GROWING GREEN WITH PHYTOREMEDIATION

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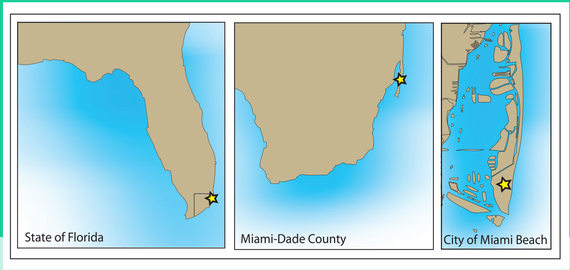
narrative

Everybody benefits from a healthy environment and all of us can make a contribution if we understand more about the concept of phytoremediation. Therefore, designing a site that incorporates education about the benefits of phytoremediation, and how it works, is extremely important.

When school children are given the opportunity of learning about phytoremediation as part of their daily educational experience, they are more likely to incorporate phytoremediation in their later lives. Making phytoremediation fun and interactional enhances the entire educational

INVENTORY AND ANALYSIS

Site Location Map



Demographics: Miami Beach

Population:
87,779

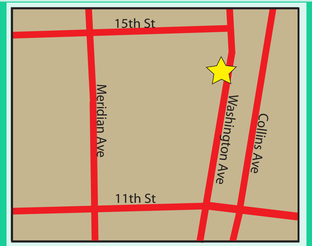
Hardiness Zone:
because of Miami's tropical climate..
....the plant hardiness zone is 10b

Languages:
Spanish: 55%
English: 33%

Area Map of Fienberg Fischer School

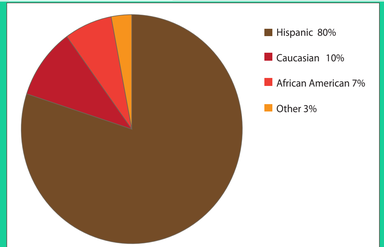
1420 Washington Ave, Miami Beach, FL

School Information



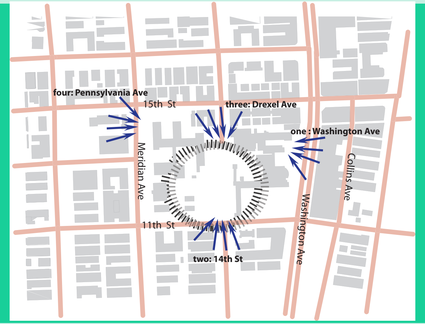
This site is currently the location of the Fienberg Fisher K-8 Center. This elementary school focuses on academic excellence, community involvement, social and emotional growth, art, international education and technology, as well as being an eco-friendly school. This is an ideal site for a phytoremedition project.

Total Enrollment

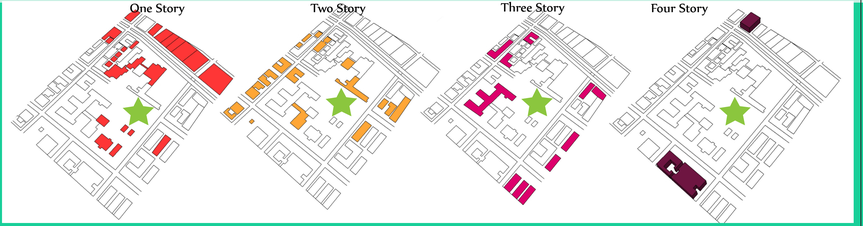


Total Student Enrollment: 839

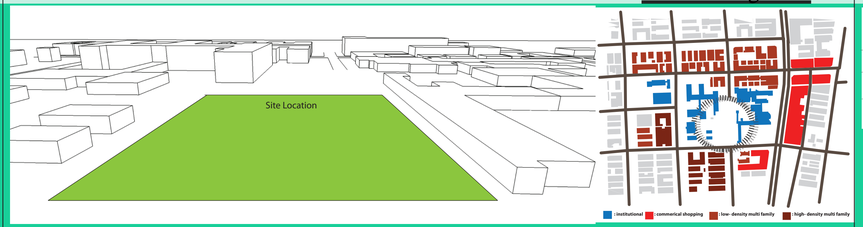
Site Entrances



Building Heights



Surrounding Area



Site Images

View from 14 St. across the site to the neighboring building

View from 14 St. toward school buildings

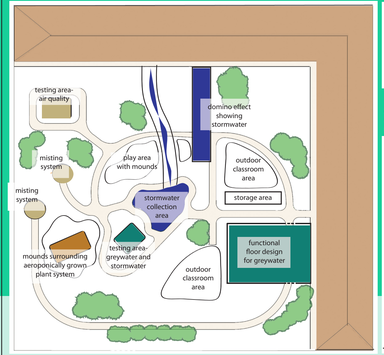
Walkway separating site from school building

Design Goals

- Design to educate students and community members about the benefits of phytoremediation.
- Incorporate the use of phytoremediation as part of the daily educational experience.
- Demonstrate how phytoremediation can improve the quality of greywater produced in a school.
- Identify how phytoremediation can assist in enhancing air quality.
- Develop an understanding of how stormwater can indicate the level of toxins in our environment.
- Use design elements to enhance student learning.

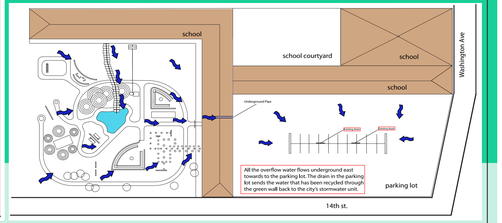
Context Map

Schematic Plan



The educational experience covers four areas:
- Phytoremediation/Root System
- Greywater
- Stormwater
- Air Quality

Stormwater Flow



Curriculum

Four areas of educational focus:

Phytoremediation/ Root System

Greywater

Stormwater

Air Quality/ Green Walls

Fienberg Fisher teaches kindergarden through 8th grade. This curriculum is for grades 1-5

Grades/Ages:	Learning Concepts:
1st grade: 6-7 years old	What is **Phytoremediation** Why is **Phytoremediation** important What is **Stormwater**
2nd grade: 7-8 years old	Why is **Greywater** important to clean How is **Greywater** cleaned Benefits of cleaning **Greywater** What are **Green Walls**
3rd grade: 8-9 years old	How do green walls help **Air Quality** Benefits of **Green Walls** Where does **Stormwater** come from Where does **Greywater** go
4th grade: 9-10 years old	How is **Greywater** calculated How is **Stormwater** calculated How do you collect **Stormwater** Benefits of collecting **Stormwater**
5th grade: 10-11 years old	How to test plants for toxins -**Air Quality** Amount of **Greywater** being cleaned How **Phytoremediation** works How do **Green Walls** work

Master Plan

Materials- Permeable Paver Walkway

These permeable pavers will be used for the walkway. They will intrigue the school children to question how permeable pavers work.

Entry point to the site viewed from the school building

Plants that uptake toxins on the site and surrounding area

Greywater
>Arsenic (Occurs naturally in the environment)
>Flouride (Naturally occurs in tap water)
>Chlorine (Added to water to kill bacteria)
>Lead (Found in plumbing pipes)
>Formaldehyde (Found in household cleaning products)

Stormwater
All toxins below are found in Asphalt
>Petroluem
>Polycyclic Aromatic Hydrocarbon (PAH)
>Carbon
>Sulfur
>Nitrogren
>Fuel Oil
>Crude Oil

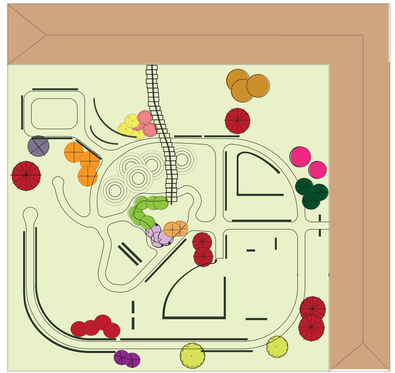
Air Quality
>Benzene (Formed by natural proccess and human activity)
>Polycyclic Aromatic Hydrocarbon (PAH) (Found in roofing tar)
>Polychlorinated Biphenyl (PCB's) (Used until 1970's, still exist in the air)
>Carbon monoxide (Formed from incomplete combustion of fuel)
>VOC's (Released into the air as gases)
>Arsenic (Caused from emission sources)
>Cobalt (Occurs naturally)
>Lead (Occurs naturally)
>Manganese (Occurs naturally)
>Nickel (Occurs naturally)

Plants
The following plants are appropiate for planting zone 10b

Plants	Planting Plan	Green Wall
Baker's Cord Grass *Spartina bakeri*	●	
Bearded Iris *Iris germanica*	●	
Blue Flag *Iris virginica*	●	
Common Duckweed *Lemna minor*	●	
Duck Potato *Sagittaria lancifolia*	●	
Golden Canna *Canna fladcida*	●	
Leather Leaf Fern *Acrostichum danaeifolium*	●	
Pickerelweed *Pontederia cordata*	●	
Spider Plant *Chlorophytum comosum*	●	
Virginia Willow *Itea virginica*	●	
Water Hyacinth *Eichhornia crassipes*	●	
English Ivy *Hedera helix*		●
Lavender Trumpet Vine *Clytostoma callistegioides*		●
Leather Leaf Fern *Rumohra adiantiformi*		●
Spider Plant *Chlorophytum comosum*		●
Narrow Leaved Cattail *Typhha angustifolia*		●
New Zealand Flax *Phormium tenax*		●
Boston Fern *Nephrolepis exaltata*		●
Castor Bean *Ricinus communis*		●
English Daisy *Bellis perennis*		●
Ivy Geranium *Pelargonium peltatum*		●
Janet Craig Dracaena *Dracaena deremensis*		●
Peace Lily *Spathiphyllum wallisii*		●
Rubber Plant *Ficus elastica*		●

Planting Plan

- Acacia choriophylla
- Castor Bean
- Common Duckweed
- Duck Potato
- Narrow Leaved Cattail
- New Zealand Flax
- Orange Cordia
- Pickerelweed
- Pink Floss Silk Tree
- Queen's Crepe Myrtle
- Red Powderpuff
- Silver Trumpet Tree
- Water Hyacinth



Plants

 Acacia choriophylla Tamarindillo

 Castor Bean Ricinus communis

 Common Duckweed Lemna minor

 Duck Potato Sagittaria lancifolia

 Narrow Leaved Cattail Typhha angustifolia

 New Zealand Flax Phormium tenax

 Orange Cordia Cordia sebastena

 Pickerelweed Pontederia cordata

 Pink Floss Silk Tree Chorisia speciosa

 Queen's Crepe Myrtle Lagerstroemia speciosa

 Red Powderpuff Calliandra haematocephalla

 Silver Trumpet Tree Tabebuia caraiba

 Water Hyacinth Eichhornia crassipes

GreenWallPlants


Baker's Cord Grass Spartina bakeri


Bearded Iris Iris germanica


Blue Flag Iris virginica


Boston Fern Nephrolepis exaltata


English Ivy Hedera helix


Golden Canna Canna fladccida


Ivy Geranium Pelargonium peltatum


Janet Craig Dracaena Dracaena deremensis


Lavender Trumpet Vine Clytostoma callistegioides

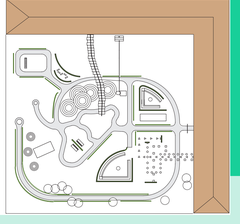

Leather Leaf Fern Acrostichum danaeifolium


Peace Lily Spathiphyllum wallisii


Rubber Plant Ficus elastica


Spider Plant Chlorophytum comosum


Virginia Willow Itea virginica



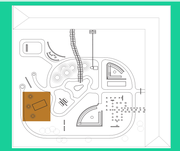
The four aspects of teaching about phytoremediation in an educational environment:

I. Phytoremediation
II. Greywater
III. Stormwater
IV. Air Quality

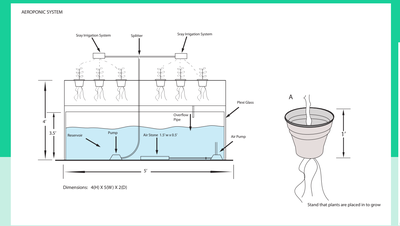
I. PHYTOREMEDIATION

School children learn best by seeing and doing.

At the Fienberg Fischer Center the school children will learn about phytoremedation by interacting with aeroponically grown plants and experiencing the science of phytoremediation in action.



Construction Document of Aeroponic System



Phytoremediation Educational Element

II. GREYWATER

Greywater Math and Corresponding Green Walls

Greywater from Student hand-wash sinks
Florida law requires 1 sink per 30 students*

841 students /30 sinks = 28.03 i.e 29 sinks
Each sink uses 10 gallons/day from September- May (School Year)***
Each sink uses 1gallon/day from June-August (Vacation)

School Year usage/day = 29 sinks x 10 gallons/sink /day = **290** gallons generated
Vacation usage/day = 29 sinks x 1 gallon/sink/day = **29** gallons generated

The design incorporates **3,072** sq ft of green walls that recycle greywater
x **0.09** gallons/sq ft = **276** gallons of water used by green walls**

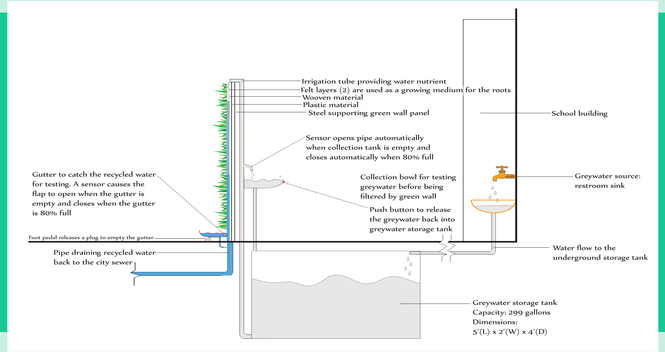
95% of greywater is used by green walls

*Florida Department of children and families
**0.09 calucation derived from information on http://www.gardenbeet.com/living-walls.html
***http://wiki.answers.com/Q/How_much_water_does_the_sink_use_per_minute

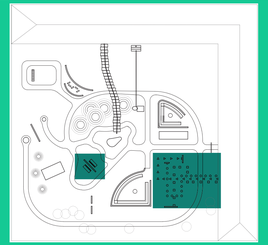
Visualize

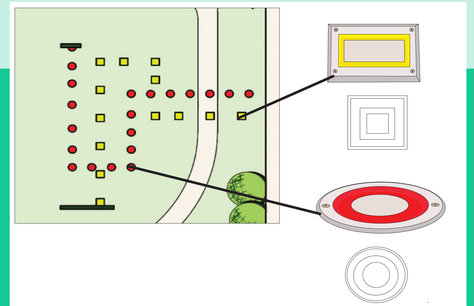
School Year usage/day = 29 sinks x 10 gallons/sink /day = **290** gallons generated
290 gallons of water represented by
290 one gallon milk jugs

Section of Greywater System



Greywater Educational Element





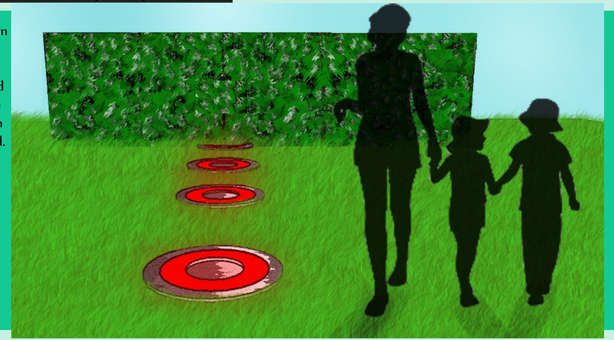
Lighting symbol to represent the use of a sink in the Girl's Bathroom

Lighting symbol to represent the use of a sink in the Boy's Bathroom

View of Greywater Functional Lighting Element

The first step in the phytoremediation process is demonstrated when the red light flashes. This indicates that the boy's bathroom sink is being used and greywater is flowing through the system. The yellow light flashes when the girl's bathroom sink is being used.

This highlights the educational aspect of a simple daily activity that produces greywater, having a scientific consequence through phytoremediation.



View of Greywater and Stormwater Testing Stations

When greywater is removed from the collection bowl it is tested at this testing center which is designed to create a fun learning environement for the school children. The children can sit on the grass, or on tall stools in front of a green wall when they test the grey water and the recycled water while being able to see the physical results of the science at work.

Another part of the learning experience is to carry the stormwater in buckets to this testing area for testing purposes.

Supplies needed for testing water quality:
*enough supplies for 5-10 people at a time

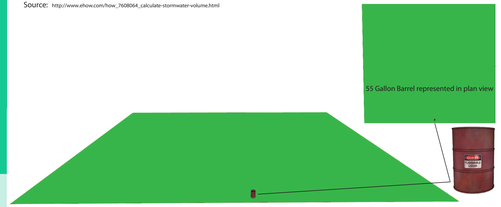
>sample collection jar
>1 ph test tube
>1 dissolved oxygen vial
>2 temperature strips
>color chart
>pencils
>100 dissolved oxygen reagent tablets
>gloves
>hand wash station

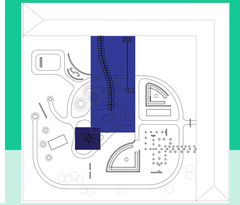
III. STORMWATER

Stormwater Volume Calculation

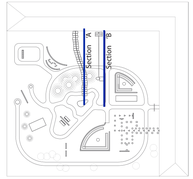
- Average Monthly Rainfall: 5 Inches
- 5/30=0.16 (Average Daily Rainfall)
- 0.16/12=0.0138 (Average Daily Rainfall per foot)
- 0.0138 x 30,000sq ft= 416.664 (Stormwater Volume in Cubic Feet per day)
- 416.664/7.48 = **55.70** gallons per day (Average Stormwater Volume of gallons per day over the **30,000** sq ft area.

Source: http://www.ehow.com/how_7608064_calculate-stormwater-volume.html





Section 'A- Stormwater Process

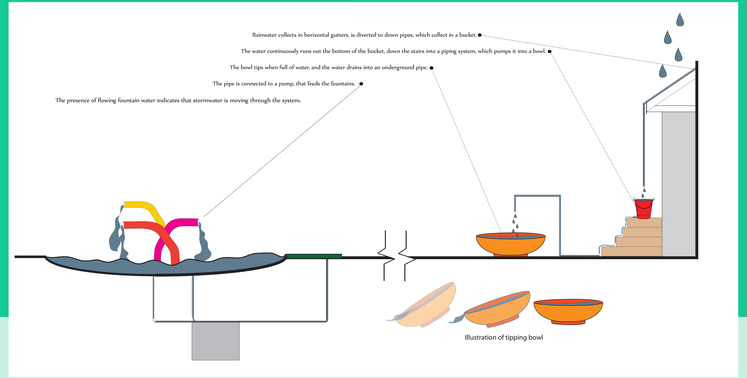


Step 1:
Stormwater from the roof is diverted into a series of bowls.

Step 2:
The water then runs down the steps into the pond.

Step 3:
When the pond is 80% full, the drain opens and the water runs into the city sewer.

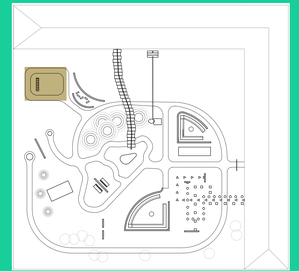
Section 'B- Domino Effect Element



View of Stormwater Educational Element

School children have an opportunity of playing in this area, while watching the water flow from the bowls into the pond. They can also watch the activation of the fountain which is triggered when water runs into the stormwater collection area. All these activities link science with education.

IV. AIR QUALITY

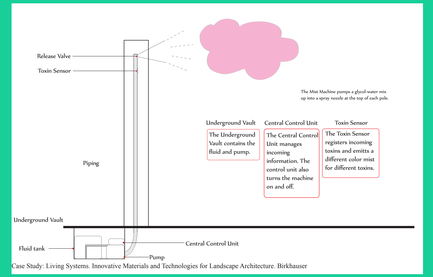


Children learn better when they are in a clean and safe environment. This includes educating them about the air that they breathe. This section creates a fun and interactive way to test air quality.

Supplies needed for testing air quality:

->Portable air sampling pump
->Batteries

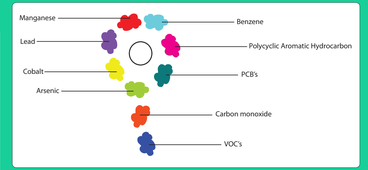
Air Quality Testing Station



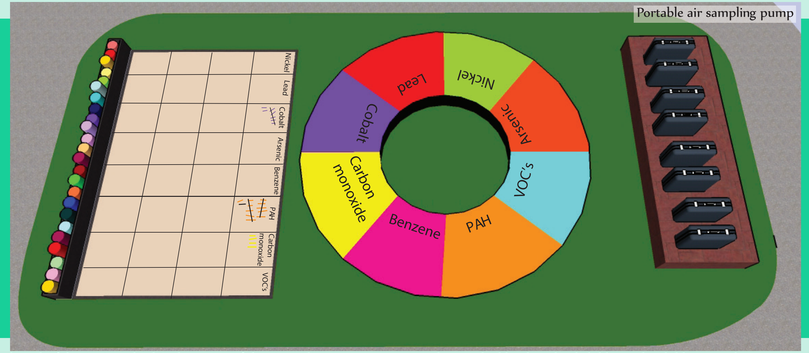
Case Study: Living Systems: Innovative Materials and Technologies for Landscape Architecture. Birkhauser

The Misting Station is automatically activated when sensors detect toxins in the air. When activated, the station emits a colored mist that corresponds to a color coded toxin identified on the walkway. This educates the children about the names and presence of toxins in their environment.

View of Misting Station

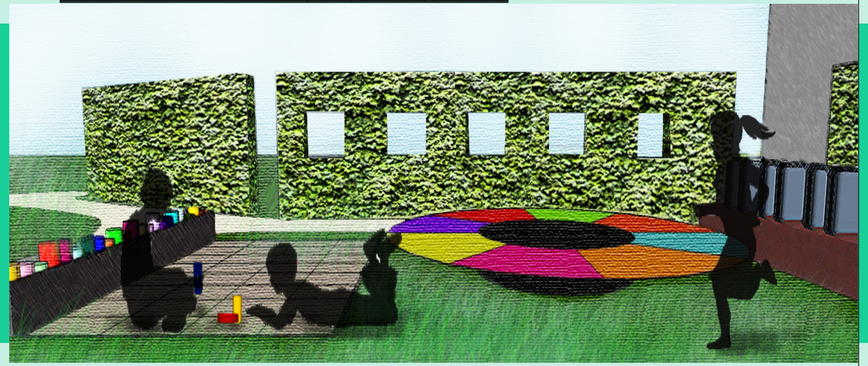


Plan View of Air Quality Testing Station

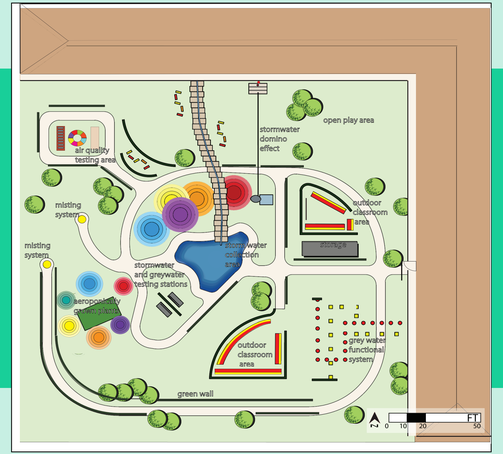


The colorful spinning wheel in the center of the air quality testing area spins when pushed by the school children. The children use the testing stations on the right to test the toxins in the air and they record each test result by the name of the toxin. In this process they learn the names of the toxins and how often the toxins appear in their own school environment. This is another example of a fun learning experience.

Another View of the Air Quality Testing Station



The design uses specific elements to respond to the exploration of phytoremediation. The design of the elements is appropriate for learners of the target age group to benefit interactively by seeing the connection between science and nature in an educational environment.



View of Outdoor Classroom