earthforce.org/green

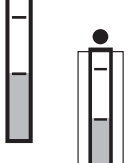
nitrate

Nitrate is a nutrient needed by all aquatic plants and animals to build protein. The decomposition of dead plants and animals and the excretions of living animals release nitrate into the aquatic system. Excess nutrients like nitrate increase plant growth and decay, promote bacterial decomposition, and therefore, decrease the amount of oxygen available in the water.

Sewage is the main source of excess nitrate added to natural waters, while fertilizer and agricultural runoff also contribute to high levels of nitrate.

Drinking water containing high nitrate levels can affect the ability of our blood to carry oxygen. This is especially true for infants who drink formula made with water containing high levels of nitrate. **You should always have a professional lab test your drinking water for the presence of nitrate.**

nitrate procedure



1. Fill the test tube (0106) to the 5 mL line with the water sample.
2. Add one *Nitrate Wide Range CTA TesTab (3703A). Immediately slide the test tube into the Protective Sleeve (0106-FP).

fecal coliform bacteria per 100 mL water

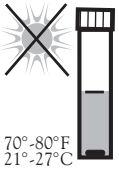
Desirable	Permissible	Water Use
0	0	Potable and well water (for drinking)
<200	<1,000	Primary contact (for swimming)
<1,000	<5,000	Secondary contact (for boating & fishing)

**For specific requirements, consult your state, regional, or local health department, or regional USEPA office.*

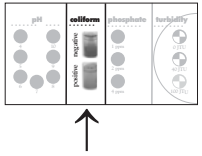
coliform bacteria procedure

1. Pour the water sample into the large test tube containing a tablet (4880) until it is filled to the 10 mL line. Don't worry if you overfill or underfill a little.
2. Replace the cap on the test tube.

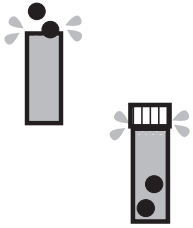
3. Stand the tube upright, with the tablet flat on the bottom of the tube.



4. Incubate by storing the tube upright, at room temperature, out of direct sunlight, for 48 hours. Store the tubes where the temperature will be fairly constant and between 70° to 80°F (21° to 27° C). Do not disturb, handle, or shake tubes during the incubation period.

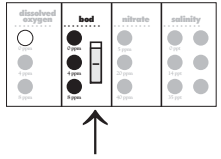


5. Compare the appearance of the tube to the picture on the coliform color chart. Record the result as negative or positive.



3. Unwrap the tube. Add two *Dissolved Oxygen TesTabs (3976A) to the test tube.

4. Cap the tube. Make sure there are no air bubbles. Invert until tablets have disintegrated. Wait 5 minutes.



5. Compare the color of the sample to the BOD color chart.

6. The difference in the dissolved oxygen level between the uncovered tube and the covered tube is the biochemical oxygen demand.

For more information on biochemical oxygen demand, including more extensive tests that you can perform and potential causes of biochemical oxygen demand, visit the biochemical oxygen demand page on the Earth Force website at:

www.earthforce.org/green

biochemical oxygen demand

Biochemical Oxygen Demand (BOD) is a measure of the quantity of dissolved oxygen used by bacteria as they break down organic wastes. In slow moving and polluted rivers, much of the available dissolved oxygen is consumed by bacteria, robbing other aquatic organisms of the dissolved oxygen needed to live.

biochemical oxygen demand procedure

1. Submerge the small tube (0125) into the water sample. Carefully remove the tube, keeping the tube full to the top. Cap the tube.

5 days

2. Wrap the tube with aluminum foil and store it in a dark place at room temperature for 5 days.

reactions

negative:

- Liquid above gel is clear.
- Gel remains at bottom of tube.
- Indicator remains red or turns yellow with no gas bubbles.
- Indicates less than 20 total coliform colonies per 100 mL of water.

positive:

- Many gas bubbles present.
- Gel rises to surface.
- Liquid below gel is cloudy.
- Indicator turns yellow.
- Indicates more than 20 total coliform colonies per 100 mL of water.

coliform test disposal

1. One tube at a time, remove the cap and add approximately 1 mL (⅓ teaspoon or 20 drops) of household chlorine bleach and immediately recap.

2. Let the tubes stand upright for about 4 hours.

3. Dispose of the closed tubes in the trash. Do not open tubes.

NEVER re-use tubes after coliform bacteria testing.

For more information on coliform bacteria, including more extensive tests that you can perform and potential causes of high levels of coliform bacteria, visit the coliform bacteria page on the Earth Force website at:

www.earthforce.org/green

8. Locate the temperature of the water sample on the Percent Saturation chart. Locate the dissolved oxygen result of the water sample at the top of the chart. The Percent Saturation of the water sample is where the temperature row and the dissolved oxygen column intersect.

For example: if the water sample temperature is 16°C and the dissolved oxygen result is 4 ppm, then the Percent Saturation is 34.

For more information on dissolved oxygen, including more extensive tests that you can perform and potential causes of low dissolved oxygen, visit the dissolved oxygen page on the Earth Force website at:

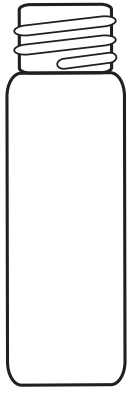
www.earthforce.org/green

**Calculations based on solubility of oxygen in water at sea level, from Standard Methods for the Examination of Water & Wastewater, 18th edition.*

percent saturation in salt water

Dissolved Oxygen

Temp°C	0 ppm	4 ppm	8 ppm
2	0	24	48
4	0	26	51
6	0	27	53
8	0	28	56
1	0	29	59
12	0	31	61
14	0	32	65
16	0	34	67
18	0	35	70
20	0	37	73
22	0	38	76
24	0	40	79
26	0	41	82
28	0	42	85
30	0	44	88



0125 vial
Actual size

dissolved oxygen

Dissolved Oxygen (DO) is important to the health of aquatic ecosystems. All aquatic animals need oxygen to survive. Natural waters with consistently high dissolved oxygen levels are most likely healthy and stable environments, and are capable of supporting a diversity of aquatic organisms. Natural and human-induced changes to the aquatic environment can affect the availability of dissolved oxygen.

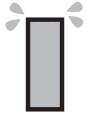
Dissolved Oxygen Percent Saturation is an important measurement of water quality. Cold water can hold more dissolved oxygen than warm water. For example, water at 28°C will be 100% saturated with 8 ppm dissolved oxygen. However, water at 8°C can hold up to 12 ppm of oxygen before it is 100% saturated. High levels of bacteria from sewage pollution or large amounts of rotting plants can cause the percent saturation to decrease. This can cause large fluctuations in dissolved oxygen levels throughout the day, which can affect the ability of plants and animals to thrive.

ppm
(parts per million)
ppt
(parts per thousand)

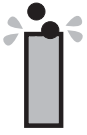
Units of measure for very dilute solutions. These units are very similar to percent. 1% is one part per hundred. 1 ppt is one part per thousand. 1 ppm is one part per million. In water testing, ppm is also called milligrams per liter. (mg/L)

dissolved oxygen procedure

1. Record the temperature of the water sample (see page 36).



2. Submerge the small tube (0125) into the water sample. Carefully remove the tube from the water sample, keeping the tube full to the top.

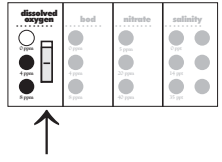


3. Drop two *Dissolved Oxygen TesTabs® (3976A) into the tube. Water will overflow when tablets are added.

4. Screw the cap on the tube. More water will overflow as the cap is tightened. Make sure no air bubbles are present in the sample.

5. Mix by inverting the tube over and over until the tablets have disintegrated. This will take about 4 minutes.

6. Wait 5 more minutes for the color to develop.



7. Compare the color of the sample to the dissolved oxygen color chart. Record the result as ppm dissolved oxygen.