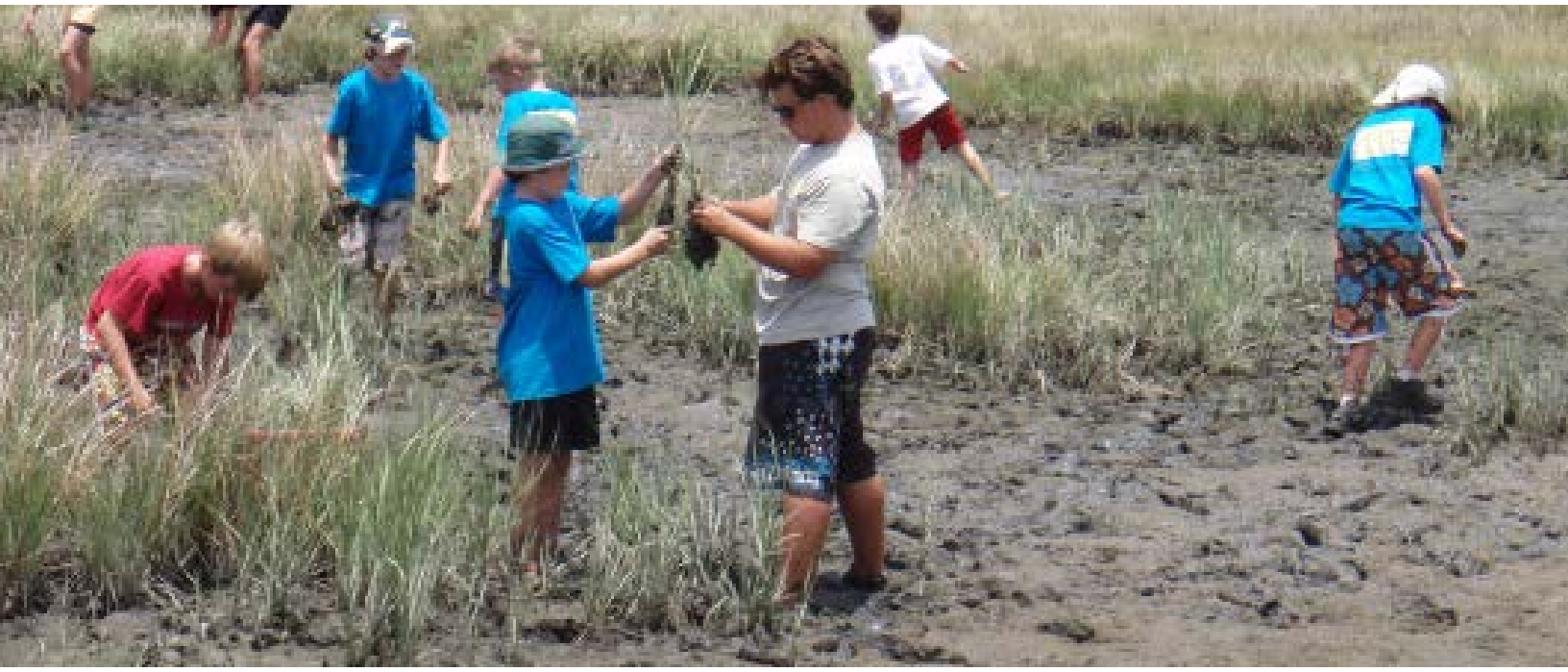
# Bay Grasses In Classes
# Wetland Nursery Program

## RESOURCE GUIDE



BUILD A NURTURE TRANSPLANT RECYCLE

BAY GRASSES *in* CLASSES

TAMPA BAY WATCH

FROM OUR CLASSROOM NURSERY TO THE SHORES OF TAMPA BAY

Prepared by
Tampa Bay Watch, Inc.
Revised May 2016

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# Welcome Letter

**Dear Teachers:**

**Welcome to Bay Grasses In Classes!** On behalf of Tampa Bay Watch, we'd like to thank you for helping to restore the health of Tampa Bay.

It is our goal that you and your students will benefit from this program while you benefit the bay. Firstly, you and your students have the chance to participate in restoring salt marsh habitat and improving the heath of Tampa Bay. Secondly, you will provide a chance for your students to apply course topics you are teaching to a real life situation. Hands-on activities are an excellent way to reinforce learning and get students outside of their comfort zone. We have provided lesson ideas and assessment questions that allow you to tie in the nursery project with your curriculum. Finally, you provide your students with a chance to learn to care for the bay while having fun!

For you and your students to get the most out of your involvement with Bay Grasses In Classes, it is best to integrate the program in to your regular curriculum. Caring for the nursery will be an on-going activity. We encourage you to involve your students in all aspects of nursery care.

General knowledge of the bay ecosystem will help your students get more out of the program. Students should be familiar with the biology of Spartina alterniflora (smooth cordgrass), what wetlands and estuaries are, how they work, how they benefit the ecosystem, the pattern of succession they follow and the variety of life in Tampa Bay. Students should also learn how humans benefit from and impact the bay. Topics such as erosion, runoff, point source and non point source pollution and habitat loss can be addressed through Bay Grasses in Classes.

This resource guide includes nursery construction and maintenance instructions, suggested student activities, Pre and Post assessment questions, and a resource list. For questions or additional information, please contact Martha Gruber, **mgruber@tampabaywatch.org,** or Melinda Spall, **mspall@tampabaywatch.org.** We look forward to partnering with you and your students to help restore Tampa Bay.

**A special note to principals:** The BGIC program offers students the opportunity to apply classroom learning to a real life application while involving students in the restoration of the bay where they live. BGIC brings the resources of Tampa Bay Watch to your school and your students. For districts that offer school choice or magnet programs, the nursery program can be an attractor. BGIC provides environmental stewardship opportunities for your students while bringing learning to life!

# Bay Grasses in Classes Waiver

**Dear Parents and Students:**

**Welcome to the Bay Grasses in Classes!** On behalf of Tampa Bay Watch, we'd like to thank you for taking part in this program and helping to restore the health of Tampa Bay. Salt marsh habitat helps to prevent erosion, filter stormwater runoff, and provides a habitat to many different species. Students will be responsible for the maintenance of their on-site salt marsh nursery, as well as, transplanting to a restoration site and recycling the nursery to begin the cycle again. Throughout this year you will be a part of multiple events surrounding your Bay Grasses in Classes on-site nursery, for these events prepare to:

- Get wet and muddy, be prepared with a change of clothes/shoes, reusable water bottle, hat, and sunscreen
- Have a good attitude and work as a team
- Learn about the Tampa Bay estuary and teach others what you have learned about Tampa Bay and how they can help!

**Your signature below indicates that you understand that Tampa Bay Watch, Inc. and all event sponsors, their principals, directors, officers, employees, staff, and affiliates shall not be held liable under any circumstances for any injuries or damages to person(s), be they physical injuries or otherwise, arising out of or resulting from or in any way connected to my/our participation in this volunteer activity. Your signature also, in case of accidental injury, I authorizes event coordinators to seek proper medical attention. Your signature also authorizes Tampa Bay Watch to utilize, without compensation, any pictures taken at the event that include your image or likeness, for any publication, newsletter, report or other documentation. Media may be contacted to cover BGIC events. Your image or likeness may be recorded or pictures may be taken for their use.**

School: _____

Student Signature: _____

Parent/Guardian Signature: _____

*(If under 18 years of age)*

Date: _____

Emergency contact name: _____

Phone number: _____

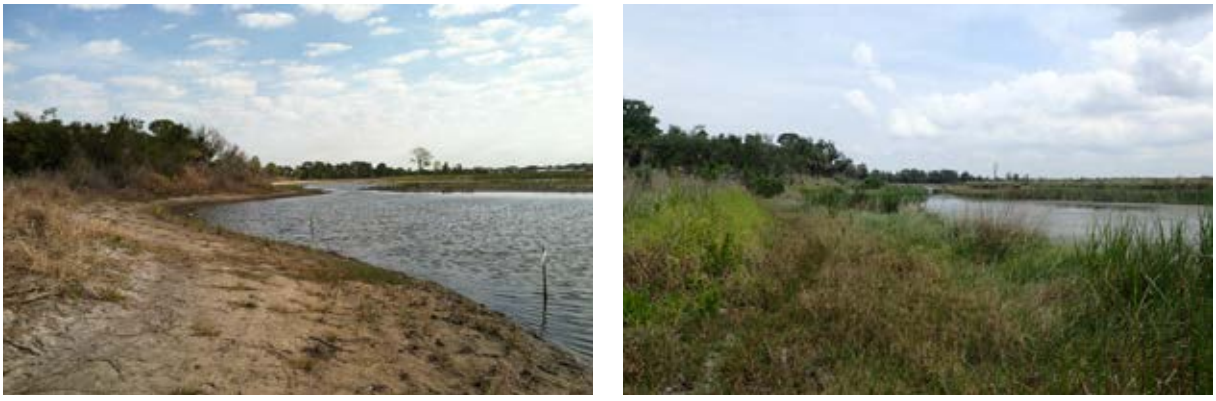
## Introduction

Estuaries are extremely important ecosystems. They are semi-enclosed coastal bodies of water where saltwater from the ocean meets freshwater from inflowing rivers and streams. This blend of bay environments – ranging from underwater seagrass meadows to surrounding intertidal salt marshes, mangrove forests and uplands – provides food and shelter for a multitude of wildlife and marine species.

Intertidal salt marsh grows partially submerged in water and partially above water due to the rise and fall of tides. This provides wildlife with excellent habitat for spawning, foraging and refuge. It supports crabs, shrimp, snails, mussels, juvenile fish and a variety of birds. Salt marsh also stabilizes shorelines and buffers uplands from storms. Salt marsh plants act as natural filtering agents for storm water runoff removing many impurities in coastal waterways. They are also a vital link in the marine food web. Healthy salt marsh habitat benefits humans by sustaining recreational and commercial fishing, improving water quality, preventing beach erosion and attracting wildlife for recreational viewing.

However, coastal wetlands, including salt marshes, throughout the nation have suffered extensive losses. The loss of coastal wetland habitats has resulted in major declines in the fisheries and wildlife that depend on these habitats for all or a portion of their life cycle.

Most scientists agree that the key to improving the health of water along the nation's coast is to improve water quality, and restore fish and wildlife habitat. Habitat restoration projects have become an increasingly popular tool to restore coastal communities, enhance fish and wildlife resources, and to promote public involvement and education. In the Tampa Bay region, many restoration programs have been initiated to restore the coastal environments including revitalizing salt marsh and mangrove communities by planting native vegetation.



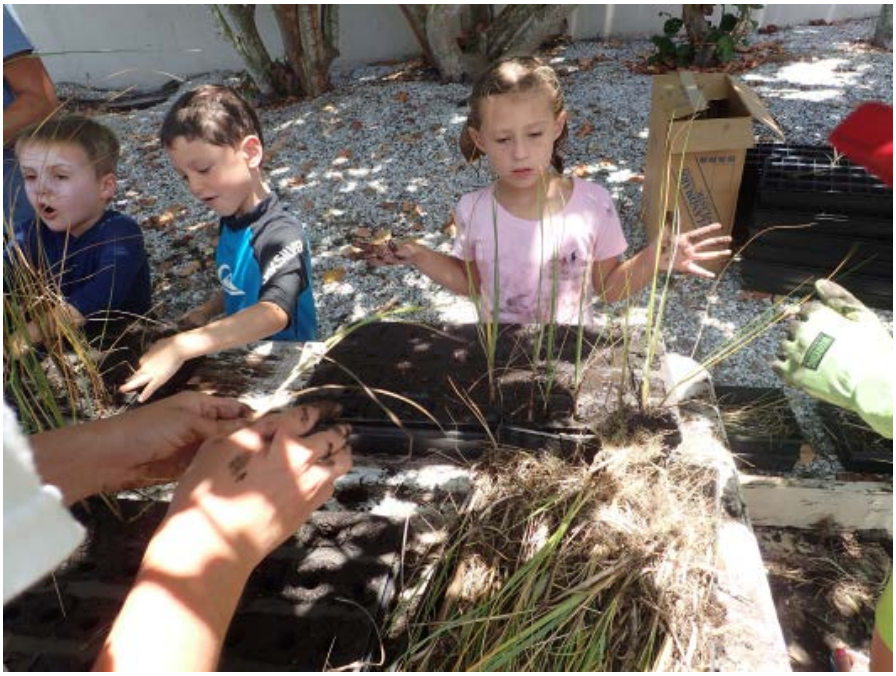
*Bahia Beach in Riverview, Florida, before and after salt marsh restoration.*

## Program Description

Tampa Bay Watch's Bay Grasses In Classes (BGIC) program facilitates the establishment and maintenance of saltmarsh grass nurseries by bay area middle and high schools. These nurseries provide an inexpensive source of native wetland plants to be used in the many federal, state, county and city habitat restoration projects in the Bay area. By raising the plants to maturity in our own nurseries, many expenses are curtailed and the cost of a planting project to government agencies is lowered significantly.

The BGIC program also provides a volunteer base for implementation of restoration projects and promotes student involvement in community-based restoration activities. With guidance from local scientists, the students maintain the nursery and monitor their plants by performing salinity tests, recording growth rates, conducting routine maintenance and documenting other pertinent information.

Through BGIC, students learn the value of maintaining a healthy environment while participating in hands-on habitat restoration activities. The nurseries also provide an excellent educational resource for applying student learning to real world ecological and agricultural practices. The students become familiar with the life cycle of the plants they are growing and the importance of the Tampa Bay estuarine ecosystem. This hands-on approach enhances education in schools as well as the health of the bay.



*Students plant trays with* Spartina alterniflora *grasses.*

## Is a Nursery Right for My Program?

**Are you considering joining the Bay Grasses In Classes program? There are some questions to ask to see if it is right for your school and program.**

1. Would I like the chance to involve my students in hands-on restoration of the Tampa Bay estuary?
2. Are my students in grades 6 – 12?
3. Do I have a 20' by 20' flat, open area for the nursery?
4. Can the open area be fenced (if necessary)?
5. Do I have additional space next to this area to set up 4-6 folding tables for harvesting and recycling of grasses?
6. Do I have or can I get a water source to this site?
7. Do I have 2 hours every 2 weeks to devote to the nursery program?
8. Can I commit to keeping track of hours and turning in timesheets every quarter?
9. Can I commit to bring my students out to work on the nursery at least twice a month while school is in session? (Tampa Bay Watch handles summer maintenance for all nurseries.)
10. Am I interested in involving my students in hands-on learning that is sometimes dirty and physically demanding? Some of the student work sessions will be messy. Students may get dirty and need to change clothes and clean up before reporting back to other classes.
11. Will I be allowed to take my students on a field trip to a restoration site to transplant their grasses?
12. Do I have a principal that will support this program? (Tampa Bay Watch would like the opportunity to meet your principal.)
13. Do I have the support of the maintenance staff from my school (to assist with checking water pipes, etc.)?
14. Does the BGIC program relate to my curriculum?

## Bay Grasses in Classes
## Wetland Nursery Program
## Teacher's Questionnaire

Your Name and Title: _____

Name of School: _____

Address: _____

_____

Principal Name and Email: _____

Phone Number (Work): _____

(Cell): _____

Your Email: _____

Name of Environmental Classes or Clubs: _____

Name of other Science Teachers who may be interested in participating or may be able to help with the program: _____

Please describe the class or club that may be available to accomplish this project:

_____

Is there the potential to bring in other science classes to help with the project?
During school hours? _____ Other? _____

How many members are active in your environmental program(s)? _____

Will it be possible for these students/club members to be out of school for a full day when we have big projects? _____

## Teacher's Questionnaire *(continued)*

Is there a secure, flat, sunny, open area approximately 20 ft. by 20 ft. where an open-air nursery could be constructed? _____ Please describe: _____

_____

_____

_____

Is there access to a water source for irrigation? _____

Is it in a secure location where vandalism or damage to the nursery or plants may be preventable? _____

(If there needs to be a fence put around the nursery, will this be possible? _____ )

Does your school have maintenance staff or other support personnel who may be able to assist with the project? _____

Please include any other information that describes your environmental program, recent club activities, or other information that may assist Tampa Bay Watch in evaluating your school program. Include any past environmental activities.

_____

_____

_____

_____

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_____

_____

**There is a $500 affiliation fee; corporate sponsorship may be sought by Tampa Bay Watch if available and if school is eligible.**

## Partnership Agreement

The Bay Grasses In Classes program is funded through several sources including grants. Because of this, it is important that both Tampa Bay Watch staff and participating teachers meet certain reporting requirements and hours of participation. This helps ensure that grants will continue to be funded and Tampa Bay Watch can continue to offer the nursery program.

The goal for the Bay Grasses In Classes Program is to learn, through hands-on restoration. This requires the contact teacher or teachers responsible for the nursery to maintain the nursery and provide healthy plants for restoration sites. This can be accomplished by spending time maintaining the nursery with students. The following tasks can be performed with students or with TBW assistance:

- removing weeds from pond
- removing algae from the nursery
- removing debris from nursery
- making sure there is properly working timer/water supply
- adding and checking salinity, checking pH and plant health
- overall maintenance of the nursery

**Remember that it is important to fill out the quarterly time sheets for your individual nurseries.** A quarterly time sheet will need to be turned in to Tampa Bay Watch, showing the time spent maintaining the nursery.

Hours that qualify are:

- Any activities that relate to the BGIC nursery, and
- Nursery maintenance that includes adding salt, checking for plant diseases, replacing wood strips, changing out batteries on timers, removing weeds from plant trays, and any other activity that you do with your students that a TBW staff member is not present for.
- In addition to the time sheet, schools should also provide TBW with a monthly quality monitoring sheet along with your quarterly time sheets.

Tampa Bay Watch will send a reminder of when time sheets are due via email at the end of each quarter. The time sheets are due by the beginning of the month after the corresponding quarter. Timesheet can be submitted online through our website at http://tampabaywatch.org/education_bgic.html with the contact's electronic signature. Tampa Bay Watch will send the completed time sheets to our grant funders. We understand that in some circumstances the time sheets will not be as 'busy' as other times, but it is still important to send them in.

**Students in the BGIC program will participate with restoration projects throughout Tampa Bay, and on occasion there will be media present. Pictures will be taken to document and create awareness to the public of the restoration events taking place in Tampa Bay. Tampa Bay Watch uses these pictures for the TBW newsletter, website, and for local print media.**

## Partnership Agreement *(continued)*

**The {partnering organization here} responsibilities are as follow:**

1. Maintaining salinity levels in nursery according to the water quality monitoring sheets;
2. Consistently submitting timesheets to TBW;
3. Providing plants for a planting event at a restoration event once a year.

**Tampa Bay Watch responsibilities are as follows:**

1. Provide any supplies needed for the nursery. These include salt, trays for planting, wood strips, timer, and any other materials needed;
2. Support to school for any in-school activities needed for nursery health; and
3. Presentation to students about the program.

We look forward to forming this partnership with you in this exciting program! This partnership states that you will be the lead teacher for the nursery program for the next two years. Please feel free to contact us with questions, concerns and ideas.

_____
Contact Signature / Date

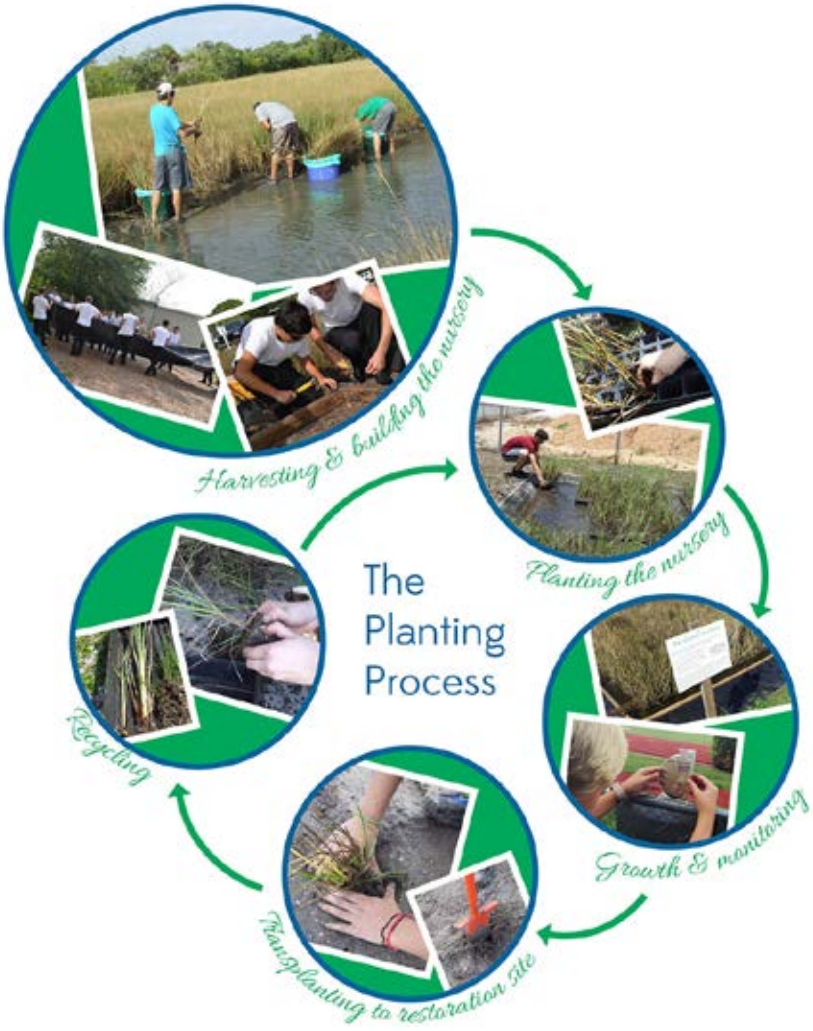
_____
Contact Signature / Date

_____
Tampa Bay Watch, Inc.
BGIC Coordinator

_____
Tampa Bay Watch, Inc.
BGIC coordinator

## The Nursery Cycle

To produce salt marsh grass for restoration activities, a nursery must be constructed and planted. Once the nursery is constructed, the plants are harvested from the donor marsh. The plants are planted in the nursery and then grow for 6 – 8 months before they are used in a restoration project. Next, one half of the nursery is harvested and transplanted at a restoration site. The remaining plants will be split and recycled throughout the nursery to begin the growing process again. An established nursery program will follow this cycle of growing plants, harvesting, transplanting, and finally recycling. As long as the nursery is well cared for and the plants are maintained in a healthy condition, the nursery cycle can continue indefinitely. Tampa Bay Watch will establish a schedule with BGIC nurseries for each phase of the nursery cycle. Harvesting and transplanting will be scheduled in the spring or fall depending on when the nursery is started. Programs not affiliated with Tampa Bay Watch should consult with local experts on the best time of year to harvest, transplant, and recycle.



## Habitat Restoration Activities

One of the goals of Bay Grasses In Classes is to extend the program to schools nationwide. Establishing these nurseries has provided an excellent educational resource for teaching students about ecological and agricultural practices involved in hands-on habitat restoration. Through nursery programs, students become familiar with their local estuarine ecosystem and its economic and ecological importance.

Outside technical support from individuals or agencies that have experience growing and transplanting marsh grasses, such as that provided by Tampa Bay Watch, is highly recommended. This is helpful for maintaining healthy plants and choosing a viable transplanting site. It is also helpful when applying for the permits that are needed when conducting a restoration project.

To learn about on-going restoration activities in your area, contact your local environmental protection organization, the United States Environmental Protection Agency, a National Estuary Program, Restore America's Estuaries program, or look for local groups that may be able to provide additional guidance.

## Nursery Construction

**A note about obtaining funds…** Many of the materials, such as the pond liner, building supplies and planting supplies can be donated by stores or obtained with grant money. Plants for the BGIC program are obtained from a donor marsh. Programs not affiliated with Tampa Bay Watch may be able to harvest plants from the wild with the proper permits. Plants can also be purchased from nursery vendors. Government environmental agencies or local corporations may have grants available to help with needed funds.

**Creating a functional nursery requires five steps:**

1. Choosing and preparing the site
2. Constructing the nursery
3. Constructing the irrigation system
4. Obtaining plants (field trip required for BGIC nurseries)
5. Planting the nursery (if plants are pulled from a donor site, they should be planted in the nursery within 24 hours)

## Choosing and Preparing the Site

The location of the nursery and preparation of the site is crucial to the success of the project. The following criteria should be used when selecting and preparing the nursery site:

1. The school must have a site to accommodate a 16' X 16' nursery plus surrounding workspace.

2. A source of fresh water should be as close as possible for the irrigation system.

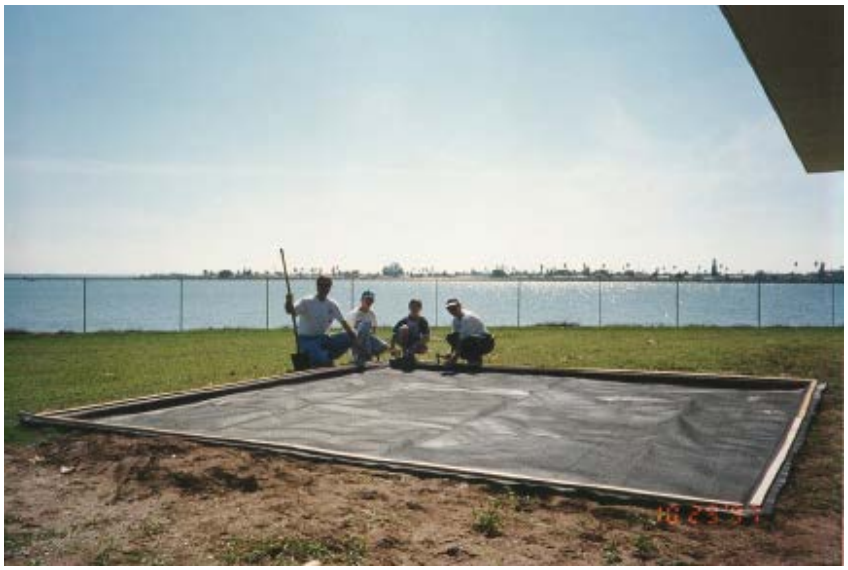
3. Like many plants, salt marsh grasses need plenty of sunshine to grow. The nursery site should receive full sunlight for most of the day. An open area, without overhanging trees or rooftops, is an excellent spot to build the nursery.

4. The site should be flat (level) to prevent dry spots or flooding. Uneven spots can be leveled with fill dirt or sand and should be accomplished prior to construction.

5. The site should be cleared of any sharp or pointed objects such as rocks or sticks that could puncture the liner.

6. The site should be in a secure area to prevent vandalism and unintentional impacts (i.e. stray animals, sporting equipment, runoff from nearby roofs, etc.) You will need to build a fence if there is a need.

7. The site should be easy to access for monitoring, maintenance and recycling of the nursery. Tampa Bay Watch will need vehicle access to the nursery for the recycling events, and during the summer months.



## Construction Supplies

Tampa Bay Watch provides building materials for its BGIC nurseries as funding permits. For programs not affiliated with Tampa Bay Watch, the following supplies are needed to build 1 nursery:

- ☐ One (1) 18' X 18' PVC or HDPE liner (30 mm or greater thickness)
- ☐ One (1) battery-operated, hose adapted, digital water timer
- ☐ Batteries for the timer
- ☐ One (1) 6' pressure treated 2" X 4" cut into a 2' section and a 4' section
- ☐ Eight (8) 4" X 4" X 8' pressure-treated wood posts
- ☐ Eight (8) 1" X 2" X 8' pressure-treated wood strips
- ☐ Two (2) 3x7 Mending Plate for "T"
- ☐ Six (6) ¾" U brackets (to hold PVC pipe)
- ☐ Twelve (12) screws for u brackets
- ☐ Four (4) 6" 12 galvanized Angle Heavy Duty Strap
- ☐ Four (4) 6" X 6" L metal straps
- ☐ Eight (8) 9" metal strap ties
- ☐ One (1) lb. 8D galvanized common nails 2 ½" Ring Shank Patio/Deck
- ☐ One (1) lb. 6D galvanized nails (for the 1" X 2" X 8' wood strips) 2" Ring Shank Patio/Deck
- ☐ Thirty (30) ft ¾" PVC pipe
- ☐ Additional PVC pipe to connect the nursery to the water source (amount and diameter needed varies by location)
- ☐ One (1) ¾" PVC cap
- ☐ Four (1) ¾" PVC connector (not threaded)
- ☐ One (1) ¾" PVC connector with male hose thread end and smooth end
- ☐ One (1) ¾" PVC connector with female hose thread end and smooth end
- ☐ Three (3) ¾" threaded PVC 90°
- ☐ One (1) ¾" smooth (not threaded) PVC 90°
- ☐ One (1) PVC 90° smooth to connect fresh water source pipe to ¾" PVC pipe (one end ¾", size of other end determined by size of site's water main)
- ☐ One (1) ¾" PVC "T" connector
- ☐ One (1) ¾" PVC ball valve
- ☐ One (1) ¾" plastic flexible tube (make sure it is 3/4" on both ends)
- ☐ One (1) ¾" hose faucet
- ☐ One (1) small container PVC primer
- ☐ One (1) small container PVC cement
- ☐ One (1) roll Teflon tape

## Construction Tools

Tampa Bay Watch provides all building tools for its BGIC nurseries when funding is available. For programs not affiliated with Tampa Bay Watch, the following tools are needed to build 1 nursery:

- ☐ 3' long level
- ☐ 2 or 3 rakes
- ☐ ground tamper
- ☐ hammers
- ☐ PVC cutter
- ☐ Power drill and ¼" drill bits

## Constructing the Nursery

After selecting a good, level and secure location construct the nursery as follows:

1. Remove debris from the site. This is very important to prevent damage to the liner.
2. Level the ground with rakes and the tamper. Use fill dirt where necessary to raise up low spots. Check with the level.
3. Using the 4" X 4" x 8' posts outline a square area on the ground measuring 16' X 16'. Make sure the ends of the posts meet at right angles at the corners.
4. Join the boards along the sides using the flat strapping connectors. Places the straps on the TOP and INSIDE of the boards. Use the 8D galvanized nails to attach the connectors to the boards.
5. Use the angle straps to join the boards at the corners. Use the 8D galvanized nails.
6. Cover the area with the pond liner. Start at one side of the pond and pull the liner over the entire pond. Make sure extra liner is laid on top of the posts. It might help to walk along the inside edge of the nursery to flatten the liner and help make a better fit.
7. Place 1" X 2" X 8' wood strips over the plastic on the top surface of the posts and nail in place using the 6D nails. Be sure the wood strips are directly over the posts and meet at the corners before nailing them to the posts. IMPORTANT: Keep the liner loose while nailing it down. If it is too tight, then the weight of the water and plant trays will stretch and eventually tear the liner.

## Constructing the Irrigation System

In order to provide water for the nursery, an irrigation system is needed. This system will need to be connected to an existing fresh water source near the nursery site. This system is designed to provide water flow into the bottom of the pond so the plants can take up water through their roots. This type of flow helps prevent fungus growth on the blades of the plants, and conserves water by slowing evaporation. The system should be equipped with a timer to regulate watering of the nursery. A digital, battery operated timer is needed due to its ease of programming, maintenance and reliability. Water needs will vary by climate so the water level should be monitored and adjusted accordingly. The nursery should dry out between waterings to control algae growth but the inside of the cells should stay moist. Initially, program the timer to have the water come on two days a week for approximately 15 minutes then adjust timer settings as needed.

A member of the maintenance team at your site who is familiar with the water or sprinkler system should be consulted before beginning construction. Determine who is authorized to run pipe to your nursery; this will vary from school system to school system. The pipeline connecting the irrigation system to the freshwater source should be buried to prevent unintentional breaks from foot traffic or lawn mowing. If constructing in an area subject to freezing weather, the pipe needs to be buried below the frost line.

The size and amount of PVC pipe and types of connectors needed is determined by the water source to be used. If the water source's water main is other than ¾", choose a PVC 90° with a ¾" end and an end corresponding to the size of the water main. The necessary amount of PVC pipe for the irrigation system is included in the construction supplies list. Each site will need to identify the diameter of pipe needed and measure for the additional amount of PVC pipe required for connecting the nursery's irrigation system to the site's fresh water source. Once the nursery is built the school's maintenance team or other authorized personnel can lay the pipe from the water source to any corner of the nursery. A small area of pipe near that corner of the nursery should be left uncovered to allow for connection to the irrigation system.

### Summary of Irrigation System

1. Identify a water source.
2. Determine size of PVC pipes
3. Construct irrigation system
4. Set up water timer

## Constructing the Irrigation System *(continued)*

Once the pipe from the water source has been run out to the nursery, build the irrigation system as follows (refer to Figure 1 for a diagram of PVC connections):

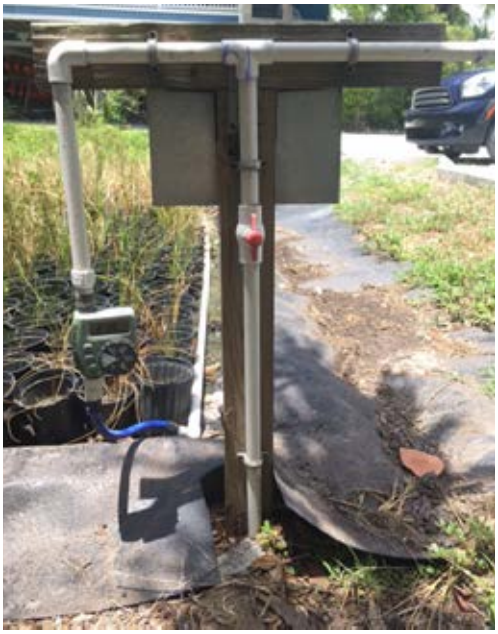
*Students dig a trench for the PVC pipe.*

1. Locate the smooth PVC 90° measured for connection to the fresh water source. If the water source pipe is other than 3/4‴, this PVC 90° has two different sized ends. Attach this PVC 90° to the water main pipe. Note: to attach smooth PVC connections, rough the outside and inside of PVC pipe with sand paper and clean the outside of pipe ends and inside of connectors with PVC cleaner. Then apply PVC cement to outside of pipe and inside of connector, push connector on to pipe and turn pipe and connector in opposite directions ½ turn. To attach hose thread PVC to hose threads, wrap the Teflon tape around the metal hose threads and screw the PVC pipe on to the taped threads.
2. Form a "T" with the 2 pieces of pressure treated 2' X 4'. The 2' section should be the top of the "T". See Figure 2.
3. Connect the pieces of the "T" using the metal truss plates. One plate should be on the front of the "T" and one on the back.
4. Attach the "U" brackets to the "T". Four of the "U" brackets will be attached to the 2' section of the "T" and 2 will be attached to the stem. Measure 6" from each end of the top of the "T" and mark the spot. Measure 2" in toward the center from each of these marks and make 2 more marks. Measure 3 inches below the truss plate on the stem and make a mark. Measure 8" below that mark and make another mark. There are now 4 marks across the top of the "T" and 2 on the stem. Attach a "U" bracket at each mark. See Figure 1.
5. Cut PVC pipe into the following sections: one (1) 10', one (1) 5', and four (4) 8" sections. There will be PVC pipe left which will be needed later.
6. Use the drill with a ¼" bit to drill holes along one side of the 10' and 5' pieces of PVC. Holes should be spaced 6" apart.
7. Attach the 10' section of PVC to the 5' section with the ¾" PVC connector. This is the irrigation tube for inside the nursery.
8. Attach the PVC cap to the open end of the 5' section.
9. Attach a threaded PVC 90° to the open end of the 10' section.
10. Find the PVC T connector. Attach one 8" section of PVC to each opening of the T.
11. Attach the ball valve to the 8" section of pipe connected to the stem of the T.
12. Attach a threaded PVC 90° to one of the 8" pieces of PVC pipe on the top of the T.
13. Attach the hose faucet to the other end of this threaded PVC 90°.
14. Attach a smooth PVC 90° to the other 8" piece of PVC on the top of the T.
15. Attach the last 8" piece of PVC to the other end of the smooth PVC 90°.
16. Attach the smooth end of the ¾" PVC connector with male hose thread to the bottom of the hanging piece of 8" PVC pipe.

## Constructing the Irrigation System *(continued)*

17. Place the assembled pipe T on the 2'X4'"T".
18. Dig the hole for the "T" next to the end of the pipe from the freshwater source. The depth of the hole should allow the pipe on the "T" to attach to the fresh water pipe.
19. Place the "T" in the ground but do not bury it yet. Measure the amount of pipe needed to connect the fresh water pipe to the ball valve on the "T".
20. Cut the necessary length of pipe and attach it to the ball valve.
21. Sink the 2'x4'"T" into the ground.
22. Attach the bottom of the pipe on the "T" to the PVC 90° from the fresh water source.
23. Backfill (pack) the "T" with dirt to secure it.
24. Attach the water timer to the male hose thread connector.
25. Measure the distance from the bottom of the timer to the top of the wood framing on the nursery.
26. Cut a length of PVC this long.
27. Attach a threaded PVC 90° to one end of this piece of PVC.
28. Attach the other end of this PVC to the smooth end of the ¾" PVC connector with female hose thread.
29. Attach the female hose thread to the bottom of the timer.
30. The timer now has a piece of PVC pipe hanging from it with a threaded PVC 90° on the end. Attach the plastic flexible tube to this PVC 90°.
31. Attach the other end of the tube to the threaded PVC 90° on the irrigation tube.
32. Lay the irrigation tube inside the nursery.

*Timer connection*

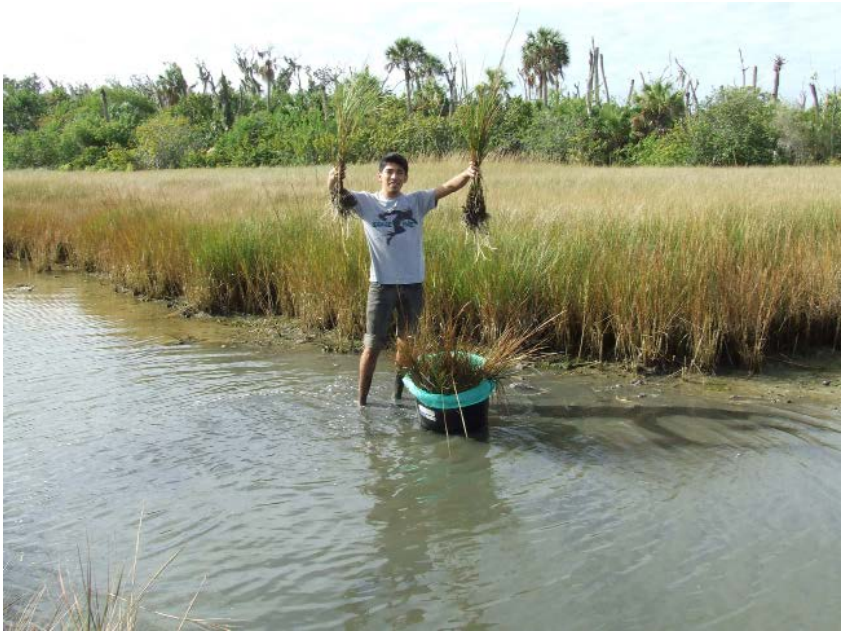


*Water setup*

## Obtaining Plants for the Nursery

Bay Grasses In Classes nurseries are planted with *Spartina alterniflora,* or smooth cordgrass. This is an intertidal marsh grass that is very hardy and tolerant of salt water. The nursery grass is pulled from a donor marsh in Manatee County. The BGIC lead teacher will need to plan a field trip to the donor marsh for students to pull plants. Please see the field trip guidelines for more information. Programs not affiliated with Tampa Bay Watch may be able to harvest plants from the wild with the proper permits. Plants can also be purchased from nursery vendors. The process of obtaining smooth cordgrass to start the nursery should be a one-time procedure. Smooth cordgrass reproduces, sexually and asexually, by seeds and rhizomes. . Our method is to rely on the asexual reproduction through the root system. We do not collect the seeds. Due to this this method one plant can produce 5 – 10 more plants. Ideally, after initially stocking the nursery, it can be recycled, always keeping enough smooth cordgrass to begin a new growth cycle while donating a sufficient number of plants to restoration projects.

If pulling plants from a donor marsh or permitted site, the plants should be pulled in bunches called plugs. Each plug will contain between 5-10 plants. It is important to pull plugs out at the base of the plant and top of the root system. This will ensure that enough roots stay intact for the plants to grow in the nursery. If plants are pulled from the top of the blades, they will pull out without roots and will not grow when replanted. For a complete nursery, 10,000 individual plants should be pulled. This means planting 2 individual plants per cell per tray to fill a nursery. Most of the mud can be rinsed off the plugs as they are pulled. This will make the plugs easier to split into individual plants. Place the plants in heavy-duty garbage bags as they are pulled and separated. Place up to 500 plants in each bag. This makes it easy to keep track of how many have been pulled. The roots of the plants need to stay moist so keep the plugs in the bags until they are planted in the nursery. Plants should be in the nursery within 48 hours after pulling to survive.



*A student pulls smooth cordgrass from a permitted donor site.*

## Planting Supplies

**Tampa Bay Watch provides all planting materials for its BGIC nurseries as funding permits.** For programs not affiliated with Tampa Bay Watch, the following supplies are needed to plant 1 nursery:

- 132 flat webbed trays
- 132 #40 plug sheet trays (each tray has 40 cells)
- One (1) 25lb box of salt (such as Instant Ocean® or other brands)
- One yard of organic top soil

## Planting Tools

**Tampa Bay Watch provides all planting tools for its BGIC nurseries as funding permits.** For programs not affiliated with Tampa Bay Watch, the following tools are needed to plant 1 nursery:

- Hedge clippers
- 3 flat shovels
- Six 20-gallon muck buckets
- Work tables
- Garden hose
- Rubber or latex gloves*
- Plastic aprons*

**Planting is a messy process. Consider providing gloves and aprons for students if they must report back to other classes after planting.*

# Planting the Nursery

Here are the steps for planting a  nursery.  There are 3 jobs that must be done when planting: mixing potting mud, filling trays with mud, and planting trays.  Students can be assigned a particular job for the event or rotate to experience the whole process.  When mud is mixed the plants can be planted.

### Mixing Potting Mud

The organic soil mixture will be mixed with water to create a mud mixture.

**Mix potting mud as follows:**

1. Fill up the muck buckets ¾ full of soil.
2. Add water and stir until the mud has the consistency of cooked oatmeal.
3. The soil should be mixed thoroughly, with no clumps in the mud.

### Planting Trays

**Plant trays as follows:**

1. Place a plug sheet tray in a webbed tray.
2. Fill the plug sheet tray with potting mud until the mud almost fills each cell.  A cell is an individual compartment in the plug sheet tray.
3. Use a stick or a finger to make a hole in the middle of the mud in each cell.  The hole should reach to the bottom of the cell.
4. Place two (2) individual plants in the hole, to increase survival rate.

5. Pack the dirt around the plant and into the hole making sure that all roots are under the dirt.  The dirt must be packed firmly so the plant does not lift up when the soil gets wet.
6. Two students can plant one tray.  Have each student start in the middle of the tray with the row farthest away from them, plant one row across and then move to the next closest row.  Working from the middle out keeps students from leaning over plants and possibly causing breakage of those plants.

*A student uses a hydrometer to test the salinity.*

7. When the tray has been planted, use hedge clippers to trim off about 6" – 8" off the top of the blades (depending on the height) of the Spartina alterniflora plant.  Cutting the tops off the blades of the plant will stimulate roots to grow quicker.  The plants should be about 10" – 12" tall after trimming.
8. As each tray is planted and trimmed, it should be placed in the nursery.  To reduce the stress on the liner, start the first row of trays about 6" away from the irrigation pipe and the 6" in from the edge of the nursery.  The row should be 4 trays across then a 9" space and another 4 trays.  Make 8 rows like this.  Leave a 9" space and then make another 8 rows.  This will form 4 quadrants ( with 32 trays in each) with empty space between for adding salt and collecting water samples.
9. After all the trays have been planted and set into the pond, fill the pond with water.
10. After a week has passed, add enough sea salt to bring the salinity to approximately 10-15 parts per thousand (you will need a refractometer or hydrometer to check the salt concentration).  It is a good idea to mix the water and salt to help it disperse evenly.  One 25 lb bag for the nursery is usually sufficient.  Check the salinity after the salt has dissolved.  If too much salt was added, add some more water.  **If salinity is too low, add more salt.**

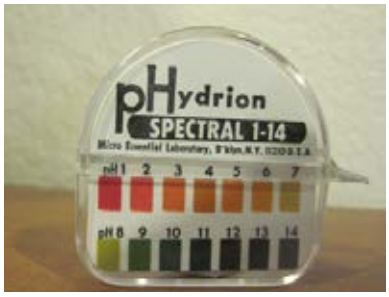
## Nursery Maintenance Tool Kit

Below is a list of supplies to have on hand for regular nursery maintenance:

- ☐ Heavy Duty trash bags
- ☐ Hydrometer or refractometer *
- ☐ pH paper
- ☐ water droppers
- ☐ Salt (25 lbs for each "feeding")
- ☐ Batteries for the timer
- ☐ Algae scrapers / Salt mixer **
- ☐ Hedge clippers or weed wacker
- ☐ Gloves (gardening, rubber or latex)
- ☐ Large paperclips to unclog holes in irrigation pipe
- ☐ Push broom (with hard bristles) for cleaning water and algae out of nursery
- ☐ Slip-on, rubber waders or gardening boots for walking into the nursery
- ☐ Disease ID cards (found in BGIC resource guide)

**Used to measure salinity, hydrometers are MUCH cheaper than refractometers but require much more water for the reading, they can be obtained through pet supply companies*

***Can be made by taking a piece of PVC pipe long enough to reach the middle of the nursery and taping a plastic shovel or other scoop to the end*


Box

## Maintenance

Maintaining the salt marsh nursery is vital to the plants' survival. The nursery must be monitored on a regular basis to ensure that the plants stay healthy. By taking care of the nursery and observing the growth cycle, students gain knowledge about the intricacies of the growth and restoration process. Tampa Bay Watch staff handles maintenance over the summer when school is not in session.

**Key points for maintaining a healthy nursery:**

- **Salinity:** Spartina alterniflora is a halophytic plant, which means that it does best in water that contains some salt (brackish). Salinity should be 10-15 ppt (parts per thousand). This is most important for the two months prior to transplanting or if there is an invasion of freshwater plants. Too much or too little salt will result in poor growth and reproduction. Salinity should be monitored at least once a week and may need adjusting after heavy rains.

- **Water:** Spartina alterniflora is an intertidal species. This means it lives in a habitat where its roots are sometimes submerged in water and sometimes above water. It is best to establish a watering schedule that mimics tidal conditions; however, water needs will vary with the nursery cycle. Right after planting or recycling a nursery, the water needs of the plants will be high. The plants will be in shock so it is important to keep them well watered. Timers are typically set for 15-30 minutes every 7 days, but are adjusted depending on specific nursery situation. If your nursery does not have a timer set-up, please flood the nursery twice per week in the summer months and once per week the rest of the year. The nursery can be allowed to dry out for 1 to 2 weeks prior to harvesting to ease the process.

- **Weeds:** Weeds may sprout initially within the nursery, but the added salt should keep them under control. Most weeds are freshwater plants and cannot tolerate salt. If the weeds continue to grow, have the students pull out "invading" freshwater plants. If the problem continues, contact Tampa Bay Watch or your nursery mentor for technical support.

- **Algae:** Algal blooms (rapid growth of algae) can kill Spartina by depriving it of oxygen and nutrients. Drying out the nursery in between watering helps control algae growth. If excessive algae develops, try to remove as much as possible. Much of the algae is filamentous which means it clumps together and can be scooped out of the water. If the algae swamps the plants (covers the surface of the water), it can be removed by allowing the nursery to dry and thus the algae to dry out. When the algae is dry, it can be lifted off the top of the plants in sheets. It is easiest to remove the trays from the nursery for this procedure.

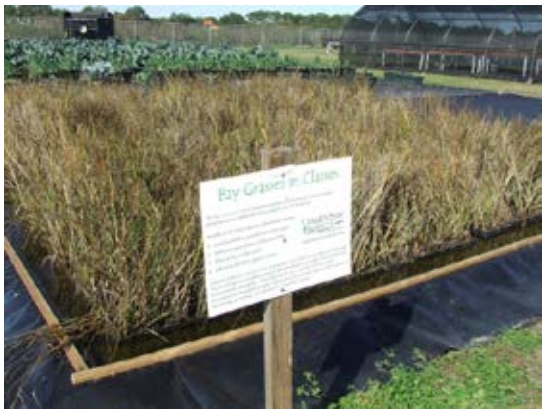
- **Disease:** Several diseases can harm the Spartina. A chart is provided in this resource guide for you to ID the most common ones. If rust (a reddish leaf fungus), black spot fungus or white scale develops on the grass blades, contact Tampa Bay Watch or your nursery mentor for technical support.

- **Battery Powered Timers:** If the irrigation system's timer is battery powered check the functioning of the timer when monitoring the nursery.

## Maintenance *(continued)*

- **Nursery Monitoring:** It is important to monitor the nursery regularly so that plants are receiving appropriate amounts of water, a stable salinity and pH range are being maintained and to catch and problems early enough to save the plants. A nursery monitoring checklist is provided. It includes procedures for monitoring and space for data collection. Ideally nursery monitoring should be conducted weekly. Students who regularly spend time in the nursery with the plants are more likely to feel a sense of connection with the program and thus derive more benefit from it. This resource guide also contains activities that help teachers integrate the program into the classroom.

- **Timesheets:** For BGIC nurseries, submit timesheets quarterly on our website. The information from the timesheets must be submitted for grant reporting, count any time spent in or out of the classroom specifically on the nursery or, on topics relating to the nursery. Tampa Bay Watch needs grants to support the BGIC program.



# Water Quality Monitoring & Nursery Check

Maintaining good water quality is vital to maintaining a healthy nursery. It is suggested to involve students in all aspects of monitoring and maintenance of the nursery. Performing analysis of water quality data collected allows students to practice Math and Language Arts skills in addition to Science skills.

**Procedures:**

Monitoring should ideally be done once a week and at minimum once every 2 weeks. It is also advisable to monitor after heavy rain storms so salinity can be adjusted as necessary. Monitoring can be performed by a few students or by the entire class. If a whole class is performing water quality tests, break them into 5 or 6 small groups and have them sample from different locations in the nursery. Students can record data from nursery monitoring and bring it back to class. Students can then perform statistical analysis (mean, median, mode) on the data collected.

The following check sheet is available online, where it can be submitted once per month. You can also print and laminate a sheet for use in your classroom. Hydrometers, pH paper, water droppers and disease ID cards are needed for the checklist. Teachers may find it desirable to create monitoring kits with all necessary supplies to aid in the process. Students will need to be trained initially on the use of testing materials, identifying diseases and completing the operations check. Once the students are properly trained and comfortable with the process, the monitoring can be completed in 15 – 20 minutes.

If time is of the essence, teachers may wish to rotate monitoring between classes. An alternative approach is to designate a few students to serve as nursery managers. These students can monitor the nursery when time permits. They might take on the project as an extracurricular activity to earn community service hours. Tampa Bay Watch staff is available to provide training for these students. If a teacher wishes to devote more time to monitoring the nursery, all classes can monitor on the same day creating a large pool of data for analysis.

## Nursery Monitoring Checklist

**Date:** _____ **Time:** _____

**Water Quality:**
**Test salinity of water.** Fill the hydrometer to the line with water from the nursery. Set the hydrometer on a level surface. Read the salinity in ppt. Good range is 10-20 ppt. Ideal is 15 ppt.
Salinity: _____ ppt Is the salinity in the good range? _____

**Test pH of water.** Tear off a 1" piece of pH paper. Use water dropper to place 1 drop of water on paper. Hold paper up to color chart and read pH. Good range is 6.5 - 8.5. Ideal range is 7.5-8
pH: _____ Is the pH in the good range? _____

Check the amount of algae in the nursery. If it covers all of the soil it needs to be treated.

Algae is covering none part all of the soil.

**Water Level:**
Check dampness of soil. Place a finger in the middle of a planting cell. The soil should be moist.

Soil is (circle one): dry moist soggy

Nursery is (circle one): full of water partially filled empty/dry

**Plant Health:**
Check plants for disease using the disease ID card. Are any of these diseases present? Circle if yes and note location of diseased plants.

Rust Black Spot fungus White scale

Location:_____

**Operations Check:**
Check the timer.

| | | |
|---|---|---|
| Is the date and time accurate? | Yes | No |
| Is the "change battery" message showing? | Yes | No |

**Notify teacher if you find any of the following:**

| | |
|---|---|
| -unsafe water quality | -leaks/valves turned off |
| -large amounts of algae | -presence of disease |
| -dry soil | -malfunctioning timer |

**Overall *Spartina alterniflora* Abundance:**

| % of Healthy trays per quadrant | % of Unhealthy/Empty trays per quadrant | Average # of plants in cells per quadrant (avg. 5 cells) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

*(Available and submitted online)*

## Quarterly Timesheet

**Quarter Months:** _____ **Year:**_____

Due to the volume of classes and assorted groups working on the wetland nursery project, please see below the categories and grand totals for each for the Bay Grasses In Classes - Wetland Nursery Program. It is very important to fill out this timesheet for your individual nurseries. The funds we receive under various grants are dependent upon student/teacher hours and the number of student/teacher participation in the program.

**INDIVIDUALS**

Number of students who worked on the Bay Grasses In Classes Program _____

Number of adults (including faculty, staff and chaperones) who worked on the Bay Grasses In Classes Program _____

**GRAND TOTAL NUMBER OF TEACHERS & STUDENTS** _____

**HOURS**

Number of total student hours worked on Bay Grasses In Classes Program including planning time for events, traveling, and any in-class activities done using BGIC (during and after school). _____

Number of total teacher hours (including Faculty and Chaperones) worked on Bay Grasses In Classes Program including planning time for events, traveling, and any in class activities done using BGIC (during and after school). _____

Number of total teacher hours (including Faculty and Chaperones) worked on Bay Grasses In Classes Program including planning time for events, traveling, and any in class activities done using BGIC (during and after school). _____

**GRAND TOTAL HOURS** _____

Teacher Signature: _____

## Harvesting

The school's nursery should be ready for harvesting six to eight months after planting. One half of the nursery is harvested for use in a restoration project. The other half is saved for recycling. Plants should be harvested no more than 24 hours before being transplanted. Plants should be kept in a shaded area between harvesting and transplanting as heat can be damaging to the plants. The only supplies needed for harvesting are work tables and 40 heavy-duty garbage bags.

**Harvest the plugs as follows:**

1. Drain the water from the nursery. This can be done up to 1 week in advance of the harvesting date. Plugs that have had a chance to dry out are easier to harvest.

2. Remove half (two quadrants) of the plant trays ( about 64) from the nursery and place them near the work tables.

3. To harvest the plugs, take a tray and turn it on its side so the grass blades are parallel to the ground.

4. The plant roots grow quickly and will most likely have grown out of the bottoms of the cells and through the flat trays. It is much easier to remove the plugs if excess roots are removed. Rip off any roots growing out of the bottom of the trays and save any root mats to include in planting.

5. Remove the flat tray from the tray with the plants in it.

6. Rip off any roots growing out of the bottoms of the cells, again taking care to save any root mats.

7. Remove the plugs from the cells.

8. If the plugs are brown, squeeze the stems of the grasses. If it flattens like a straw when squeezed, the plant is dead. If it is alive, the stem will be firm when squeezed. Some may be alive even if some are dead. If part of the cell is alive, it can be transplanted. Plugs with all dead plants cannot be transplanted.

9. Place 50 live plugs in each garbage bag. This is done to determine the number of plugs provided by your school.

10. Keep the bags of plants in a shaded area until it is time to transplant them.

## Transplanting

A transplanting requires three aspects to be successful: selection of a suitable site, determination of an appropriate tide, and transplanting into a restoration project. After the smooth cordgrass plants have been allowed to mature in the nursery for approximately six to eight months, they should be ready to be planted in a saltmarsh restoration project.

**For BGIC nurseries, Tampa Bay Watch will work with the BGIC lead teacher to identify a transplanting date with appropriate tides.** Once a date has been agreed upon, the BGIC lead teacher will need to plan a field trip for the restoration site for students to transplant. Please see the field trip guidelines for more information.

For programs not affiliated with Tampa Bay Watch, the following transplanting guidelines are provided:

- Ideally, a calm backwater area should be chosen as the restoration site. Boat and human traffic needs to be minimal. Wave action should be at a minimum to prevent erosion of the newly transplanted cordgrass. The shoreline area needs to have a gradual slope.

- The optimum elevation that Spartina alterniflora salt marsh grows at is +0.5' to 1.8' MLW (Mean Low Water). Plants need to be installed within this range or they will have too much or too little water.

- Most schools will find it easier to participate in an ongoing restoration project. Check with your local environmental protection agency, the National Estuary Program, Restore America's Estuaries, or other environmental organizations for information on restoration projects near your school.

- Planting events need to take advantage of lower tides (below +0.5' MLW) so that volunteers are planting along dry shorelines. Local tide tables can be consulted to determine the time and date of these low tides at the restoration site.

One person digs the holes along the planting line. When transplanting, it is most efficient to have students work in teams of 3. The first person digs the holes along the planting line. The second person places the plug in the hole, adjusting the depth if necessary. The third person packs in the sand around the plug. Choose a handful of students who are detail oriented and have them check the planted areas to make sure all plugs are planted properly.

## Transplanting Supplies and Equipment

**Tampa Bay Watch provides the transplanting equipment from the list below for BGIC nurseries while the schools provide the students and the plants.** For programs not affiliated with Tampa Bay Watch, the following equipment is needed to transplant a one-acre site:

a. 1,500-2,500 plugs

b. 20-30 students

c. 10-15 shovels or dibble bars

d. Planting flags

e. Water, sunscreen, bug spray

**The restoration site is planted as follows:**

1. Determine the width and depth (how far toward the water and how far up the beach) of the beach area to be planted.
2. Mark off the area with posts or flags.
3. Using a dibble bar, draw planting lines parallel to the beach. The planting rows should be 2'-3' apart. This spacing allows for optimal growth of each plant.
4. Dig holes about 1" – 2" in diameter and 3" – 4" deep along the planting lines. Space holes approximately 3 feet apart.
5. Place the Spartina alterniflora plug in the hole. Remember – green side up, root side down! The top of the soil must be level with the ground in which it is being planted. Adjust the depth of the hole if necessary by adding or removing sand.
6. Fill in the rest of the hole with sand and pat the ground firmly around the new plant to prevent it from floating away when the tide comes in. Be sure all roots are covered.
7. Survey the planted areas making sure all plugs are properly planted.

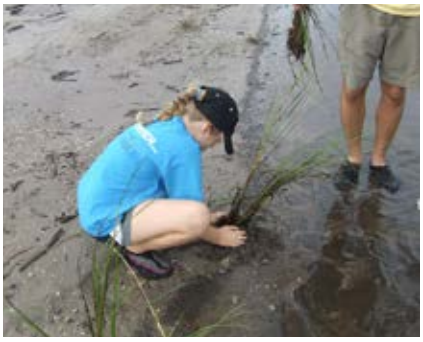
## Recycling

The salt marsh that is left in the nursery after harvesting is recycled. Recycling involves separating the existing plugs into individual plants and replanting them in planting trays. Because Spartina reproduces through rhizomatic growth, each individual plant will have reproduced 3-8 plants per cell. There should be enough grass left to refill the whole nursery. The plugs to be recycled will need to be removed from the planting trays using the harvesting method. Once the nursery has been recycled, it will be monitored for the next 6-8 months until the grasses are ready to be harvested and transplanted again.


## Splitting the Plugs

Whether grass plugs (bunches of plants) are pulled from a donor marsh or recycled in an existing nursery, the plugs contain multiple plants. The plugs will need to be separated into individual plants with good roots. If a plant is very small it should be planted with another one. The plants should be handled with extreme care! It can be difficult to separate the roots, since they are often intertwined around each other. Great care should be given to preserve the maximum number of roots so that the plants will be able to anchor themselves and also take up water and nutrients. Keeping the plugs moist will make it easier to separate the plants and prevent root damage.

**Split plugs as follows:**

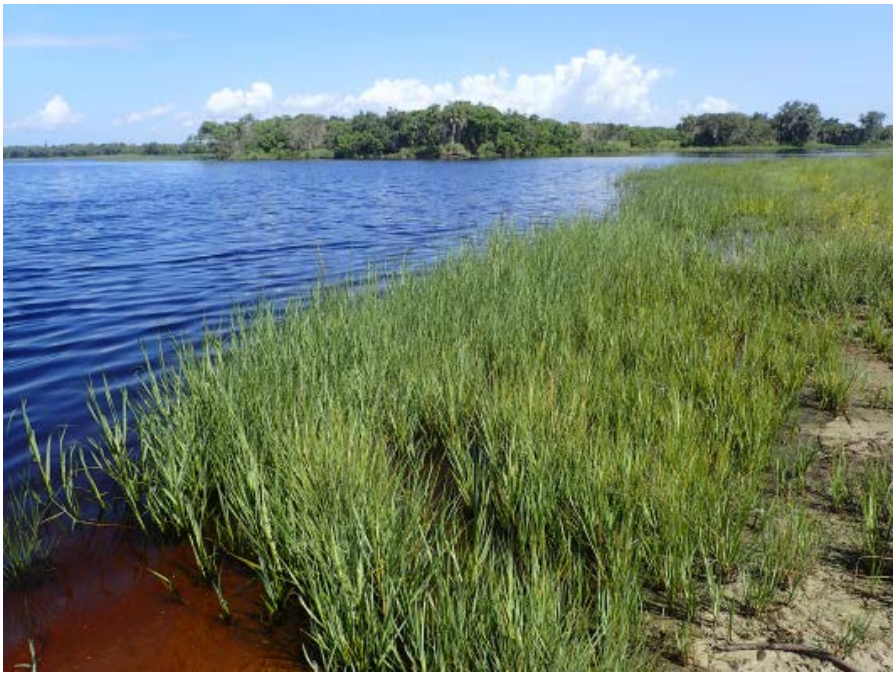


1. Grasp the plug with 2 hands, one on each side of the plug, at the base of the plant / top of the root ball.
2. Place thumbs into the root ball.
3. Gently pull the plug in half, keeping as many roots in tact as possible. If the roots are tightly intertwined, a slight twisting motion is effective to separate them.
4. Continue splitting the pieces of plug until each individual plant is separated.
5. Remove as much mud as possible from the plant without damaging the roots.
6. The potting cells are only 4" deep so long roots will need to be shortened by gently ripping off excess length or wrapping them around to form a root ball. Mature plants may also contain taproots. These roots are very thick unlike the small hair-like roots. These roots will need to be shortened or removed. They can be broken off with excess root length.

## Conclusion

Once the nursery has been harvested, transplanted and recycled, the students will have come full-circle with the program. However, the learning does not have to end here. Teachers can incorporate this program into the classroom. This manual contains lesson, labs and assessment questions related to salt marsh and its estuarine habitats. Science fair projects and individual research papers can be designed around the BGIC nursery.

Students should be encouraged to monitor the transplanted area over the year. They can monitor growth rates of the plants, and see the marine organisms and other wildlife that make the marsh their home. Students can feel proud of the newly created habitat that was developed with their help, and that hopefully will remain protected and preserved for years to come.



*This portion of the Rock Ponds Ecosystem Restoration Project in Palmetto, FL was planted by students in fall of 2014; photo was taken 6 months later.*

## Field Trip Information

Field trips are an integral part of the Bay Grasses In Classes program. Field trips need to be arranged for the initial stocking of a new nursery and for transplanting at restoration sites. Tampa Bay Watch plans trips with the lead teacher for each BGIC nursery. For nurseries not affiliated with BGIC, trips will need to be arranged independently or with a sponsoring organization. Since these trips involve students being in or on water, it will be important to be aware of district requirements for this type of field trip and to make sure the requirements can be met. Some restoration sites may only be accessible by boat so it is important to find out any limitations on water related activities before selecting a restoration site. Keep in mind it may be necessary to start planning the trip several months in advance.

Safety is a primary concern on any field trip and in particular with water-related field trips. Science classes usually start the year by reviewing laboratory safety and having students and parents sign a safety policy. Outdoor sites are an extension of the classroom laboratory and all safety rules will apply. General safety procedures should be reviewed with students before the trip. Below are additional safety considerations to be reviewed with all students and adults participating in the trips:

**Prepare for the weather:** BGIC nurseries usually transplant in the spring and fall. The main concern in Florida is ample protection from sun exposure. All participants should wear sunscreen. Participants may also want hats and insect repellent. Participants should bring a reusable water bottle and be sure to drink enough water to stay hydrated. In other areas of the country, exposure to cold may be the issue. Be aware of weather conditions and plan accordingly.

**Prepare for the site:** Closed toed shoes are essential for the trip. Places where grasses are planted may contain oyster or other sharp shell, broken glass and other trash. Transplanting happens in or very close to water, so shoes will get wet. Participants should bring a pair of shoes to change into after transplanting.

**Use good judgment and common sense:** These trips are safe as long as guidelines are followed. All participants need to listen closely to instructions on getting to and from the site, proper planting techniques and boater safety where applicable. All participants need to stay in designated areas for planting and traveling to planting sites. Participants need to be focused and pay attention to the task at hand. Do NOT go off on your own! Stay with the group at all times.

**Injuries:** Know the location of the first-aid station. In case of injury, report accidents to the teacher or Tampa Bay Watch staff, we will have first aid kits on site.

A sample letter for participants is included. The letter is targeted for BGIC nurseries and Tampa Bay restoration sites so modify the letter as necessary.

## Essential Knowledge for Students

In order for students to fully benefit from the Bay Grasses In Classes program, they need to have a solid understanding of ecosystems and how they function as well as basic plant biology. This may be information they have learned previously or can be taught throughout the year and tied in with the BGIC nursery program.

**Students should know the following:**

**Definition of an ecosystem**

**Components of an ecosystem**

- abiotic factors (nonliving factors such as water, soil, air, amount of sunshine)
- biotic factors (living factors such as plants, animals, protists)

**Definition of habitat:**

**Components of a habitat:**

Ecosystem niches

- producers
- consumers
- decomposers

**Food webs and food pyramids**

Examples of the relationships between living and nonliving factors in an ecosystem and how each is impacted by the others

Plant anatomy

- roots
- rhizomes
- leaves

**Plant maintenance requirements**

Photosynthesis

Sexual vs. asexual reproduction in plants (Spartina reproduces by asexual reproduction through rhizomatic growth)

## Corellations for Activities

It is our goal at Tampa Bay Watch to ensure the Bay Grasses In Classes program will provide an opportunity for teachers to integrate hands on learning and habitat restoration into their regular curricula. To that end, we have a link on our website with activities/lessons and assessment questions that relate to the nursery project.

If you have questions or would like to discuss ways to integrate these lessons with the nursery project, please contact Tampa Bay Watch's Environmental Scientist, Martha Gruber, at **mgruber@tampabaywatch.org** or Melinda Spall at **mspall@tampabaywatch.org.**

# Glossary of Terms

## A

**Acid:** A substance that increases the H+ concentration when added to a water solution.

**Agriculture:** Preparing soil, producing crops, and/or raising livestock.

**Algae:** A one-celled or multi-cellular plant that lacks normal stems, roots, and leaves, but does contain chlorophyll. An example is seaweed.

**Algal Blooms:** An above normal concentration of algae can be toxic to fish.

**Anoxic:** A condition where no oxygen is present.

## B

**Bacteria:** Any of a number of prokaryotic, one-celled microorganisms appearing in various forms and having a wide range of biochemical properties.

**Base:** A substance that increases the OH- concentration of a solution.

**Biome:** A complex biotic community characterized by the interaction of living organisms and climatic factors.

**Brackish water:** A mixture of salt water and fresh water.

## C

**Carbon Dioxide:** The fourth most-abundant gas in the Earth's atmosphere. Animals exhale carbon dioxide and plants convert it to sugars and other forms of energy during photosynthesis.

**Chlorophyll:** An important pigment found in plants that allows them to convert sunlight into sugars. This process is called photosynthesis.

**Compost:** A mixture of decaying organic matter, such as leaves and manure that can be used as fertilizer.

**Concentration:** The relative amount of a particular substance, solute or mixture.

**Consumer:** An organism that must eat (consume) another organism for nutrients and energy.

**Crustacean:** The class of aquatic arthropods characterized by having jointed legs and gills. Includes copepods, isopods, amphipods, barnacles, shrimp, and crabs.

## D

**Decay:** To decompose or rot.

**Decompose:** The separation or breaking down of a substance into its simplest parts.

**Detritus:** small pieces of decomposing plants, animals, and other organic material.

**Dissolved Oxygen:** Microscopic bubbles of oxygen mixed with water. Dissolved oxygen is necessary for healthy lakes, rivers, and estuaries. Most aquatic plants and animals need oxygen to survive.

**Drainage:** The process or action of a liquid flowing off land, often through a channel.

**Dredge:** To clean, deepen, or widen with a mechanical scoop.

**Dredged Material:** Soil or sediment taken from the bottom of a river or stream.

## Glossary of Terms *(continued)*

### E

**Ecology:** The relationship among living things and their biological, physical, and chemical environment.

**Ecosystem:** All the organisms in a particular region and the environment in which they live. The elements of an ecosystem (living and non-living) interact with and depend on each other.

**Effluent:** A discharge of liquid waste.

**Endangered Species:** A species in immediate danger of becoming extinct. Its numbers are low, and it needs protection in order to survive.

**Energy:** The capacity for doing work.

**Estuary:** The region where a river meets an inlet of the ocean, with salinity between that of fresh and ocean water.

**Erosion:** The process by which wind, water, or waves wear away soil.

**Euryhaline:** Being able to tolerate a wide range in salinity.

**Evaporation:** The process by which liquid is changed into gas or vapor.

**Evapotranspiration:** A process in which water is released into the atmosphere by evaporation from moist soil and plant transpiration.

### F

**Fertilizers:** Any of a large number of natural and synthetic materials, including manure, used to increase soil fertility.

**Flooding:** An overflowing of water onto land that is normally dry.

Floodplain: Extends from the toe of each valley wall to the bank tops of the stream channel. The soils are frequently wet and as the name implies, periodically inundated by floodwater.

**Food Chain:** A succession of organisms in a community that form a chain in which food energy is transferred from one organism to another as each consumes a lower member and in turn is eaten by a higher member.

**Food Web:** A network or "web" showing the interconnections between one organism and all others in its habitat.

**Forest:** A complex ecological system in which trees are the dominant life form.

**Fresh water:** Water that has little or no salt dissolved in it with salinity below 1 ppt.

### G

**Groundwater:** Underground water that collects when precipitation soaks into the soil and becomes trapped between the soil above and a rock or clay layer below.

### H

**Habitat:** The area or type of environment where an organism or biological population normally lives and grows.

**Hydric:** characterized by excessive moisture

## Glossary of Terms *(continued)*

### H *(continued)*

**Hydrology:** The scientific study of the properties, distribution, and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

**Hydrometer:** an instrument used to determine the salinity of a liquid.

**Hydrophytic:** growing wholly or partially in water

**Hypoxic:** A condition where only very low levels of oxygen are present.

### I

**Invertebrates:** Animals that lack a backbone (example: insects, squid, octopus, lobster, shrimp, crab, shellfish, sea urchin and starfish).

### J

### K

### L

**Land Subsidence:** The sinking of land, in some cases may be due to removing groundwater.

Larvae: the early form of an animal that at birth or hatching looks different from its parent and must grow and change before looking like the adult.

### M

**Marine:** Refers to the ocean where there are typically around 30 ppt (parts per thousand) of salt dissolved in the water.

**Marsh:** An open wetland that occurs along the coast of a river, lake, or ocean and in many other areas. Sedges, reeds, rushes, and grasses are the dominant plants within.

**Marsh Grass:** See submerged aquatic vegetation.

**Migratory:** A creature that moves from one region to another when the seasons change.

### N

**Native:** An animal or plant that lives or grows naturally in a certain region.

**Neutral:** A substance with a pH of 7, exactly between being basic and acidic.

**Niche:** The unique position occupied by particular species in terms of the area it inhabits and the function it performs within the community.

**Nitrogen:** An element in the atmosphere. It naturally occurs as a colorless, odorless gas, and can be found in various minerals and in all proteins. It is a major component of fertilizer. (Symbol, N).

## Glossary of Terms *(continued)*

### N *(continued)*

**Nonpoint Source Pollution:** Scattered sources of waterborne pollutants that can't be attributed to one specific location. Examples include nutrients that runoff from surfaces such as cropland, feedlots, lawns, parking lots, streets, forests, pavement, rooftops, and golf courses and then enter waterways. It also includes nutrients that enter waterways from air pollution or ground water.

**Nonrenewable:** Something that is limited in supply and cannot be replenished by natural processes, at least for thousands of years. Fossil fuels are a nonrenewable resource.

**Nutrients:** Substances that an organism must obtain from its surroundings to live and grow. Nonessential nutrients are those that can be made by the organism if they are absent from the food. Essential nutrients cannot be produced and must be present in the food. See also: runoff.

**Nutrient Overloading:** The process in which excess nutrients flow into waterways, typically the result of runoff from farms.

### O

**Organic Matter:** Any material that was produced by living organisms.

**Oxygen:** A nonmetallic chemical element. It is a colorless, odorless, tasteless gas, the most plentiful element in the Earth's crust; its most important compound is water (Symbol, O).

**Oyster Bed:** A hard structure where oysters can attach, live and reproduce.

### P

**pH:** A measure of how acidic or basic a solution is. The measurements of pH are given on a scale of 0.0 to 14.0. 7.0 is considered neutral (pure water), anything less than 7.0 is acidic (lemon juice), and anything greater than 7.0 is basic (baking soda).

**Phosphorus:** (symbol, P) A nonmetallic chemical element of the nitrogen family that is used in fertilizers.

**Photosynthesis:** The process by which plants convert carbon dioxide and water into carbohydrates and oxygen. The carbohydrates are then available for use as energy by the plant or other consuming organisms. ($CO_2 + H_2O$ + sunlight = $C_6H_{12}O_6 + O_2$). This process is also referred to as "primary production."

**Phytoplankton:** Microscopic (very small) organisms that produce their own food by photosynthesis and cannot swim against water currents, instead they float and are carried by the currents.

**Plankton:** Small or microscopic algae and animals associated with surface water and the water column.

**Point Source Pollution:** Pollution that drains from a specific identifiable physical location, such as from a pipe of any industry, wastewater treatment plant, or septic systems.

**Pollution:** The contamination of soil, water, or the atmosphere by the discharge of harmful substances.

**Population:** All of the organisms that constitute a specific group or occur in a specified habitat.

**Precipitation:** Rain, sleet, snow, or hail, etc.

**Predator:** An animal that lives by preying on (or eating) others.

**Producer:** An organism that produces its own energy and is therefore, at the start of the food chain (i.e. plankton, algae).

## Glossary of Terms *(continued)*

### Q

### R

**Refractometer:** an instrument used for measuring the salinity of water. Light rays bend differently in salt water than in fresh water.

**Renewable:** Something that can be replaced through natural processes if not overused or contaminated.

**Resource:** Something that is available that can be used to take care of a need.

**Respiration:** The process by which animal organisms take up oxygen and discharge carbon dioxide in order to satisfy their energy requirements. Energy and carbon dioxide are the byproducts of the oxidation of sugars and other molecules containing carbon.

**Restoration:** The process by which something is brought back to its original condition.

**Revitalization:** To impart new life or vigor to.

**Ridges:** A long, narrow elevated section of land.

**Riparian Buffers:** A protective, neutral area found in the riparian zone.

**Riparian Zone:** narrow strips of land that border creeks, rivers or other bodies of water.

**Runoff:** Water, including rain and snowmelt that runs down the surface of the land and into rivers, streams, and other waterways. Nutrient runoff is when water runoff carries with it nutrients that it has picked up from the land (from farms, lawns, factories, etc.).

### S

**Salinity:** The number of grams of dissolved salts in 1,000 grams of water. Salinity is usually calculated in parts per thousand (ppt), where a higher number indicates a higher salinity level (contains more salts). Fresh water is 0 ppt and the ocean is 35 ppt.

**Salt Flat:** A saline body of water that has dried over time leaving minerals behind.

**Salt Meadow Cordgrass:** See Spartina patens.

**Salt water:** Water that contains dissolved salt.

**Sea Grass:** An aquatic plant that lives submerged which is found in the Chesapeake Bay. Has an extensive underground root system that anchors them to the bottom. Commonly found in shallow coastal marine locations, salt marshes, estuaries, and in the tropics.

**Sediment:** Particles that settle to the bottom of liquid or that are deposited by water or wind.

**Sewage:** Liquid and solid waste carried off with water in sewers or drains.

**Shorebird:** Any bird that is found on shores, such as beaches and mudflats. Also known as wading bird.

**Silt:** Tiny particles of soil, or other matter floating in or left by water.

**Sink:** A downward slope where water can flow.

**Smooth Cordgrass:** See Spartina alterniflora.

**Solution:** One or more substance dissolved in another, usually liquid, but can be gases or solids.

## Glossary of Terms *(continued)*

### S *(continued)*

***Spartina alterniflora:*** Smooth cordgrass. A low to tall, erect grass (1-8 feet high) with elongate, smooth leaves. Flowers from June through October and is found in salt and brackish marshes (regularly and irregularly flooded zones).

***Spartina patens:*** Salt meadow cordgrass. A low to medium-height, erect or spreading grass (1-3 feet high) with very narrow linear leaves. Flowers from June through October and is found in irregularly flooded salt, brackish, and tidal fresh marshes, on wet beaches, sand dunes, and borders of salt marshes.

**Species:** a group of organisms of common ancestry able to reproduce only among themselves and usually geographically distinct.

**Stratification:** The formation, accumulation, or deposition of materials in layers, such as layers of fresh water overlying higher salinity water (salt water) in estuaries.

**Submerged Aquatic Vegetation (SAV):** Green, leafy, rooted plants (vegetation) that grow under water in shallow zones where light penetrates. Also known as "Bay grass", "sea grass" or "marsh grass".

**Succession:** The progressive replacement, on a single site, of one type of community by another.

**Swamp:** A forested or shrubby wetland.

### T

**Temperature:** The measure of hotness or coldness usually expressed in degrees Fahrenheit, Celsius, or Kelvin.

**Tidal Wetland:** A wetland that is subjected to changes in water level due to the phases of the moon. It is a transitional area between terrestrial and aquatic systems.

**Topography:** Detailed and precise description of the physical features of a region.

**Transpiration:** The process by which water is lost by being released from the skin of both plant and animal tissue.

**Turbidity:** The measure of how muddy or cloudy water is.

**Turbulence:** The mixing or churning of a substance, can be liquid or gas.

### U

**Uninhabited:** An area that is not occupied.

**Urban:** Of or located in a city.

### V

**Vapor:** The gaseous state of a substance that is normally a liquid or solid under normal conditions. Includes ferns and seed bearing plants.

**Vascular Plant:** Any plant in which the phloem transports sugar and the xylem transports water and salts.

## Glossary of Terms *(continued)*

### W

**Water Cycle:** The process by which water evaporates into vapor, condenses into liquid form in the clouds, precipitates as rain, snow, etc, and seeps back into groundwater or enters a body of surface water to be used or evaporate again.

**Water Vapor:** Tiny drops of water floating in the air as a gas.

**Watershed:** An area of land that drains into a particular body of water.

**Watershed Plateau:** Extends from the rim or watershed perimeter to the stream valley wall. It usually contains the flattest and, therefore, the most suitable areas for farming, development, and similar uses within the watershed.

**Wetland:** A landform characterized by the presence of water, soils, and vegetation. Often wetlands form the transition zones between upland and deep-water environments.

### X

### Y

### Z

**Zooplankton:** Animal forms of plankton. They cannot swim against water currents; instead they float and are carried by the currents. They cannot produce their own food, so they are consumers feeding off of phytoplankton and detritus.

**Adapted from The National Aquarium in Baltimore's Wetland Nursery Program Operations Manual*

# Bay Grasses In Classes Program
# Teacher Evaluation

**Please complete this evaluation form and return it to:**

**Bay Grasses In Classes**
**Tampa Bay Watch**
**3000 Pinellas Bayway**
**Tierra Verde, FL 33175**

Phone: 727-867-8166
Fax: 727-867-8188
Email: **mgruber@tampabaywatch.org** or **mspall@tampabaywatch.org**

Please feel free to attach a separate sheet of paper if you have additional comments. Your feedback is very valuable for the improvement of this program, and we greatly appreciate your taking the time to complete this evaluation.

Name (optional): _____

Date: _____

School/Organization: _____

County and State: _____

1. Did the resource guide provide you with enough information and directions to effectively construct the wetland nursery pond? Why or why not?

_____

_____

_____

2. Did the background section of the resource guide provide you with sufficient information to feel comfortable with this project? Why or Why not?

_____

_____

_____

## Teacher Evaluation *(continued)*

3. Would you make any modifications to the resource guide to help you more effectively use it? If so, what modifications would you make and why?

_____

_____

_____

4. Did you use any of the classroom activities? If so, which ones?

_____

_____

_____

5. Did you change any activities to make them more effective? If so, how and would you be willing to share?

_____

_____

_____

6. Did this project fit in with your science curriculum? Why or why not?

_____

_____

_____

7. What did your students think of the wetland nursery project?

_____

_____

_____

8. Was the project appropriate for your grade level? If you had to modify the activities to make them age/grade appropriate, what changes did you make?

_____

_____

_____

## Teacher Evaluation *(continued)*

9. Do you plan to continue in the wetland nursery program? Why or why not?

_____

_____

_____

10. Would you recommend the nursery program to other teachers? Why or why not?

_____

_____

_____

11. What would you change about the wetland nursery program to improve it?

_____

_____

_____

12. Other comments:

_____

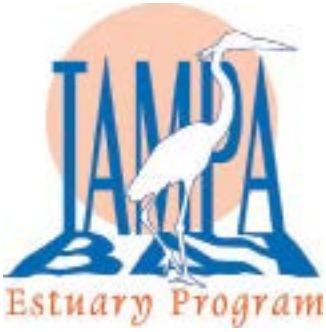
_____

_____

## Bay Grasses in Classes Program Sponsors





## About Tampa Bay Watch, Inc.

**OUR MISSION:**

Tampa Bay Watch is a 501(c)(3) nonprofit organization dedicated to the protection and restoration of the Tampa Bay estuary through scientific and educational programs.

Incorporated in 1993, Tampa Bay Watch, Inc. performs habitat restoration and protection activities throughout the year. Our programs seek to build citizen awareness, concern, and participation through educational outreach. Tampa Bay Watch also assists governmental agencies by helping to coordinate volunteers for restoration activities. Tampa Bay Watch's projects rely heavily on the efforts of community volunteers. Involving youth volunteers is a way to ensure long-term community commitment to restore and protect Tampa Bay. Additional information about Tampa Bay Watch can be found at www.tampabaywatch.org.

**Some of BGIC's accomplishments include:**

- Establishing a **nationally acclaimed and award-winning school wetland nursery program** to promote student involvement in regional habitat restoration initiatives.

- 39,578 students and 1,578 teachers have participated since 1995.

- These students and teachers have planted **294,993 salt marsh plugs** in habitat restoration projects, restoring about **150 acres** of new coastal tidal marsh.

- The program has saved over $4,424,895 to government agencies for restoration

## Tampa Bay Watch Staff

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