THE **GLOBE** PROGRAM
A Worldwide Science and Education Program

Introduction to GLOBE

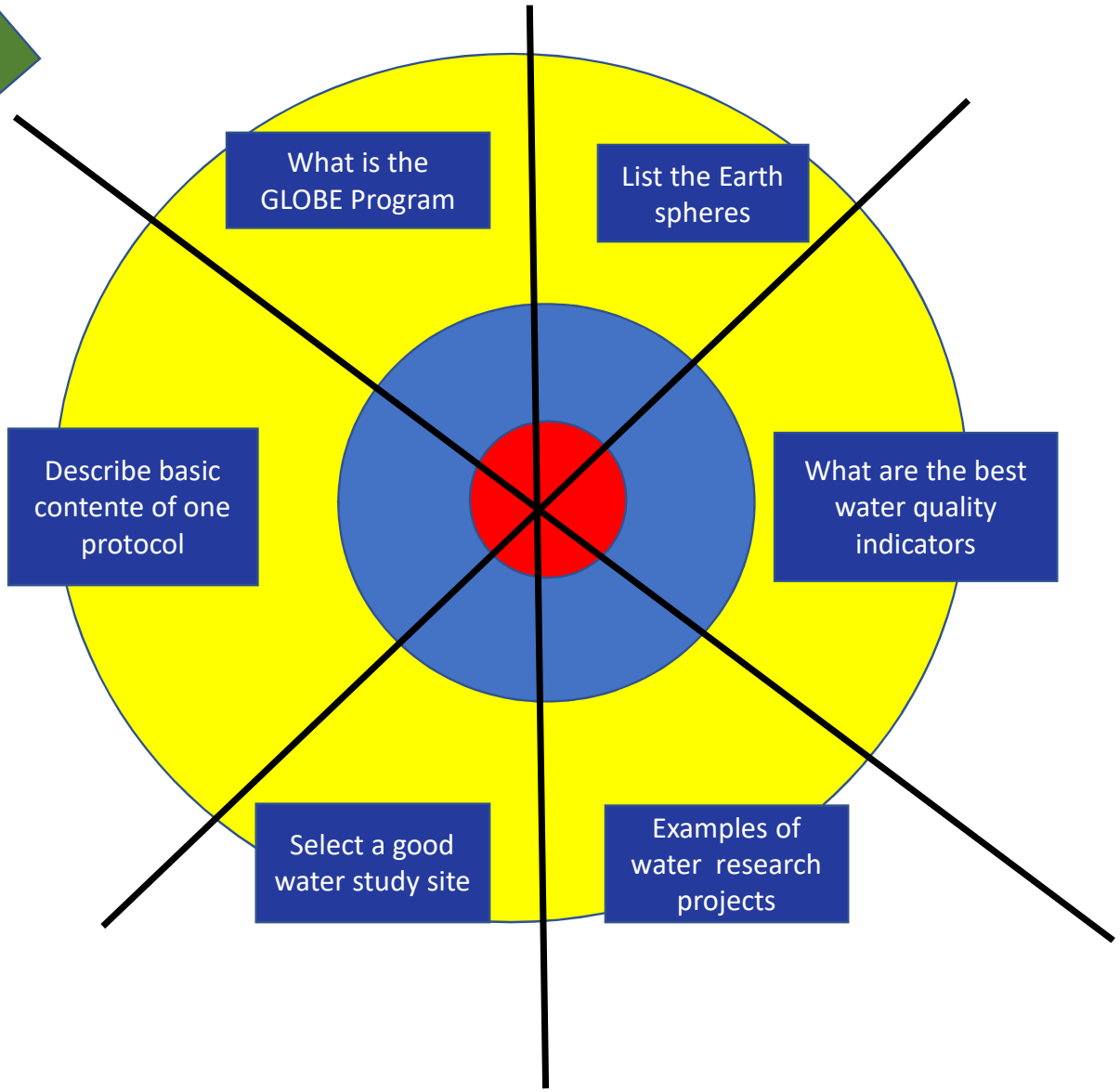
Introduce yourself!

My name

Why am I here?

What do I expect of this session?

EVALUATION BY POINTS



Nothing

Few

More or less

A lot

Objectives

Knowing the GLOBE Program and its way of seeing the world as a system

Learn how to make GLOBE observations related to water in our environment

Share ideas about how to incorporate the GLOBE Program in the classes

Dreaming to become a scientist

Scientific projects
research-based learning

Significative learning

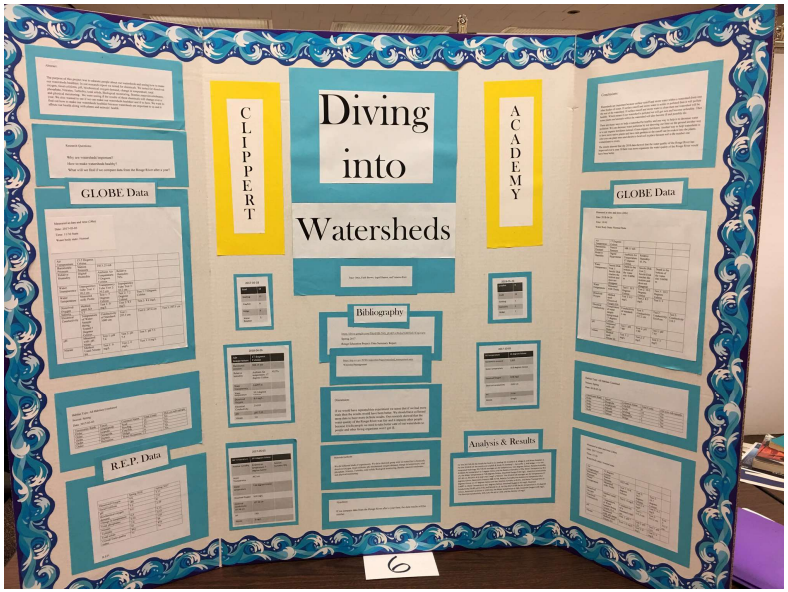
Why do I learn?

Making real field observations you discover what you learn

Gathering data
Producing information

Data collected in the field helps to better understanding of the world
Data makes sense in a context

Sharing information



More science, more cultures, more languages

Africa	Asia and Pacific	Europe and Eurasia	Latin America and Caribbean	Near East and North Africa	North America
26 Countries	18 Countries	41 Countries	20 Countries	13 Countries	2 Countries

Take action

- Give sense to the data
- Generate information
- Share information
- Make informed decisions
- Take actions

Some Statistics

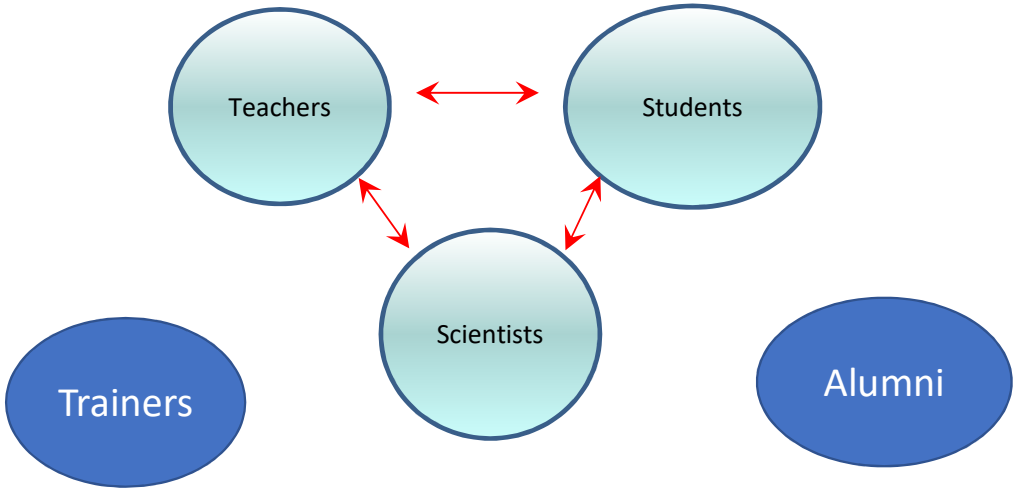
- The beguining: 1995
- **121 countries**
- **33,569 teachers**
- **32,988** schools
- **5839** teachers in training
- **762,208 students**
- **147** GLOBE alumni
- **150 000 000 of data**

GLOBE

Hands on program of

Science and education to

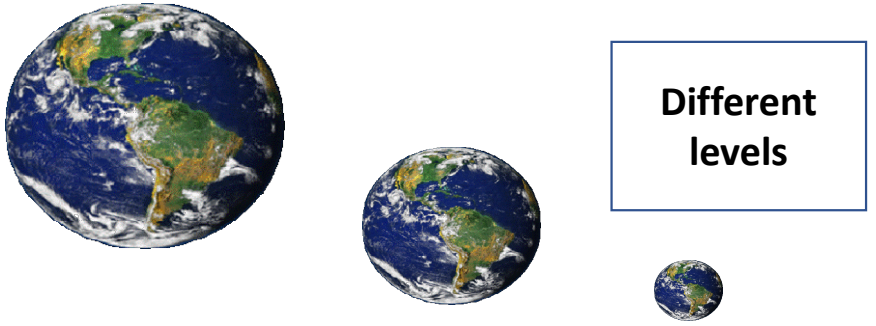
Improve environmental awareness



Around the World

- To create identity with the local environment
- Applying valid scientific research methods: Protocols
- Reporting information
- From local to global environment: Systems

Network



- Improve student performance across the curriculum

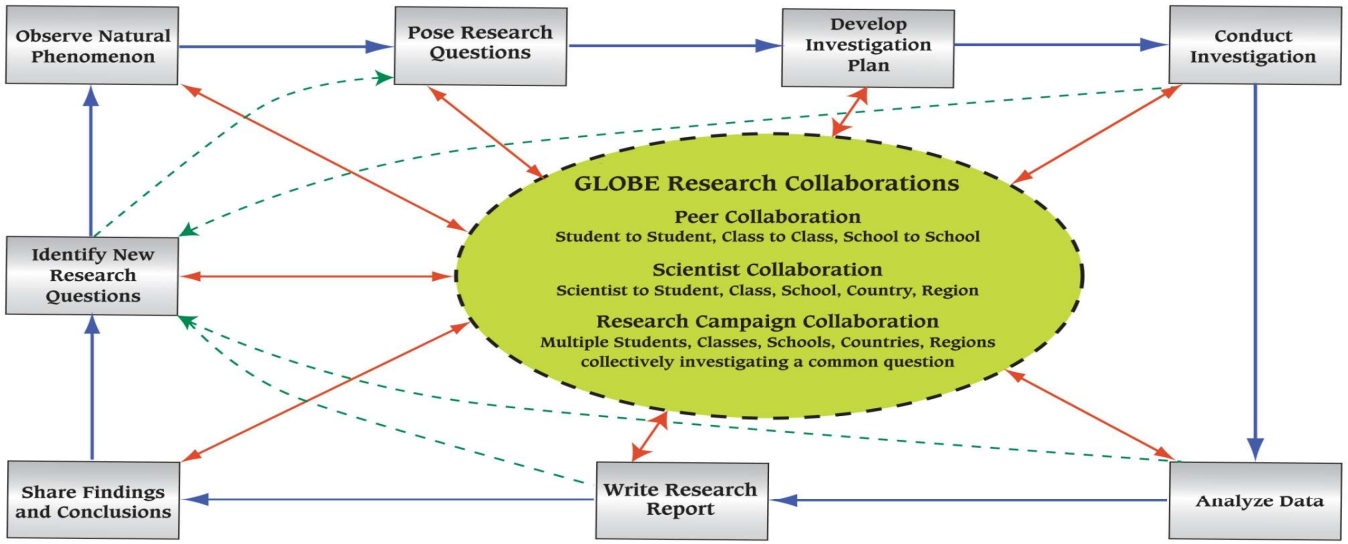
Promote knowledge and support for people's activities, for the benefit of the environment

Contribute to the scientific understanding of the Earth

- Inspire the next generation of scientists in the world

Build an environmentally informed generation.

GLOBE Model for Student Scientific Research



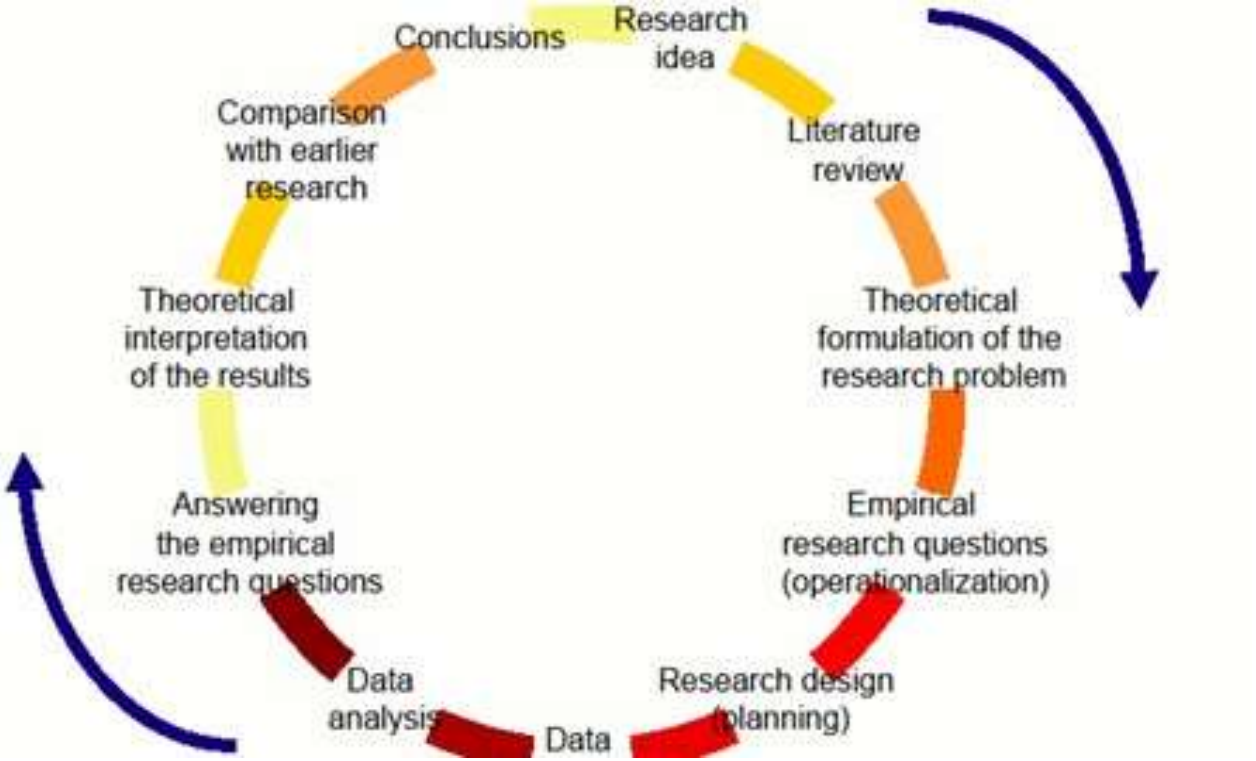
Legend

Primary Pathways

Secondary Pathways

Collaboration Pathways

- **Curiosity**
- **Make questions**
- **Looking for answers**
- **Hypothesis**
- **Take notes, data**
- **Built information**



Before you can test a hypothesis it is important to have a plan

How do I go to a place I do not know?

If I have many things to do how I do them at the same time

- **Why?**
- **Where?**
- **When?**
- **How?**
  - **Materials**
  - **Steps**

Protocols

GLOBE Protocols, instrumentation standards and reporting conventions make sure that GLOBE data are sufficiently accurate and precise to be used in scientific research:

Why are they important?

Reduce mistakes
Make comparisons
Replicate data gathering

Same criteria

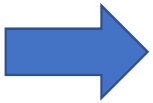
- **Select a good study site**
- **Calibrate equipment**
  - **Considering environment conditions**
  - Temperature: Master variable
  - Conductivity: 200 us/cm
  - Altitude/ pressure
  - Salinity (fresh water?)
- **Meassure: When and how**
- **Repeat three times at least**
- **Report data -------- Analize data**

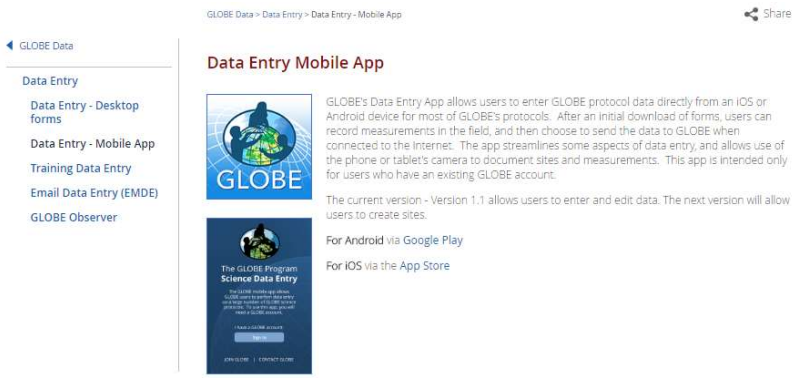
Experimentation

REPEAT data gathering

Datasheets

Report

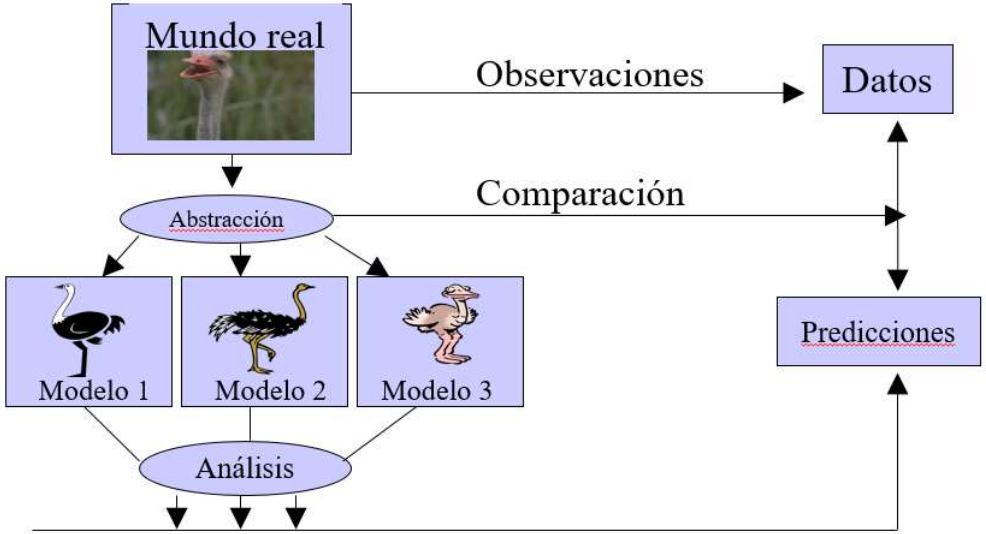




Analize
Increase knowledge

Results

- Analize data
- Interprete data
- Give the context
- Make general affirmations
- Write

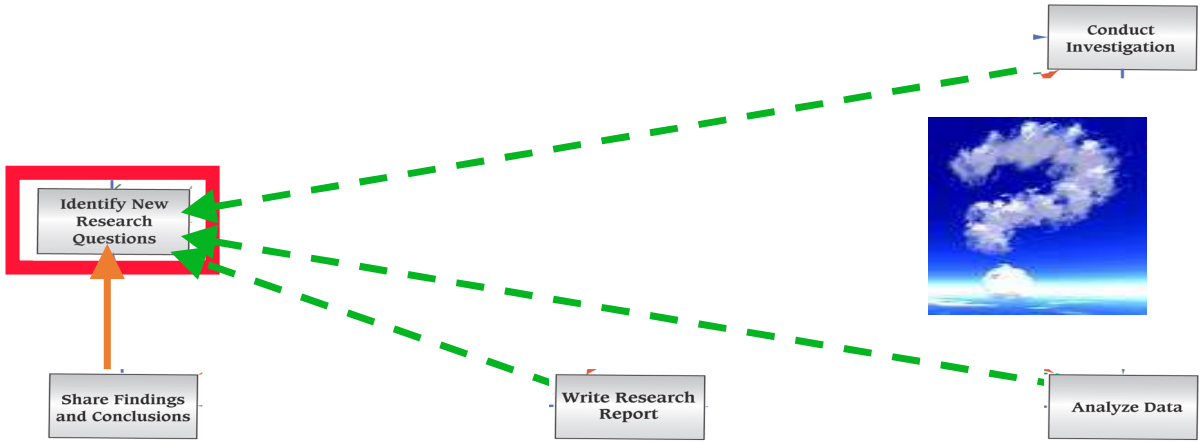


Writing a Report

Share results

- IVSS
- Science fairs
- Research campaigns teams

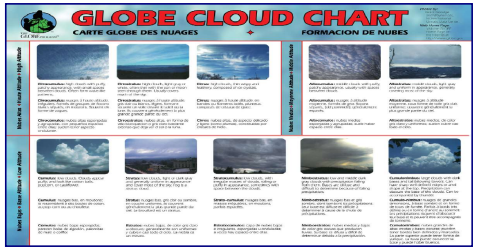
New questions

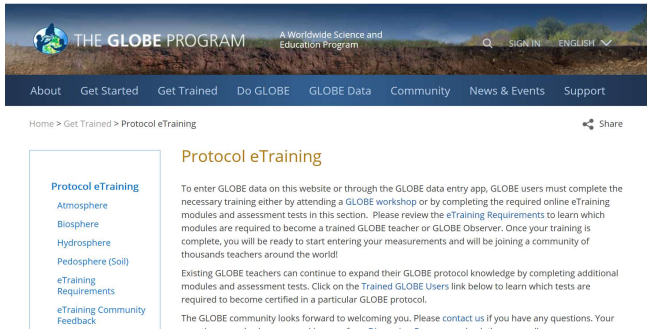


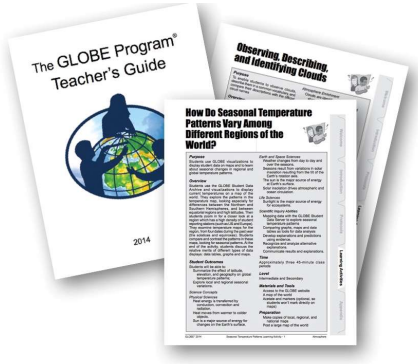
A Class with GLOBE

GLOBE offer:

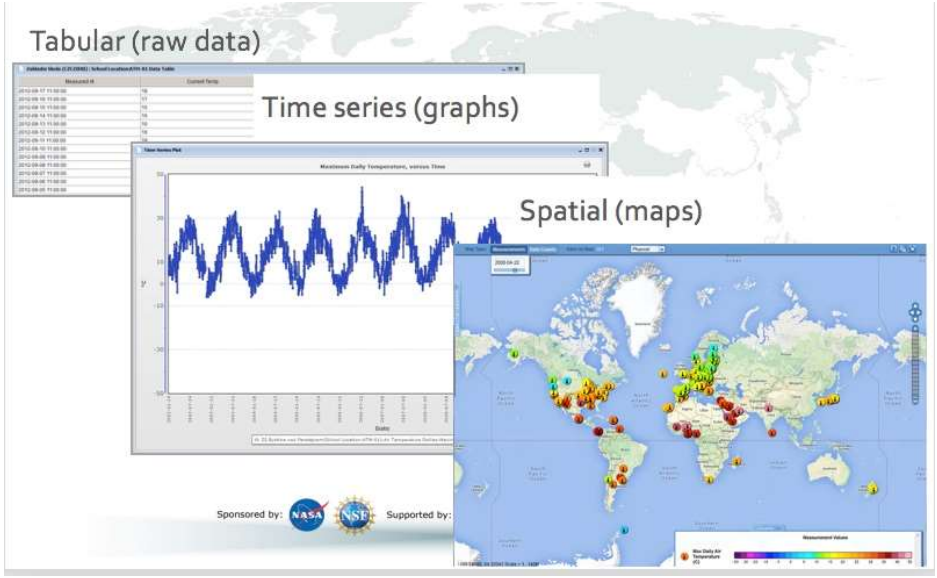
- Learning activities
- Scientific information
- Protocols
- Apps
- Teacher materials



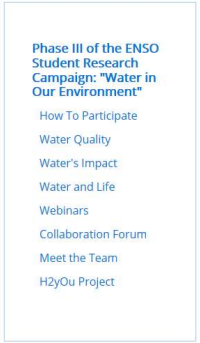




Opportunity to upload and download environmental data to understand in better way what happen with the world

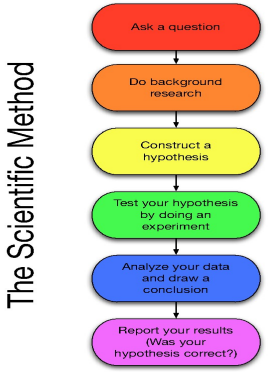


Research campaigns
Formative webinars



S T E A M

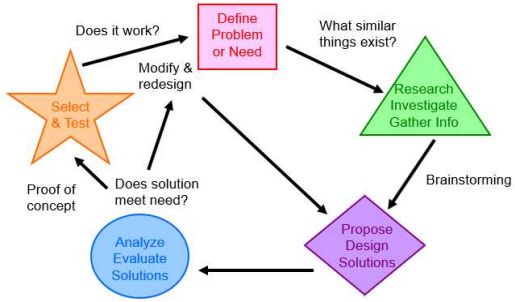
Science
Information
Knowledge
Science facts
Gaps
Questions



Technology
Equipmet
Apps
Design of process

Art
Music
Paint

Engineering
Problem solution

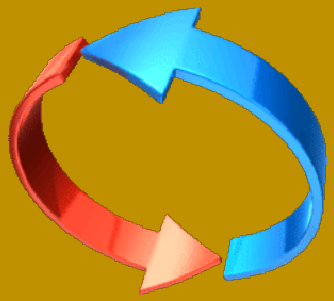


Maths
Measurements

Project and Problem-Based Learning Process

Project or Problem
Observation

Ideas
Research questions
Hypothesis



Knowledge
Literature review
GLOBE teacher guide review

Learning Issues

Protocols selection
Concepts/Procedures/Attitudes

Course of Action

Data gathering
Data entry

Evaluation of Process and Results
Data retrieve
Data analysis
Research report

Preparing a Class

1. Identify the learning objective

-Soil

-Water

-Energy

2. Post questions:

- What I know
- What I would like to know

-Select EUREKA questions

3. Awareness list:

Knowledge	Skills	Attitudes

4. Literature review

-Scientific information

-GLOBE teacher guide

-Select protocols

5. Action

-Get data

-Report data

-Analyze data

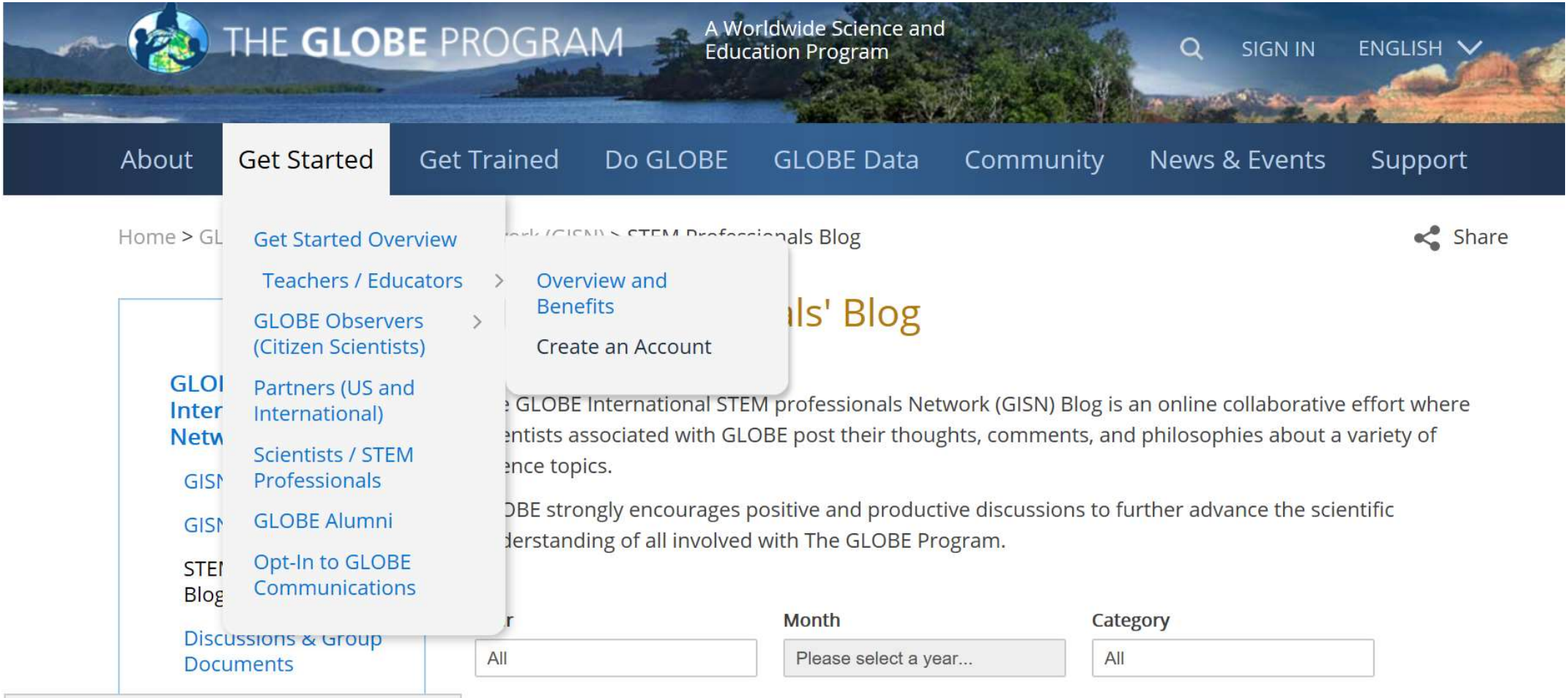
-Create knowledge

6. Share

-What do I learn

-Write a report

-Present your results


THE GLOBE PROGRAM
A Worldwide Science and Education Program
SIGN IN
ENGLISH
About
Get Started
Get Trained
Do GLOBE
GLOBE Data
Community
News & Events
Support
Get Started Overview
Teachers / Educators
Overview and Benefits
Create an Account
GLOBE Observers (Citizen Scientists)
Partners (US and International)
Scientists / STEM Professionals
GLOBE Alumni
Opt-In to GLOBE Communications
Share
Discussions & Group Documents
GLOBE International STEM professionals Network (GISN) Blog is an online collaborative effort where
BE strongly encourages positive and productive discussions to further advance the scientific
Month
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Category
All

THE GLOBE PROGRAM
A worldwide science and education program

Introduction to the Hydrosphere

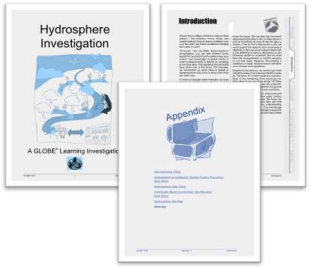
- Hydrosphere as a part of the Earth system
- GLOBE protocols associated with the Hydrosphere
- Start with the hydrology research

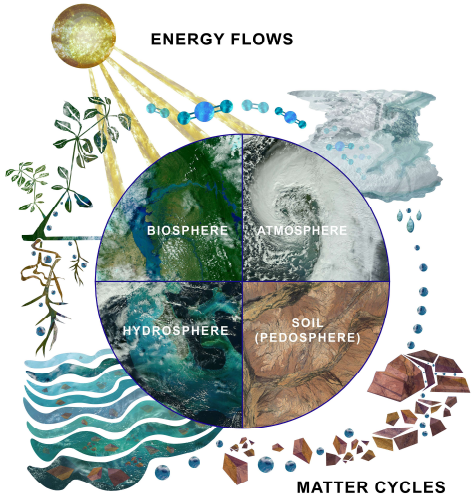
1. Introduction: The Hydrosphere and the Earth System

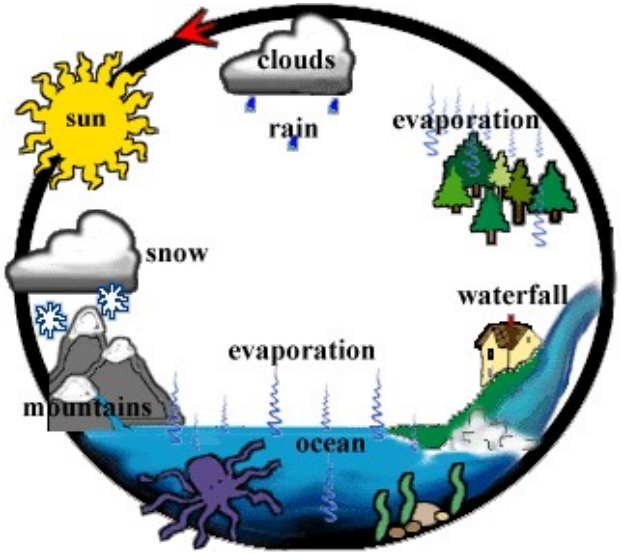
Earth's water bodies- our hydrosphere

Objective

Improve our understanding of Earth's natural waters, and their role in preserving our ecosystems as well as human health.







71% Of the Earth is water

70% of livingthings are water

Water conect spheres

What Can GLOBE Hydrosphere Data Tell Us?

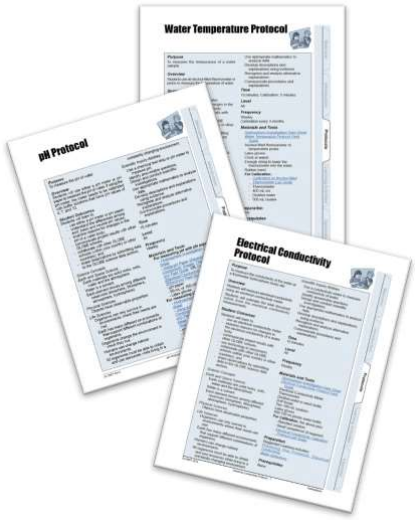
Water is part of important chemical reactions.

- Pure water is not easy to find, this usually have impurities
- By **studying changes in the quality and composition of water** bodies, we are also gathering clues about changes in other parts of the Earth system.

Introduction to GLOBE Hydrosphere Protocols

Some variables could tell us things about water condition. The best are:

- **Water Temperature**
- **Electrical Conductivity**
- **Water pH**
- **Dissolved Oxygen**
- **Salinity**
- **Nitrates**
- **Macroinvertebrates**



Be careful with chemicals for your health and the environment

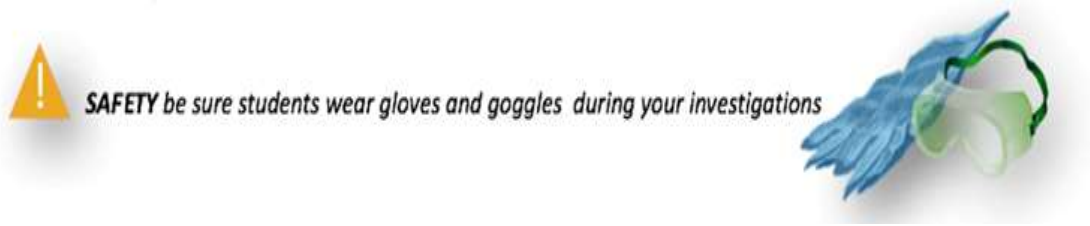
GLOBE Hydrosphere Protocols Safety Precautions

Because some protocols need some chemicals

- Gloves
- Glasses

If work in an environment with mosquitos

- Repellent
- Cloth
- Solar cream



Selecting your Hydrosphere Study Site

All your hydrosphere measurements are taken at the same Hydrosphere Study Site.

Any surface water site that can be safely visited and monitored regularly

Natural waters are preferred. Sites may include (in order of preference):

- **1. Stream or river**
- **2. Lake, reservoir, bay or ocean**
- **3. Pond**
- **4. An irrigation ditch or other water body, if natural body is not available**

Equipment Needed to Document your Hydrosphere Study Site

Assemble Equipment:

- Pencil or pen
- Compass
- GPS receiver
- Camera
- GLOBE Science Log

Assemble Necessary Documents:

Selecting and Documenting your Hydrosphere Study Site

GPS Protocol

Time: 10 minutes

Suggested Frequency: one time; update if the site changes

Determining your Location using a GPS Receiver

Collect positional data using a GPS receiver.

- Wait at least four satellites, this is indicated by the appearance of a “3-D” message.

- **At one minute intervals and without moving the receiver more than one meter, make five readings**

  a. Latitude

  b. Longitude

  c. Elevation

  d. Time

  e. Number of satellites

  f. “2-D’ or “3-D” status icons

Site Definition Sheet * Required Field

School Name: _____ Site Name: _____
Choose a unique name based on location, e.g. "Grassy area - Front of School"

Names of students completing Site Definition Sheet: _____

Date: Year_____ Month_____ Day____ Check one: ❑ New Site ❑ Metadata Update

*Coordinates: Latitude: _____° ❑ N or ❑ S Longitude: _____° ❑ E or ❑ W
Elevation: ___ meters

*Source of Location Data (check one): ❑ GPS ❑ Other _____

Comments: _____

_____

Site Type (select all that apply based on intended measurements, then complete the necessary fields below): ❑ Atmosphere ❑ Surface Temperature ❑ Hydrosphere ❑ Biosphere (Land Cover) ❑ Biosphere (Greening) ❑ Soil (Pedosphere) Characteristics ❑ Soil (Pedosphere) Moisture and Temperature

_____

Adding Data to the Hydrosphere Fields

Record the **name of the water body**

Record whether the water is **salt water or fresh water**.

If your water site is **moving water**, record whether it is a stream, river, or other and its approximate width in meters.

If your water site is a **standing water,** record whether it is a pond, lake, reservoir, bay, ditch, ocean or other and whether it is **smaller than, larger than**, or about equal to a 50 m x 100 m area. If known, indicate the approximate area (km2) and depth (meters).

Record whether your **sample location** is an outlet, bank, bridge, boat, inlet or pier.

Record whether you can see the **bottom**.

Record the **material** from which the bank or channel is made.

Record the **type of bedrock**, if known. Sediments

Record the **manufacturer and model number** for each chemical test kit you are using, if any.

Adding Data to the Hydrosphere Fields

Record in the **Comments Section** any information that may be important for understanding the water at your site. Some possible observations might be: human activities

Standing where you will be collecting your water sample, **take four photographs** of your sampling area, one in each cardinal direction (N, S, E, W). Use a compass to determine the direction (five - surface-could be great)

- If you've taken photographs of your site **label each photo**

Mapping your Hydrosphere Study Site

Assemble Equipment:

- Pencil/eraser
- Compass
- Flags (18)
- Measuring tape (50 m)
- 1 cm grid paper

Assemble Necessary Documents:

Mapping Your Hydrosphere Study Site Field Guide

Hydrosphere Study Site Mapping Sheet

Time: 30 -45 minutes

Suggested Frequency: one time; update if the site changes

Creating Your Site Map

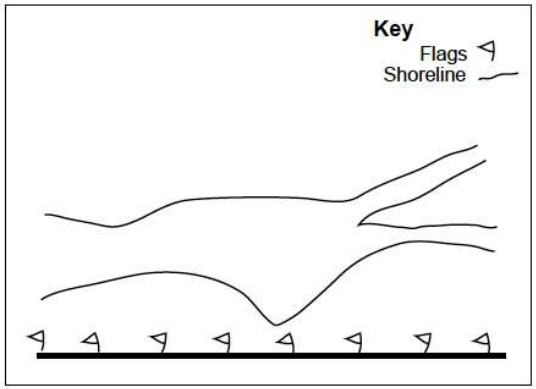
Select a section of the bank at least 50 meters long as your study area. The area should contain the sampling site where you collect your water measurements and representativity of the habitats

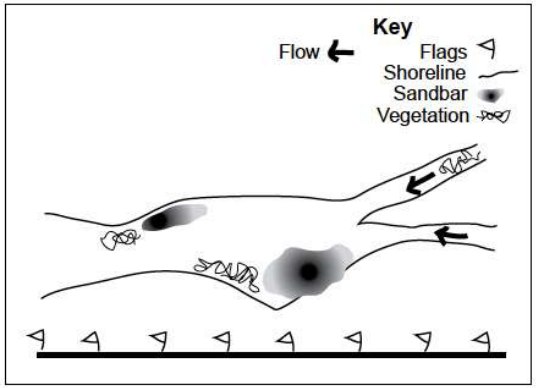
50 meters long, parallel to the shoreline, and within 10 meters of the bank. The transect will be varying distances from the water if the bank is not straight.

Place flags at the two ends and at every 2 meters along the transect.

Start drawing your map using the flags to help keep it to scale.

Note: Use the Mapping Field Sheet or graph paper with 1 cm squares, each square should represent 2 meters. Put the scale on your graph.





Drawing your Site Map

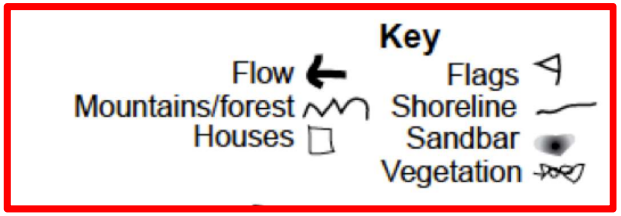
Mark the transect and flag positions on the map.

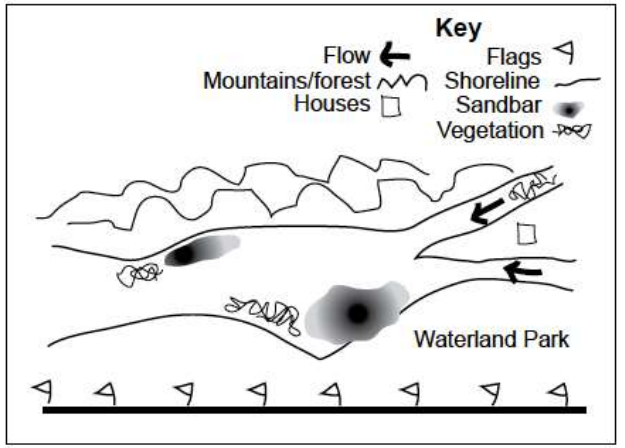
Draw the waterline or bank by measuring from each flag directly to the water, placing a small dot on the map to show the waterline, then connect the dots with a dotted line to indicate the bank.

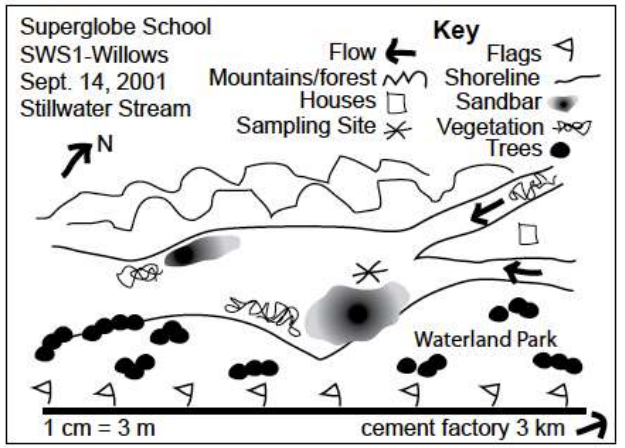
Put in the opposite bank or indicate the **approximate distance to the opposite bank** if known.

Use an arrow to indicate the **direction of water flow** or the inlet and outlet of your water body.

Create a key with symbols for special features found at your site.







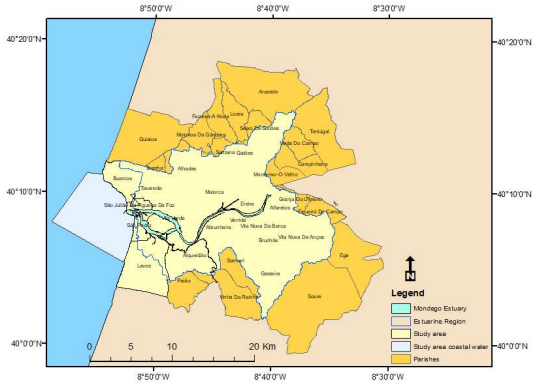
Create a Key for your Map

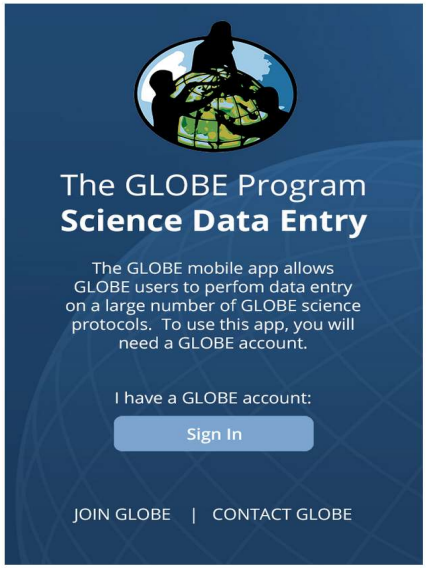
Within the sampling area: riffle areas, pools, vegetated areas, logs, rocky areas, gravel bars, bridges, docks, jetties, dams, etc.
Around the sampling area: land cover (or MUC codes), geological features such as cliffs or rocky outcrops, man-made features such as houses, parks, parking lots, factories, roads, dumps or debris, etc.

Show the location of your Hydrosphere Sampling Site.

Include the following information on the map:

- Name of site
- Name of water body
- North arrow
- Date
- Scale (e.g., 1 cm = 3 m)
- Key to all symbols used on the map





Water Transparency Protocols

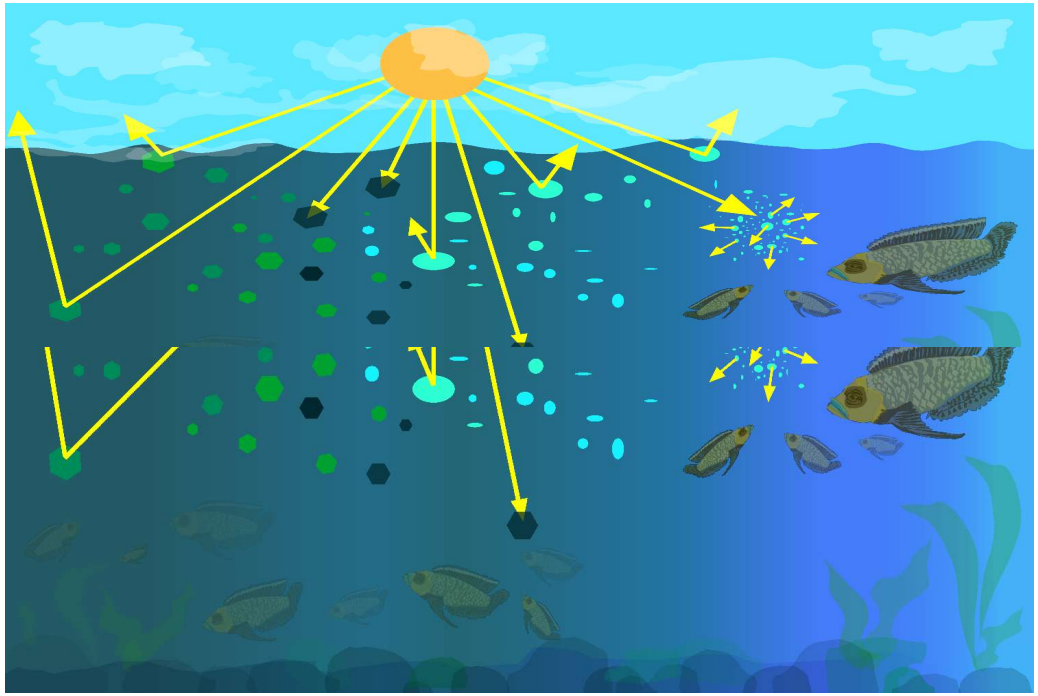
Water transparency measures depth of light penetration into the water.

Water transparency depends on the amount of suspended particles.

These particles limit the penetration of light through the water column.

Algal blooms such as this, significantly reduce water transparency and contaminate onshore drinking water.

Photosyntesis, water quality



Suspended particles interact with light's penetration through the water column. Particles in the water will reflect, absorb or scatter light, thus determining the depth at which more light can't penetrate.

Water Transparency Protocols: Should I use a Secchi Disk or a Transparency Tube to measure water transparency?

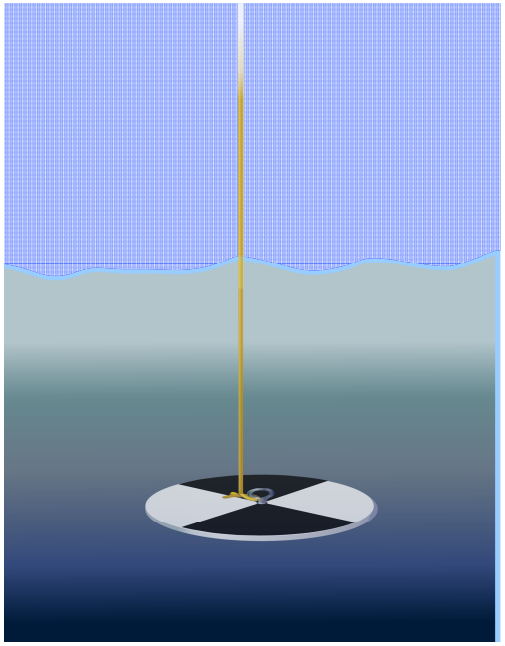
There are two techniques to choose from.

Secchi Disk deep or still water

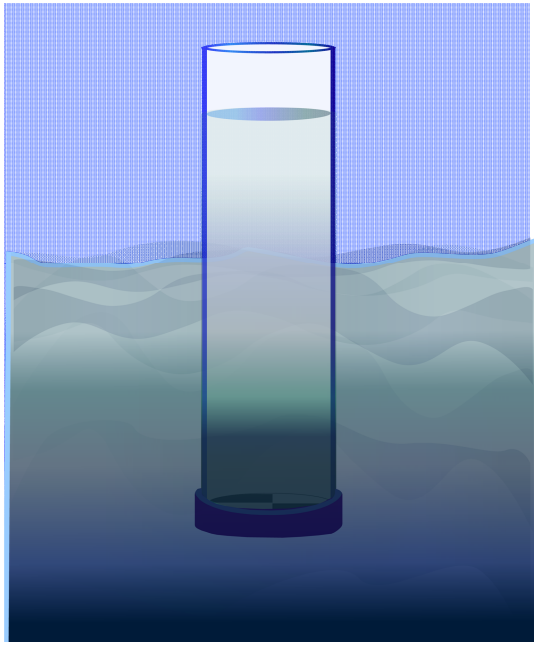
transparency tube shallow or flowing water.

Both instruments can be built easily using household materials by following instructions in the GLOBE Teacher's Guide.

Require: Description of the Sky Conditions, Cloud Type and Cloud Cover.



Secchi Disk is used with deep and still water



Transparency Tube used with shallow or Flowing water

Time Requirements for Secchi Disk Method

Time to complete protocol: About 10 minutes

Stand so that the **Secchi disk** will be shaded or use an **umbrella or cardboard** to shade the measurement area.

If you cannot reach the water surface, establish a reference height.

Verify that the data from the three measurements are within **10 cm** of the mean, (but do not average your data for reporting)

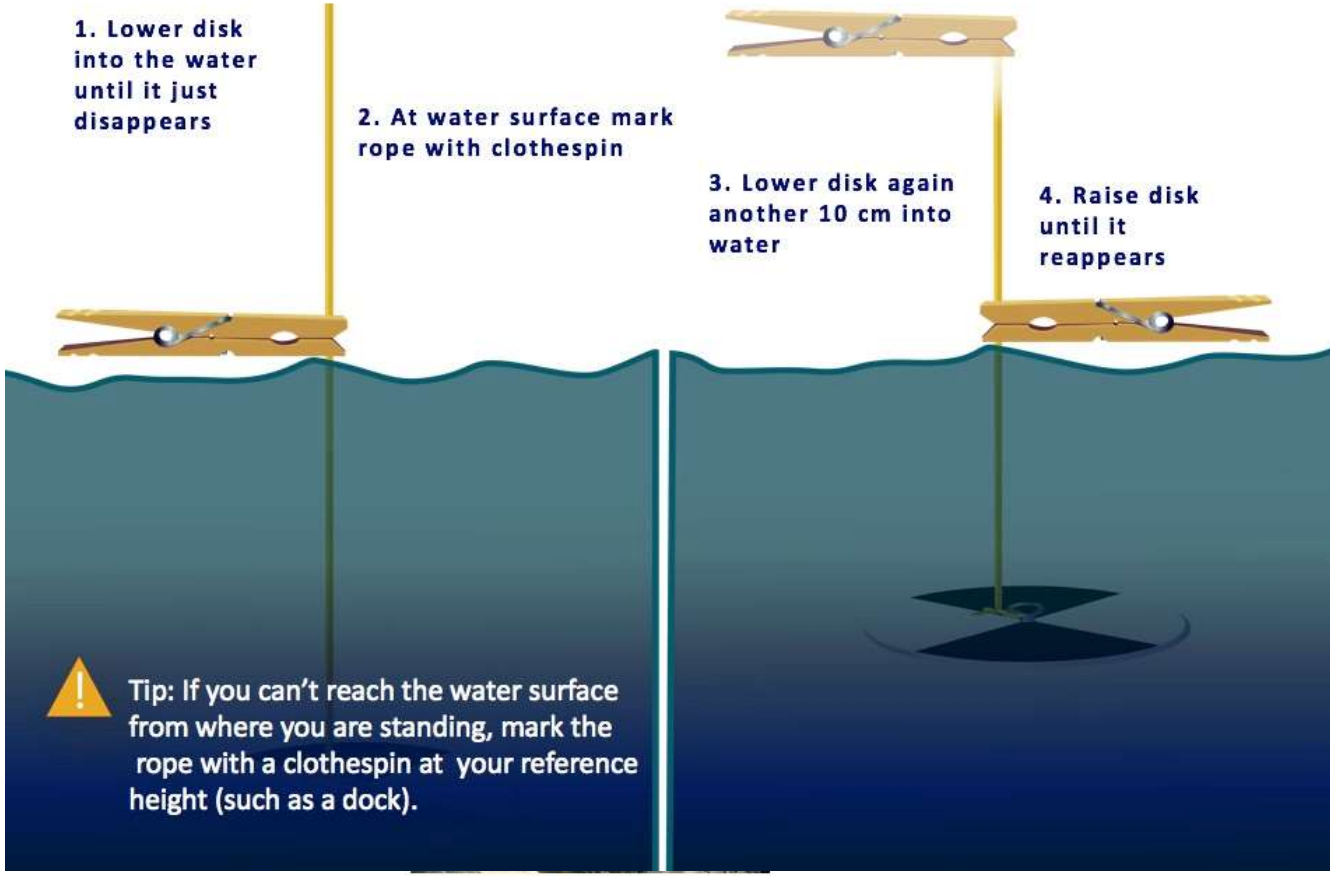
Lower the Secchi Disk until it disappears under the water

Lower the Secchi disk gradually. As it is lowered, the black cross will become less visible. Eventually it will disappear completely.

Note: You will need to remove sunglasses/goggles when lowering the Secchi Disk, so you can identify the extinction depth correctly.

There should now be two points marked on the rope. Record the length of the rope between each mark and the Secchi disk on your Hydrosphere Investigation Data Sheet to the nearest cm.

If you marked the rope at the water surface, record "0" as the distance between the observer and the water surface.



Instrument Construction Instructions for Making a Transparency Tube

Materials:

- *Clear tube approximately 4.5 cm x 120 cm
- PVC cap (to fit snugly over one end of the tube)
- Permanent black marker
- Meter stick or meter tape

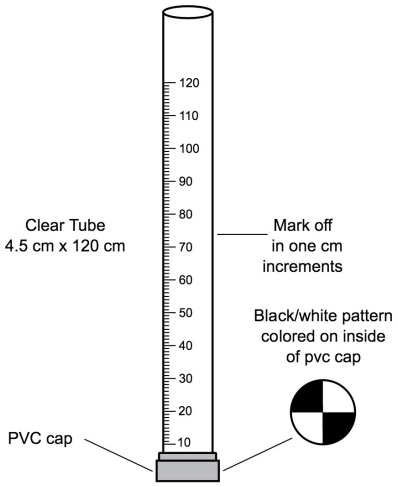
Construction:

1. On the bottom of the inside of the PVC cap, draw a Secchi disk pattern (alternating black and white quadrants) with the black permanent marker.

2. Put the PVC cap over one end of the tube. Cap should fit tightly so water cannot leak out.

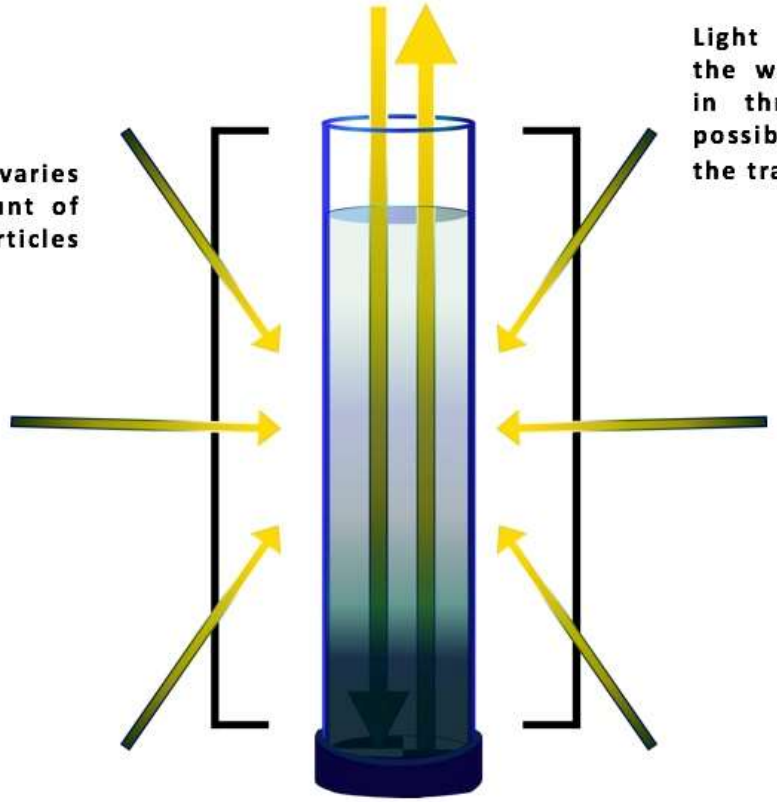
3. Use the marker and meter stick to draw a scale on the side of the tube. The bottom of the inside of the PVC cap where the Secchi disk pattern is drawn is 0 cm. Mark every cm up from that point.

4. A shutoff valve can be installed near the bottom of the tube to allow water to escape in a controlled manner; this would resemble commercially-available transparency tubes. You can also drill a small hole near the bottom that you can plug with your finger when you are making measurements.



**Many hardware stores carry long tubes for protecting fluorescent light bulbs. These are inexpensive and make excellent transparency tubes. If these are not available, any long, clear plastic tube may be used: the length is more important than the diameter.*

In the Field: Collect Your Water Sample



⚠ Be sure to rinse bucket with sample water

Water Temperature Protocol

- How hot or cold the water is

- Water has a **higher heat capacity** (specific heat) than air, thus it heats and cools more slowly - termorregulator

- **Master variable** because almost all properties of water, as well as chemical reactions taking place in it, are affected by it.

- Temperature influences the amount and diversity of aquatic life.

- Electrical conductivity and dissolved oxygen, require water temperature data.

How to Collect Water Temperature Data

Using an **alcohol-filled thermometer** or using a **temperature probe**..

Except for transparency, take water temperature before the other water measurements.

Take the water temperature measurement as soon as possible because temperature tends to change very rapidly

Read with the bulb inside the water

When	**Weekly (if possible)**
Where	**Hydrosphere Study Site**
Time Needed	**10 minutes**
Prerequisites	**Hydrosphere Study Site**

References:

- Hydrosphere Investigation Data Sheet
- Water Temperature Protocol for Thermometers
- Calibrating an Alcohol-filled Thermometer Lab Guide
- Water Temperature Protocol for Thermometer Probes Field Guide

Water Temperature with Alcohol Filled Thermometer Protocol

Assemble Equipment:

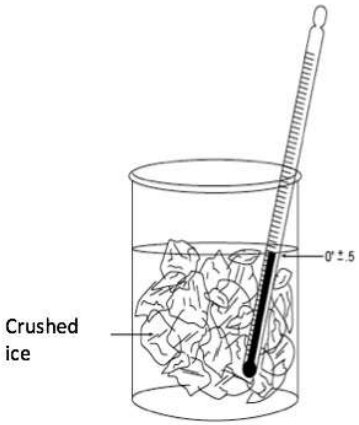
- Alcohol-filled thermometer
- Latex gloves and goggles
- Clock or watch
- Rubber band
- Enough string to lower the thermometer into the water

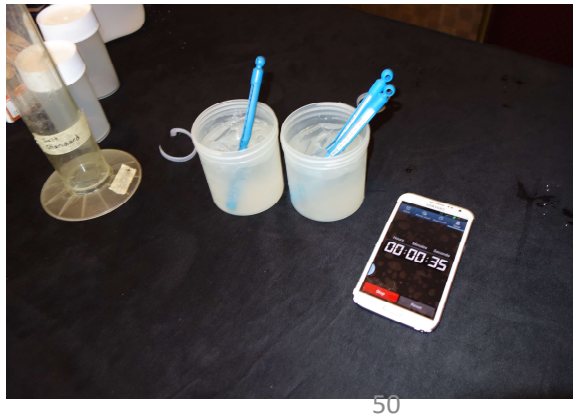
For Calibration, You Also Need:

- Thermometer
- 400 mL ice
- Distilled water
- 500 mL beaker

Thermometer Calibration- Steps 1-4

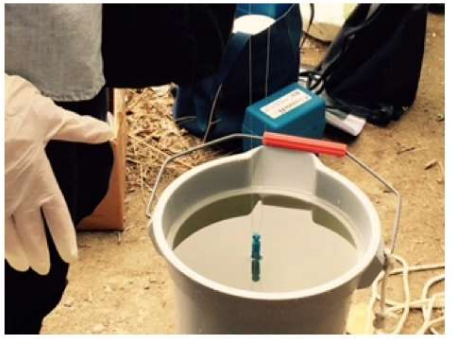
1. Stir together 100 mL of water and 400 mL of crushed ice in the beaker
2. Let the ice-water bath sit for 10 to 15 minutes so that it reaches its lowest temperature.
3. Put the bulb of the thermometer into the bath.
4. Leave the thermometer in the water for three minutes.
5. Read the temperature without removing the bulb of the thermometer from the water.
6. Let the thermometer stay in the water sample for one more minute.
7. Read the temperature again. If the temperature has not changed
8. The thermometer should read between -0.5˚ and 0.5˚ C.
9. Alcohol-filled thermometers do not have an adjustment and must be replaced if they do not read temperature with the expected accuracy (± 0.5° C).





Collecting Data in the Field with Alcohol Filled Thermometer - Steps 1-5

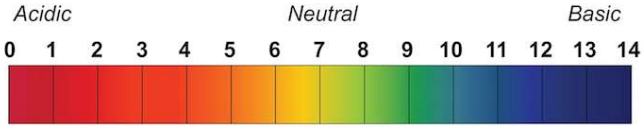
1. Put the bulb end of the thermometer into the sample water to a depth of 10 cm.
2. Leave the thermometer in the water for three minutes.
3. Read the temperature without removing the bulb of the thermometer from the water.
4. Let the thermometer stay in the water sample for one more minute.
5. Read the temperature again.
6. Record the temperature on the datasheet and after in the Web page



What is Water pH?

PH is a measure of the relative amount of free hydrogen ions there are in the water, which determines the acidity of the water body.

pH = - log [H+]



Logarithmic units from 0-14, with 7 being neutral. Each number represents a 10x change in the acidity or alkalinity of the water.

The pH values for your water site will depend on the geology, soil and vegetation of your area as well as other inputs

Most lakes and streams have pH between 6.5 and 8.5. Oceans have a pH value of 8.2.

pH of a water body can be measured using either a pH meter or pH paper. The accuracy of either method depends on the **electrical conductivity** of the water. The electrical conductivity needs to be at least 200 µS/cm for these methods to report accurately.

What is Electrical Conductivity?

- Electrical conductivity measures **the capacity of water to transmit an electrical current**.
- Capacity directly related to the concentration of salts in the water. Salts **disassociate** into positively and negatively charged ions in solution
- The amount of mineral and salt impurities in the water the **total dissolved solids** (abbreviated TDS)
- We use electrical conductivity as an indirect measure to find the TDS of water.
- **How much electricity is being conducted through a centimeter of water**.
- The higher the water temperature, the higher the electrical conductivity would be
- Pure water does not have dissolved solid ions to conduct the electricity
- The local geology affect the electrical conductivity. Granite bedrock tend to have lower electrical conductivity, clay soils tend to have higher electrical conductivity
- All water should be brought to room temperature (20˚ - 30˚ C)
- Most conductivity meters cannot measure the high conductivity characteristic of salt waters.
- A low Electrical Conductivity value from 10 to about 200 µS/cm, suggests that the water may be drinking-water quality.

Assemble Equipment for Calibration of the EC Instrument

Your task is to measure the electrical conductivity of your water sample. Before you begin, make sure that the sample has the right temperature and salinity to produce an accurate reading.

You will need:

- Electrical conductivity meter
- Thermometer
- Distilled water in a wash bottle
- Paper towels or soft tissue
- 2 100-mL beakers or plastic cups
- Protective gloves
- Small screwdriver
- Standard Calibration solution

Document Links:

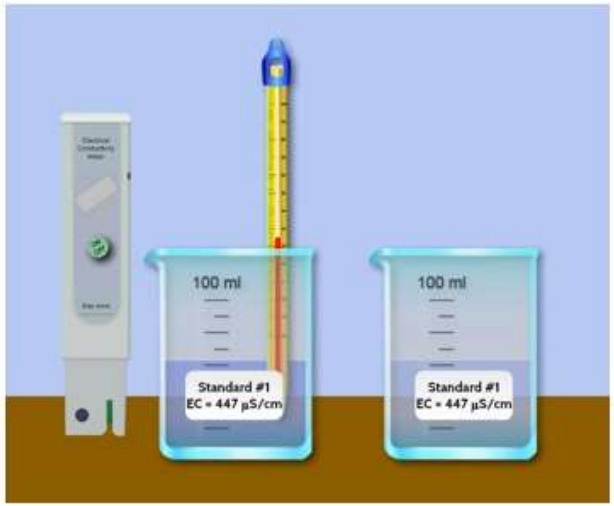
- Electrical Conductivity Field Guide Protocol
- Hydrosphere Investigation Data Sheet

Calibration of the Electrical Conductivity Probe (1/2)

Before you take electrical conductivity measurements, you need to ensure that your meter is calibrated and able to take accurate measurements.

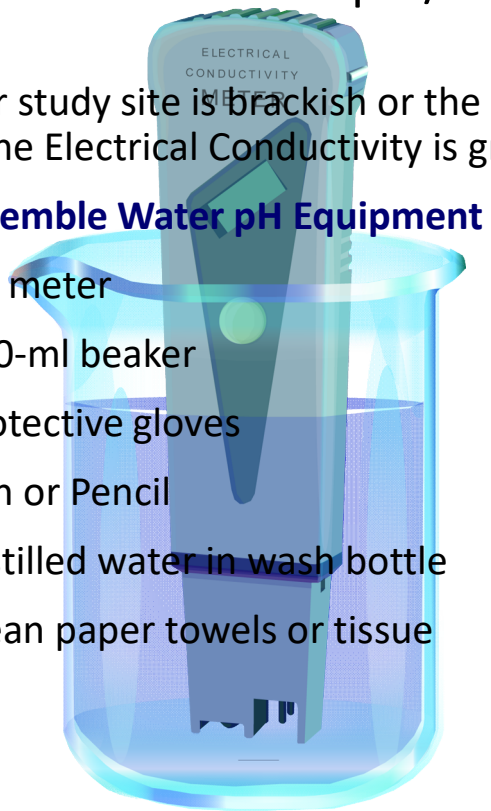
Here are the steps:

1. Bring the standard solution to room temperature (about 25° C).
2. Pour standard solution into each of the two clean 100-mL beakers or cups to a depth of about 2 cm.
3. Remove the cap from the electrical conductivity tester and press the On/Off button to turn it on.
4. Rinse the electrode at the bottom of the tester with distilled water in the wash bottle.
5. Gently blot dry with a tissue.
6. Each of the observations **should be within 40 µS /cm** of the average.



Do not rub or stroke the electrode while drying as it may damage the probe.

pH Water Protocol using a pH Meter: Electrical Conductivity Greater than 200 µS/cm



If your study site is brackish or the Ocean, you can assume that the Electrical Conductivity is greater than 200 µS/cm.

- **Assemble Water pH Equipment**
- pH meter
- 100-ml beaker
- Protective gloves
- Pen or Pencil
- Distilled water in wash bottle
- Clean paper towels or tissue

Calibrate the pH meter according to the manufacturer's directions, using the three buffer solutions.

Rinse a 100-mL beaker three times with sample water.

Pour 50 mL of sample water into the 100-mL beaker.

Put the electrode part of the meter into the water.

Stir once with the meter. Do not let the meter touch the bottom or sides of the beaker. Wait one minute. If the pH meter is still changing numbers, wait another minute.

Three times media . Check to see if each of the three observations is within 0.2 of the average

Rinse the electrode with distilled water and blot dry. Turn off the meter. Put on the cap to protect the electrode

pH Water Protocol using a pH Meter
Electrical Conductivity Less than 200 µS/cm

Fill one beaker or cup with about 50 mL of sample water.

Using the tweezers, place one crystal of salt in the sample water. (If you do not have salt crystals, use a few grains of table salt and pour that into the sample water)*.

Stir thoroughly with stirring rod or spoon

Measure the electrical conductivity of the treated sample water (with the added salt) using the **Electrical Conductivity Protocol.**

If the electrical conductivity is at least 200 µS/cm, record value on Data Sheet. If not add more salt

If use a paper follow instructions of the box

Dissolved Oxygen (DO)?

- Dissolved oxygen (DO) measures the amount of molecular oxygen (O_2) in the water. It does not measure the amount of oxygen in the water molecule (H_2O).
- DO less than 3ppm could be stressful to most of organisms
- D0 of at least 6 pmm could be considered as good
- Factors affecting the solubility of dissolved oxygen include:
  - Water temperature: Colder water can dissolve more oxygen than warmer water
  - Atmospheric pressure: Water at higher elevations holds less dissolved oxygen since the atmospheric pressure is less.
  - Salinity: Saline water can hold less oxygen at the same temperature and pressure than can fresh water

Dissolved Oxygen Protocol Using a Commercial Test Kit

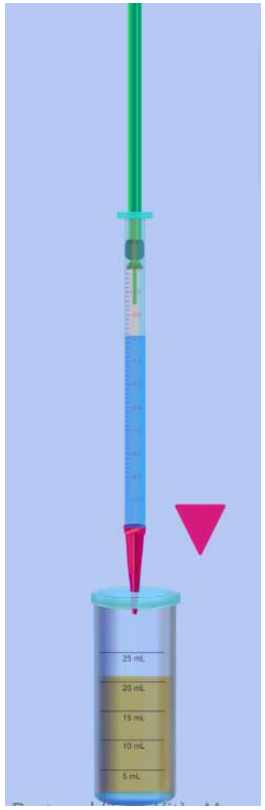
- **Objective:** Measure dissolved oxygen of water sample with test kit.

- **What You Need**
- Distilled Water
- Waste Bottle with Cap for used chemica
- Latex Gloves
- Pen or Pencil
- Goggles
- Dissolved Oxygen Test Kit

Dissolved Oxygen Protocol Using a Commercial Test Kit

- **In the field**

1. Rinse the sample bottle and hands with sample water three times.
2. Place cap on sample bottle and submerge in sample water.
3. Remove the cap and allow bottle to fill (agitate the bottle to remove air bubbles).
4. Replace cap while bottle is submerged.
5. Remove sample bottle and turn upside down to check for air bubbles (if present discard sample water and repeat process).
6. Follow the measurement instructions included with the kit.
7. *Note: Each measurement should be within 1 mg/L of the average. If one measurement is not, take the average of the two remaining measurements.*



Water DO Protocol Using a Probe: Salinity Correction

- When measuring dissolved oxygen in salt waters (salinity greater than 1 ppm), you will need to apply a salinity correction factor .
- Different probes have different procedures for this correction.
- As this correction can affect your measurement, it is necessary to measure salinity each time you measure DO and mark it down on your *Hydrosphere Investigation Data Sheet.*
- Determine the elevation at your sampling site if you are not using a barometer.

Salinity

- The salinity measurement is used to find the total dissolved solids of brackish or salt water.

- Beyond the 200 µS /cm of electric conductivity, you need to use the salinity protocol.

- The Earth's oceans average 35 ppt salinity. Fresh water measures 0.5 ppt or less

Which Technique To Use? Advantages and Disadvantages

Hydrometer

- *Advantages*
- Easy and quick to use
- No chromium by-products

- *Disadvantages*
- Breakable

Salinity Titration

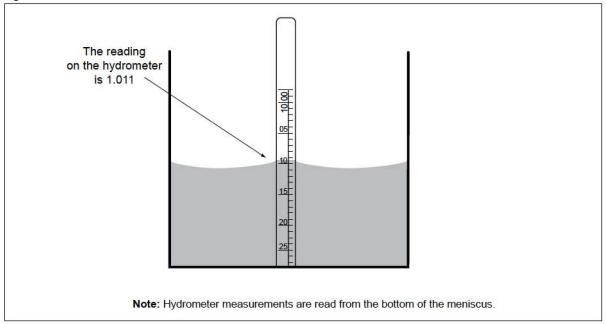
- *Advantages*
- Less math involved
- Practice in chemistry

- *Disadvantages*
- Chromium by-products
- Takes more time to take measurement

Salinity Water Protocol: Hydrometer Method

- Rinse the 500-mL cylinder with sample water twice.
- Fill the cylinder with sample water to within 2 or 3 cm of the top.
- Measure and record the temperature of the water in the cylinder. (See *Hydrosphere Investigation*, *Water Temperature Protocol Field Guide*)
- Gently put the hydrometer into the cylinder.
- Wait for the hydrometer to stop bobbing. It should not touch the sides of the cylinder.
- Read the hydrometer at the bottom of the meniscus. Read the specific gravity to three decimal places. Record the specific gravity on the *Hydrosphere Investigation Data Sheet*.
- As the water gets denser, more of the hydrometer is exposed. Marks along the hydrometer allow you to read the specific gravity directly.

Figure HY-SA-1



Note: Hydrometer measurements are read from the bottom of the meniscus.

Overview of Water Salinity Protocol: Hydrometer Method

With the hydrometer, you will collect a specific gravity reading. You also need to take the temperature of the water. With the temperature and specific gravity values, you use a a table to determine the salinity in parts per thousand (ppt). For instance, if you had a hydrometer reading of 1.005 and a temperature reading of 11°C, you would have a salinity of 7.0 ppt.

Table HY-SA-2: Salinity (parts per thousand) as a function of specific gravity and temperature (as of 9/2005)

	Temperature of Water (°C)																
Observed Reading	-2	-1	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0.998																	
0.999																	
1.000																	
1.001	2.0	1.9	1.9	1.8	1.8	1.5	1.5	1.5	1.5	1.5	1.5	1.8	1.8	1.9	1.9	2.0	2.1
1.002	3.3	3.2	3.2	3.1	2.9	2.9	2.9	2.8	2.8	2.9	2.9	2.9	3.1	3.2	3.3	3.4	3.6
1.003	4.6	4.5	4.4	4.2	4.2	4.1	4.1	4.1	4.1	4.1	4.2	4.2	4.4	4.5	4.6	4.7	4.9
1.004	5.8	5.7	5.5	5.5	5.4	5.4	5.4	5.4	5.4	5.4	5.5	5.5	5.7	5.8	5.9	6.1	6.2
1.005	7.1	7.0	6.8	6.7	6.7	6.7	6.6	6.6	6.7	6.7	6.7	6.8	6.8	7.0	7.1	7.2	7.5
1.006	8.3	8.1	8.1	8.0	7.9	7.9	7.9	7.9	7.9	8.0	8.0	8.1	8.1	8.3	8.4	8.5	8.8
1.007	9.4	9.4	9.3	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.3	9.4	9.4	9.6	9.7	9.8	10.1
1.008	10.7	10.6	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.6	10.6	10.7	10.9	11.0	11.1	11.3
1.009	11.9	11.8	11.8	11.7	11.7	11.7	11.7	11.7	11.8	11.8	11.9	11.9	12.0	12.2	12.3	12.4	12.6
1.010	13.2	13.1	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.1	13.1	13.2	13.3	13.5	13.6	13.7	13.9
1.011	14.4	14.3	14.3	14.1	14.1	14.1	14.1	14.3	14.3	14.4	14.4	14.5	14.7	14.8	14.9	15.0	15.2
1.012	15.6	15.6	15.4	15.4	15.4	15.4	15.4	15.4	15.6	15.6	15.7	15.8	16.0	16.1	16.2	16.3	16.5
1.013	16.9	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.9	17.0	17.1	17.1	17.3	17.5	17.6	17.8
1.014	18.0	18.0	17.9	17.9	17.9	17.9	17.9	18.0	18.0	18.2	18.3	18.3	18.4	18.6	18.8	19.0	19.1

Alkalinity Protocol

Alkalinity and pH are properties of water that are related, but different. Alkalinity is the measure of the pH buffering capacity of the water. pH, on the other hand, is the acidity of water.

Alkalinity is expressed as the amount of calcium carbonate ($CaCO_3$) in your water, although other substances can contribute to alkalinity as well. The units of alkalinity are either part per million (ppm) or mg/L. These units are equivalent, as 1 ppm = 1 mg/L.

Alkalinity comes from dissolved rocks, particularly limestone ($CaCO_3$), and soils.

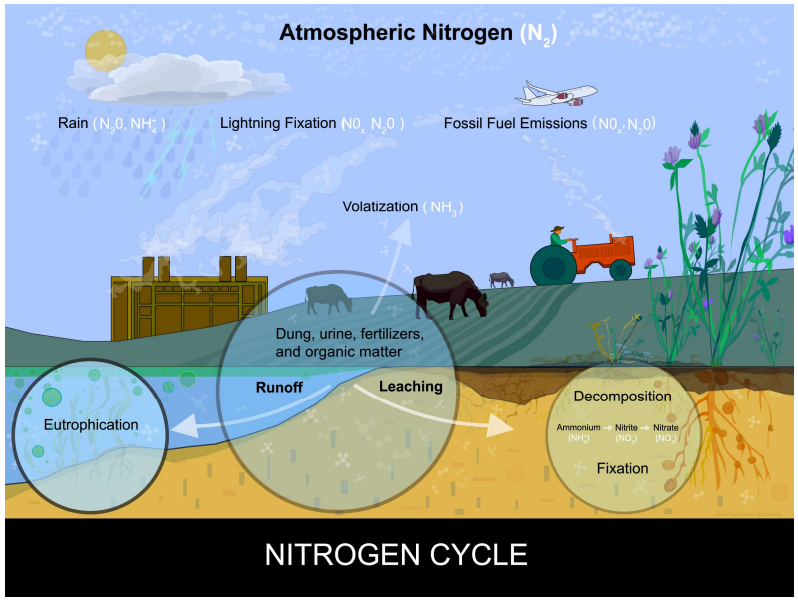
Those water bodies that have high alkalinity are well buffered and resist changes in pH even when acid is added to the water.

Kit: read instructions and conserve it

Nitrates

Nitrogen can be found in many chemical forms in water. Biological and physical processes transform the chemical forms as part of the nitrogen cycle. The GLOBE Nitrate Protocol targets nitrate (NO_3^-). Nitrate (NO_3^-) is usually the most important inorganic form of nitrogen because it is an essential nutrient for the growth and reproduction of many algae and other aquatic plants. Nitrite (NO_2^-) is usually found only in waters with low dissolved oxygen levels, called suboxic waters.

To test for nitrates, you will use a commercial test kit. Nitrates are a common pollutant that is transferred from overfertilized agricultural fields by runoff.



Overview of the Water Nitrate Protocol

The GLOBE Nitrate Protocol uses a chemical based test kit. Always look at the manufacturer's instructions on how to perform the test

Although nitrate (NO_3^-) is the chemical form of nitrogen of interest, it is difficult to measure directly. So, nitrate test kits have you perform a chemical reaction where the nitrate in the sample of water will be transformed into nitrite (NO_2^-) which is a form more easily measured . oxidation – reduction reaction

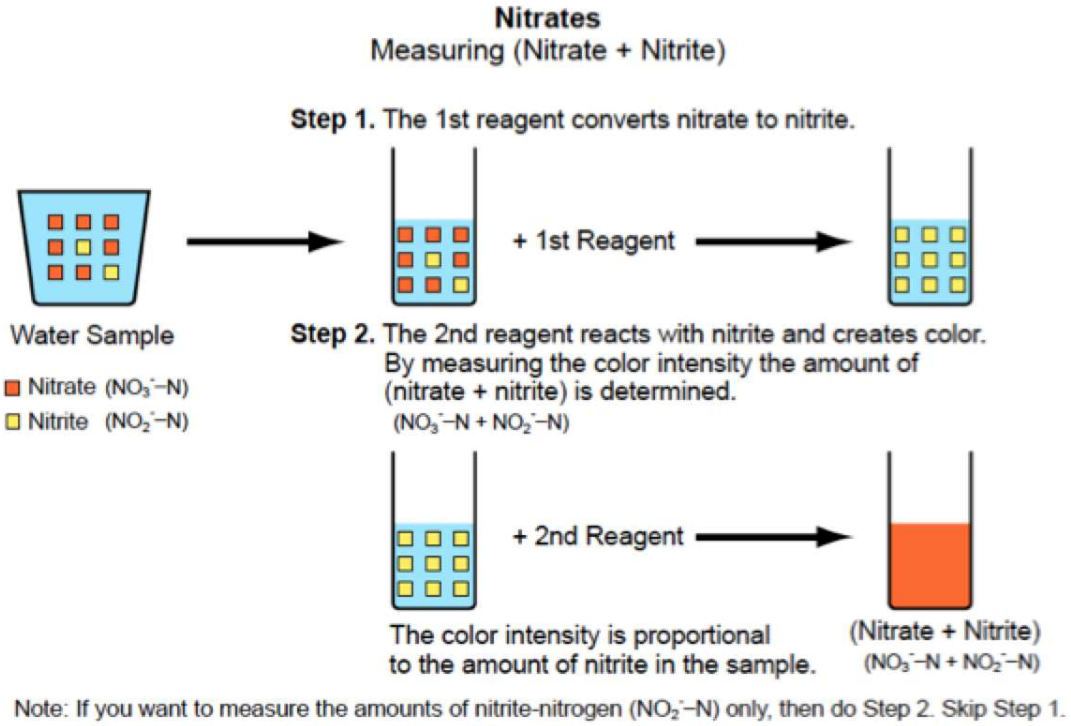
Often, the kits will say that they use a cadmium reduction method. This means that the cadmium has removed electrons from nitrate (NO_3^-) to form nitrite (NO_2^-)

Most natural waters have nitrate levels under 1.0 mg/L NO_3^--N

Check to see if each of the three measurements is within 0.1 ppm of the average (or within 1.0 ppm of the average if using the high range test)

Measuring Nitrates and Nitrites using a Commercial Test Kit

These are the chemical reactions that you will be using in the Nitrate Protocol:



Note: If you want to measure the amounts of nitrite-nitrogen (NO_2^-–N) only, then do Step 2. Skip Step 1.

Freshwater Macroinvertebrates Protocol

Millions of small creatures inhabit fresh waters of lakes, streams, and wetlands.

Macroinvertebrates, consisting of a variety of insects and insect larvae, crustaceans, mollusks, worms, and other small, spineless animals live in the mud, sand, or gravel of the substrate or on submersed plants and logs.

They play a crucial role in the ecosystem: Part of the food chain

Macroinvertebrates offer services as clean water (filter feeders)

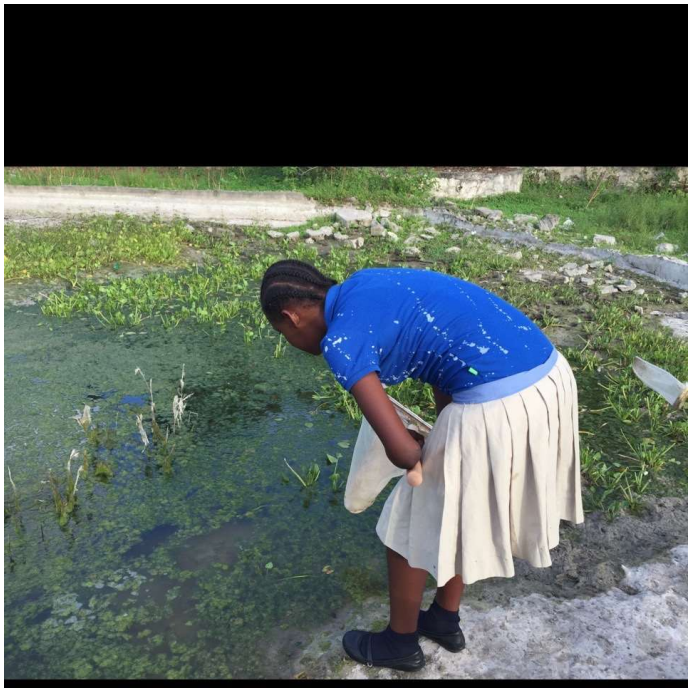
Freshwater Macroinvertebrates Protocol

Macroinvertebrates can tell us a lot about the conditions within a water body.

Many macroinvertebrates are sensitive to changes in water conditions

Macroinvertebrate samples allow us to estimate biodiversity, examine the ecology of the water body and explore relationships among water chemistry measurements and organisms at your Hydrosphere Study Site.

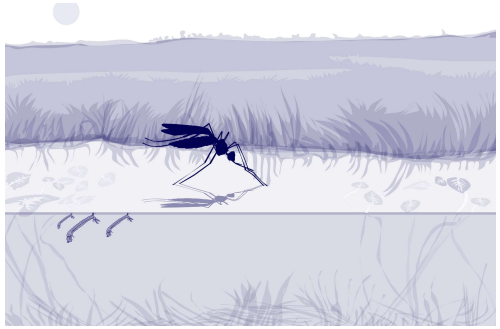
Ideally, you will sample freshwater macroinvertebrates twice a year, about 6 months apart, during the spring and the fall, or during the wet and dry seasons, about 6 months apart.



Mosquito Larvae Protocol

The Mosquito Larvae Protocol is one of the hydrosphere protocols used by GLOBE to describe the status of a water body.

Identifying the breeding areas of mosquitos that are disease vectors for humans is an important component of local disease management and eradication.



Healthy Freshwater Conditions for Turtles

Hannah Thornton and Ella Ware

Innovation Academy

Abstract

Upper Lake's location is less than a mile from our school. It's a lake that locals visit frequently and is a home to various animals. It was observed at the lake that Red Eared Sliders are a common turtle. After researching, we came to a conclusion that Red Eared Sliders and Mary River turtles require similar water chemistry such as dissolved oxygen, pH, and Nitrogen. However, the Mary River turtle is endangered due to the lack of dissolved oxygen in it's environment. With a series of tests and data collected at the lake, we wanted to find out if Upper Lake showed symptoms of possibly becoming an unhealthy lake based off the needs of the freshwater turtles and water chemistry. From our observations, we concluded that the Upper lake is a healthy lake that meets the requirements of freshwater turtles, based off Dissolved Oxygen, Nitrates, and pH. Future research is needed to expand our time limit to allow several years for collecting data, so that we can say with confidence that many generations of Red Eared Sliders could thrive in the ecosystem.

Research Question

While at Upper Lake gathering data, we noticed turtles basking on rocks and in the lake. We wondered what conditions in a lake cause turtles to become endangered. We compared the Mary River Turtle, a critically endangered species from Australia, and the Red-Eared Slider, a common breed native to East Texas. We planned on testing the water chemistry to determine if Upper Lake was a suitable environment for the freshwater turtles, based on the data to be collected. We asked the questions,

How does the water chemistry in Upper Lake compare to ideal levels for the Red Eared Slider?

Based on the conditions of the endangered Mary River Turtle, does the Upper Lake show symptoms of deterioration?

Hypothesis

#1 We hypothesized that Upper Lake would have ideal water chemistry to meet the Red Eared Sliders living requirements.

#2 Based on the conditions that threaten the Mary River Turtle, Upper city lake will have stable, healthy water chemistry.

Investigation Plan

We started out by testing Upper Lake's pH, Nitrate, temperature, and Dissolved Oxygen. After we tested the levels, we recorded the data onto the GLOBE website. We then researched what the ideal levels are for freshwater species (like the Red Eared Slider and the Mary River Turtle), and compared them to the levels at Upper Lake. Finally, we looked at what was causing the Mary River Turtle population to dwindle, and researched whether our own lake showed signs of threatening its turtle population, based on the data we collected. We also tested the dissolved oxygen in upper lake and our lower lake to see if dissolved oxygen changes due to the dam.

Research Methods

- Our team went to Upper Lake to test the pH, Dissolved Oxygen, temperature and Nitrate levels in the lake. Following the protocols* for each test, we collected multiple samples from the lake and tested them all to investigate our research questions.
- To test for Dissolved Oxygen, we first had to fill up the water sampling bottle. Then, we added 8 drops of Manganous Sulfate Solution and 8 drops of Alkaline Potassium Sulfate Solution. We capped the water sampling bottle and mixed the solutions thoroughly. After allowing the precipitates to settle in the bottle, we added 8 drops of sulfuric acid. We, once again, capped the bottle and mixed the solutions together until the reagent and precipitates dissolved. We then filled up the test tube to the 20 millimeter line, and filled a titrator with Sodium Thiosulfate. Titrate until the sample color turns pale yellow, and then add 8 drops of starch indicator. Continue titrating until the blue color disappears and the solution is colorless. Finally read the results to find the Dissolved Oxygen level.
- To test for Nitrate, we first filled up the test tube to the 5 milliliter with water from the lake. We then had to add one Nitrate tablet, cap the test tube, and mix the solution until the tablet dissolved. Then, we added Nitrate #2 tablet and capped the test tube, once again mixing until the second tablet dissolved. After waiting 5 minutes, we inserted the Nitrate-Nitrogen Octa-Slide viewer and inserted the Octa-Slide viewer into the test tube. Finally, we matched the color of the sample to the color standard record as ppm.
- To test for pH, we first placed the Axial reader on the table top with the open side facing the operator, with the mirror facing the operator. Then, we positioned the Octet Compactor in the open slot of the Axial Reader, with the labels facing the operator and the bottom of the compactor flat on the surface. We filled two test tubes to the 10 milliliter line, to be the blank samples. We then filled the third test tube with sample water according to the test procedure instructions. We tested the one test tube according to procedure, left the other two to be used as blanks, and removed the test tube caps after adding the reagents and mixing. Then, we inserted ampoule of distilled water into the square hole on the left side of the Octet Compactor, and inserted 2 test tubes with the untreated samples into the slot in the Axial reader on either side of the treated sample. Finally, we slid the Octet Compactor down even to the top of the Axial reader and held the compactor up to natural sunlight, and compared the colors of the center test tube to the color on the compactor.



Field Photos

Testing Location

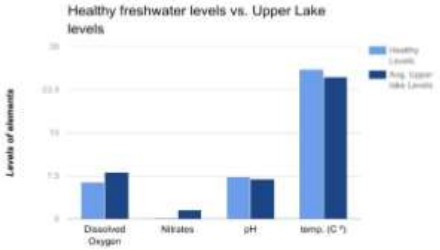
Upper lake, Palestine, TX
Longitude: 31.768383783946195
Latitude:95.66486583232421

GLOBE Data

	pH avg over 1 years	pH range	Dissolved oxygen avg over 1 year	Dissolved oxygen range	Nitrate avg over 1 year	Nitrate range	Avg. Temp. in C° over a year
Upper Lake	7	7-7	8.2 mg/L	7-1	1.6 mg/L	1	24.75° C
Ideal Levels	7.4	6-8	6.5 mg/L	6.5-12 mg/L	.15	0.0-0.3 mg/L	23.8-30 C

Data Summary

Figure #1



Data Analysis

After extensive research we found that the "ideal" pH level for freshwater turtles is 7-8 , which means Upper Lake is borderline acidic, but still in a healthy range. When we compared our dissolved oxygen levels to what's considered an "ideal" level of at least 7.5 mg/L, (according to Minnesota Pollution Control Agency) we found that our lake is considered healthy in this area as well. An acceptable nitrate level is considered at least under 1 mg/L (according to Sharon Behar), so our lake has considerably high nitrate levels compared to a healthy pond or lake. 10 dissolved oxygen levels were recorded in Upper Lake within a year, the average of this data is 8.2 mg/L, and the range is 7.1. 3 pH levels were recorded within a year, the average of this was 7, and the range is 0. 4 nitrate levels were recorded within a year, the average was 1.6, and the range was 1. After interpreting this data, we found that Upper Lake had healthy pH and dissolved oxygen levels, but had a high level of nitrates.

Conclusions

We found that the primary reason the Mary River Turtle is endangered is because of dams and impoundments in their habitats. When testing both Upper Lake and Lower Lake we discovered there is no change in dissolved oxygen due to the dam, both were 8ppm. Still water in dams have a decrease in oxygen, which causes poor water quality for the Mary River Turtle. Because the water quality is declining in oxygen, the time that turtles can spend diving for food is reduced, and turtles are exposed to predators more frequently when they come up for air. The nesting areas are also affected by dams. Conditions in impoundments don't create the sand banks needed for nesting. Dams that block access to nesting sites seriously hinder breeding success, which could eliminate the population entirely. Red eared sliders are reproducing and thriving in their environment at Upper Lake, but similar problems (such as lack of sufficient dissolved oxygen) that the Mary River Turtle faces could potentially cause problems in population if they occurred in Upper Lake. The level of dissolved oxygen in Upper Lake is sufficient for the Mary River Turtle and the Red Eared Slider. The pH is also in healthy range for both species of turtles, as well as the temperature. The nitrates, however, are marginally higher than what is recommended for a healthy pond. In excess levels, nitrates can cause rapid algae growth and fluctuations in dissolved oxygen (for example, high levels of oxygen during the day and extremely low levels at night, as a result as oxygen consuming bacteria feeding on dead algae). To fully conclude that Upper Lake shows no symptoms of deteriorating, long term research and monitoring would be necessary. Unless nitrate levels rise in the future and cause drastic dissolved oxygen fluctuation, Upper Lake does not show signs of deteriorating or endangering the turtle population. The Mary River Turtle and the Red Eared Slider could survive and thrive in Upper Lake, so therefore, our hypothesis was correct.

Limitations/ Sources of Error

We have only been collecting data since March of 2016, but we were able to access some data from last April. Collecting samples over a longer period of time would increase confidence in our results.

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Testing for Low Levels of Dissolved Oxygen in Upper City Lake

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Innovation Academy

The University of Texas at Tyler Innovation Academy

THE GLOBE PROGRAM
Global Learning and Observations to Benefit the Environment

Abstract

After observing a decrease in aquatic plant life in Upper City Lake we decided to run several tests to investigate what could have caused it. When comparing GLOBE data from the spring of 2016 and our own from the spring of 2017, we had noticed a dramatic decrease in the amount of dissolved oxygen in the water. Intrigued, we continued to tested the lake and did some outside research on what could cause dissolved oxygen levels to fluctuate. We discovered that the decrease in the amount of hydrilla we observed, rainfall, and air temperatures were some common factors that could cause the levels of dissolved oxygen in water to change. By gathering data on local rainfall and temperature from the spring of 2016 and 2017 we found that the rainfall and air temperature did have a slight correlation to the decreasing dissolved oxygen levels of the water. However, due to their little effect, we were able to rule them out as the major factors contributing to the decreasing dissolved oxygen levels in the lake. More tests should be conducted to understand why the hydrilla is dying and why the levels of dissolved oxygen in the water are decreasing.

Research Question

Upper City Lake, a commonly used recreational lake in Palestine Texas, appeared to be in a healthy state; however, after noticing a dramatic decrease in aquatic plant life we got concerned for the lake's health. We decided to investigate further by comparing past GLOBE data from spring of 2016 and the spring of 2017 to see what could have caused this. According to the data gathered this year and last, the levels of dissolved oxygen in the water have drastically decreased. This made us wonder. Why have dissolved oxygen levels in the lake decreased in the past two years and what other factors of the lake could this phenomenon affect?

Hypothesis

Based on the data collected in spring of 2016 and 2017, as well as our own observation of the lake, we hypothesise that the levels of dissolved oxygen could be decreasing due to rainfall, the loss of aquatic plants, a fluctuation in air temperature, or even the amount of nitrates present in the water. In order to find this out we can gather information on local rainfall and temperatures from the spring of 2016 and spring of 2017 to see if there is a correlation between them and the lowering dissolved O2 levels in the water.

Investigation Plan

Our plan for investigating the cause for the decrease of dissolved oxygen in the water.

1. Test the water at a given location in Upper City Lake for dissolved oxygen once a week for three weeks in both March and April.
2. Find the average dissolved oxygen levels collected each month in the spring of 2016 as well as the spring of 2017.
3. Compare and analyze the average levels of dissolved oxygen data from both years
4. Research what factors cause dissolved oxygen levels to fluctuate and apply this knowledge to other data gathered and look for a comparison.

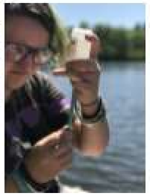
Upper City Lake, Palestine Tx 75803 (31.765495, -95.664723)

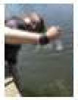
Research Methods

Testing water for dissolved oxygen:

1. Collect water in water sampling bottle (make sure not to grab surface water)
2. Add 8 drops of both Manganous Sulfate solution(4167) and Alkaline potassium Iodide Azide(7166).
3. Cap the bottle and mix it by inverting the bottle.
4. Let the precipitate settle below the shoulder of the bottle.
5. Add 8 drops of Sulfuric Acid, 1:1 (6141 WT)
6. Cap the bottle and invert gently until dissolved
7. Fill titration tube (0608) to 20 ml line with the fixed solution from the sample bottle.
8. Collect Sodium Thiosulfate 0.025N (4169) in plunger and fill to 0 ml line (if the fixed solution is already a pale yellow, skip step 9)
9. Depress plunger (0377) slowly into titration tube and gently swirl until the liquid is a pale yellow
10. Add 8 drops of the Starch Indicator Solution(4170WT)
11. Continue depressing plunger until liquid turns clear
12. Read the scale on the side of the titrator barrel and find what number the large ring on the plunger reaches.
13. Record as ppm Dissolved Oxygen







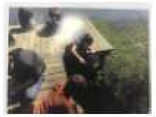

Field Photos

Additional Research Information

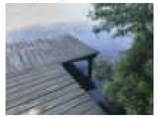
From further research we discovered that there are many factors that could lead to a large decrease in dissolved oxygen. The main factors being temperature, a decrease in photosynthesis, and decomposition of plants in the water. Cold water holds higher concentrations of dissolved oxygen; therefore, as the water temperature increases the dissolved oxygen levels decrease. Additionally, aquatic plants are big contributors of dissolved oxygen as they photosynthesize and release oxygen into the water. However, when those plants die and decompose they remove oxygen from the water in a process known as Carbonaceous Biochemical Oxygen Demand (CBOD).

GLOBE Data

Spring 2016



Spring 2017



Dissolved Oxygen

Table 1

Date	Average Dissolved O2
April of 2016	[illegible]
March of 2017	[illegible]
April of 2017	[illegible]

Table 2

Date	Dissolved O2
4/4/16	8.1ppm
04/12/16	12.9ppm
04/18/16	12.8ppm
3/3/17	7.1ppm
3/27/17	7.3ppm
3/31/17	7.1ppm
4/12/17	6.1ppm
4/18/17	5.8ppm

Data Summary

Figure 1

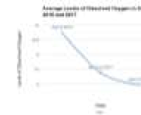


Figure 2

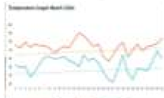


Figure 3

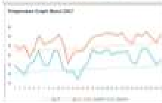


Figure 4

Figure 5

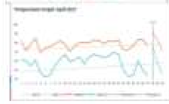


Figure 6

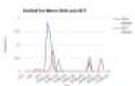


Table 3

[illegible]

Figure 7

Table 4

[illegible]

Data Analysis

When comparing the levels of dissolved oxygen in the months of March and April in 2016 and 2017 (see figure 1 and tables 1 and 2), we noticed a distinct decline of about 5.31 ppm between the two years. The air temperature (figures 2-5) and rainfall data (figures 5 and 6 and tables 3 and 4) that was gathered for the two months in question revealed a slight correlation to the dropping dissolved oxygen levels as well. This data shows us that rainfall and air temperature do have a slight influence on the dissolved oxygen levels of water. However, due to their little effect, we can also infer that they are not the contributing factors to the decreasing dissolved oxygen levels in the lake.

Conclusions

After gathering data on the dissolved oxygen levels in the lake, we found that there was a dramatic decrease in dissolved oxygen levels between the spring of 2016 and 2017. We were unable to identify the causes of this phenomenon, but ruled out the possibility of it being due to temperature and rainfall. Our data shows that rainfall and outside temperatures did have an effect on the dissolved oxygen levels; however, they were not dramatic enough to be the only factors at work. Although we speculate that the decrease in hydrilla this year could be also a major reason for this decline, we were unable to test it due to a lack of resources. Future research is needed in order to find out what other variables have caused this decline in dissolved oxygen so that our lake can effectively support the ecosystem that thrives in it and the community that uses it.

Limitations/ Sources of Error

Our data was just as limited as was our testing time, so solid evidence is hard to come by. Our theory that the hydrilla could be dying and not reproducing like they should be is a stretch because of our limited testing. Although, there are many other factors that could cause a fluctuation in dissolved oxygen levels, we were unable to test for them due to limited resources. There is much more hydrilla under the surface of the water, as well as data that we were unable to collect, which could potentially obscure a perfect diagnosis of what might be happening. However, with the data that we have, we are unable to come to a conclusive cause to this phenomenon.

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