engaging cultural + environmental ecologies on the Elizabeth River
DESIGN I: eleven individual explorations
**Hybrid Space**

The barge is a vehicle to experience the Elizabeth River as a hybrid landscape, where large scale ecologic and industrial processes occur.

The form of the structure references the scale of its surroundings. While the structure has the ability to create some degree of enclosure, it is built to allow the natural elements to permeate the barge.

A sectional strategy is employed to allow access to the water, and to reveal the processes and life of the benthic layer.

Strategies employed in the wetlands will allow visitors to become involved in ecological processes at a tangible scale, whether through harvesting decaying plants or providing a native plants nursery for the shores of the Elizabeth River.

- Laura Bandara
One element of the sectional strategy is the construction of a stair/aquarium from Plexiglas which will contain submersed aquatic vegetation and estuarine life.

Opposite the stair/aquarium will be a window into the water of the Elizabeth, allowing students to see her murky color, and understand its relationship to the tannins in the Great Dismal Swamp.

The Elizabeth River is a dialectic - a landscape created by the intersections between Chesapeake Bay and Great Dismal Swamp, salt and freshwater, between land and sea, between ecology and industry.

The form and educational strategies of the barge will embody this dialectic, allowing students to open to the multiple processes which occur on the river.

A mobile nursery will permit students to participate in ecological processes, while understanding the dynamism of estuarine ecosystems. The form of the plant nursery becomes a hybrid of the industrial and ecological landscapes of the Elizabeth.
The Learning Barge is didactic architecture that functions at multiple scales; most clearly, it must have meanings at the scale of the river and the visitor. Creating narratives that describe how the barge is to be understood is an important first step in determining its physical form. By programming narratives rather than spaces, the barge becomes part of its educational goal, not just the site for it.

These narratives include, the barge as a:

- **lens**: making large things small and small things large. The barge is a mediating device that brings global issues to the size of the students and exposes hidden life within the river. The same place can be understood in dramatically different ways depending on the lens that is used.

- **display**: Against the backdrop of the city, it is a marker of the work being done to clean up the river; within reach of curious hands, it is a place that has three dimensional value and interest.

- **threshold**: providing transitions through path, light and sound that remove visitors from the environment of the everyday in order to re-present it to them.

- **filter**: that sorts through the muddied relationship of industry, culture and nature. Both the physical filtering of water and the conceptual filtering of information can break down opaque wholes into their usable parts – revealing hidden processes.
The parameters that clarify the function of the barge and unify its many lessons have physical parallels in a strong structural armature that is a framework to serve multiple functions. Rather than a series of discreet objects or spaces, singular interventions on the barge can be at the scale of industrial and maritime technologies, and still allow for flexibility within them.

- Kimberly Barnett
Project Intentions

To represent the ground / background / field / site of the Learning Barge in such a way that the figure of the barge is transformed by this context.

The barge is a work of environmental design that engages, amplifies and reveals the historical and present ecology of the Elizabeth River.

Two crucial aspects of this story are the “legacy” contamination in the soils of the river, and the current regeneration efforts achieved by the efforts of volunteers.

Use the barge as a transformative space for children’s environmental ethics.

The barge design, fabrication materials and operation should clearly embody an attitude towards material production, using renewable resources for its energy needs.
Spatial / Program Ideas

Spatial issues operating on the barge:

Facilitating contact with the water. Transitioning from the barge surface, at minimum six feet above water, to a contact zone one foot above water.

Using the “river as sink,” a traditional pollution model, as a formal element.

Interfacing solid forms with fluid, such as is evident on the river bank.

Exploring the spatial compression and multi-tooling typical of boats/ houseboats/ nomadic structures.

Using the darkness below deck as an asset, perhaps as a “lab” for science on materials pulled from the river.

- Neil Budzinski

The barge at the Elizabeth River Project docking site. Proposed wetland on board represented alongside volunteer efforts re-vegetating Paradise Creek shoreline.
Sliding walls and movable storage partitions create adaptable space, while solar panels with a tracking system allow the barge to settle into its site. Operable floor grates allow use of the space above the greywater garden, while facilitating the opportunity to descend into the garden for “bottom grabs”. The garden may be extruded above deck to allow views of the rich benthic zone.

The studies explore the Learning Barge as movable as both an object and a collection of objects or onboard components. Adaptable architecture has the ability to alter itself to suit the diverse needs of its users, in this case the need for a place that supports education, wetland planting operations, conferences and even fundraising events. The barge must also adapt to the sun and changing tidal conditions. As a collection of objects it must have the ability to be both open and closed to a spectrum of activities and conditions. These models explore these ideas in a multitude of ways.

Access to the water is studied in both inboard and outboard solutions, such as cutting the deck and lowering a mobile gangplank to the water’s surface for educational activities as well as easy access from boats. Natural ventilation is studied as the primary means of cooling the spaces utilizing the breeze off the river’s surface.
Layers of Interior/Exterior space wrap around a central service core, with storage above and mechanical below. The permeable border between interior and exterior space promotes ventilation, while a solar roof provides power for the barge and shelter from the sun. Eaves overhang a stair to the lower deck where an enclosed space can be used for secure storage of electronic equipment and batteries for the solar power system. There is the possibility of an additional learning environment below deck. An open deck facilitates experiential learning on the barge facilitates.

Two gardens have very precise functions, one purifying greywater and the other growing plants harvested annually for methane production to heat the barge in the cold winter months. A ramp allows access to the lower level where visitors can witness the abundant life hidden below the surface of the water garden. An open steel grate system covers the wetland allowing full occupation of the deck, as the gardens still perform the filtration function required of them. These gardens do not represent the natural environs but recreate the functions that these environs perform for us.

- Adam Donovan
Contextualizing with industry and environment

Visiting the Elizabeth River, we experienced a palpable disconnection between the waterfront and the land. Security and environmental concerns combine to create a fragmented landscape. I see one mission of the barge design to connect the land, water and shore. As a framework for thinking about methods of accomplishing this, I looked for the elements that tied together the “natural” and “man-made” and found it impossible to avoid seeing them as interconnected cycles. A normal wetland or river circulates nutrients and is a balanced system. Industry is a cyclical process as well, however imbalanced it may be.
What are the reasons for and consequences of environmental and industrial imbalances? How can the Learning Barge express the mechanisms of these coexisting cycles while contributing to an awareness of the essential phenomenological conditions of water, shore, and land?

The incorporation of a wetland into the design of the barge is important. No attempt should be made to replicate a fragment of an actual wetland, but the barge wetland should function as a water treatment mechanism. The idea would be to show the cyclical nature of production, consumption, waste and transformation. This should be accompanied with some element of interaction with actual wetland areas, possibly through participation in restoration.

The barge should be as self-sufficient as possible, harvesting rainwater and sun, and wasting as little as possible. Enclosure should be kept to a minimum. Perceptual connection to the water and land would be on more than one level, but sectional manipulation would be minimized to maintain the expansive sensation offered by the barge deck. This would also help to control costs. The industrial character of the landscape and culture would be acknowledged in a way that makes clear the interconnectedness of constructed and naturally-occurring processes.

Zoe Edgecomb
The Elizabeth River is water in process. Tidal flow, temperature, salinity, imports, exports, each changes hourly, daily, yearly. These explorations look at one or a combination of those processes and make them manifest. The architectural interventions become forces and movements frozen in time, or lenses and keys that make those processes visible.

What if all five sites could be condensed? As the barge moves, students realign elements to call out the sun at noon, the north star, the rising of the moon. A giant solar clock tracks the sun as it passes each hour. A cut through the barge reflects the sky above, as a tower projects from the depths. Spaces are created to learn how to navigate on earth with what is above. At night, the structures themselves become sextant and astrolabe.
Battery + Process

What if the barge plugged into something else and became new? If the barge had a presence on the land, it could become the generator of process, rather than merely an observer. When the barge changes site, its wetland attaches to one on land, taking on stormwater runoff that is treated and held. Pneumatic panels in the ground translate the energy of hopping children into air pressure, driving pumps that carry clean water back on to the land. The barge becomes a battery, storing energy needed elsewhere, and releasing it at just the right moment.
What if everything the barge needed could be held in one box? As elements are needed, they are pulled or folded out from the central box. The conference table slides over a hole in the barge and unfolds, becoming a water testing laboratory. Windows slide outwards and become interactive maps. Floors unwrap, exposing structure and water below. The movement itself is used to power process. Certain elements generate the pressure needed to move water, create enclosure; nothing exists in isolation.

Solar, pneumatic, hydrodynamic, vegetal, heat, are all types of energy in different states. Plants can be considered organic translations of energy from the sun, from the ground, from water. The energy needed to drive a tugboat is energy from the sun turned to food, turned to animal, compressed and turned to oil. Each manifestation is one moment in this process.
What if other ships could read the barge as they passed? This exploration combines the previous. There is a tower that unfolds to the sun and stars, and a box that explodes into student activity stations. But now, as each piece changes, it becomes a signal representing what occurs within. Areas of the barge flood and dry as the tide ebbs and flows. Window panels are historic photographs aligned with locations on the shore. As each piece is moved, the enclosure is rapidly eroded until the box is less building and more ruin.

- Matt Hural
Emphasizing Sectional Experience

My goals combined a practical solution to fitting possible program elements within the structural constraints of the barge bulkheads, while at the same time emphasizing the sectional experience by excavating below deck and constructing on top of it. The experience of the path was intended to take advantage of these sectional qualities, allowing for visual connections to the various systems at work on the barge and in the adjacent landscapes. Material changes are used to emphasize different types of intervention on the barge. Given its mass and opacity, steel plate would become oppressive as an additive material above deck. To maintain a sense of the deck's vastness, some transparency should be achieved so as not to clutter the barge's surface. Due to the rigid, rectilinear quality of the barge's shape and internal structure, an intervention above the deck might break from that orthogonality by moving in ways oblique or even curvilinear to the structure of the barge itself.

The Hopper barge (above right) allows for greater sectional flexibility without compromising structure.

The deck barge (far right) requires more careful modifications to achieve sectional experiences that penetrate below the surface of the deck.
Wind Power Exploration
The most promising source of electric power for the barge is to harness both solar and wind energy. These two power sources work well in tandem since neither will reach their optimum performance in the Elizabeth River area. For instance, on hot, sunny days, winds tend to be calm and during storms and at night winds tend to pick up in speed.

- Matthew McClellan
This scheme explores the connection between the barge and the land. It operates from the idea that there is inherent reciprocity between our own constructions and ones found in nature. Ideally, these are harmonious situations that coexist, both as nature. This scheme anchors the barge into its surroundings with a literal connection from its deck to the ground of the shore. The model, loosely based on conditions at Money Point, shows a ramp leading from the barge to the ground, over the water between them. There is also an “arm” or small ramp structure that protrudes from the opposite side of the barge, over the River, to afford the opportunity for children and other visitors to get very close to the water while being as removed as possible from where they have come.

This scheme suggests that the program allows students to cross this edge between water and land, recognizing that the two depend upon one another seamlessly, each permeating the other. More specifically, this would include the literal transport of young plants from a barge nursery to land, so that students may contribute to the regeneration of conditions in the landscape that may have been erased. This new vegetation would contribute to the efforts of many to restore habitats and bring to the River more closeness between man’s building and the building of nature.

- Katherine Pabody
Below is a drawing that shows half of a longitudinal section cut through the barge in water. The central of five levels upon the barge is marked by a cut in its side, which allows the water of the river to move over the deck as conditions enable. Shown below the barge is a floating oyster cage that is accessed from the lowest level of the barge. Students would participate in the periodic transport of oysters that have been grown in the cage to reefs further into the Bay.
This exploration takes advantage of the subtractive and additive barge section to allow people to experience didactic elements in a sectional and processional way. One enters the barge at deck level and then ascends via ramp, passing platforms/containers of: filtering oyster beds, wetlands, green roof, recycled/reused roof/floor material, solar water heaters, and photovoltaic panels. As one descends, the lower portions of the wetland, green roof, and oyster beds are visually accessible and a sheltered space is available for gathering or inhabiting. As the “terraces” ascend, the progression from ground/water to sky occurs abstractly along the procession.

Surface / Ground
Section
Didactic Procession
Open View
Ramp / Accessible
Compartmentalization
Gather
Path
Exploded Surface
Oysters: filtering
Wetland: filtering
Green Roof: thermal, inhabitable
Recycled Materials
Cistern
Photovoltaics
This idea also relates to interlocking/compact space by allowing people to experience didactic elements in a sectional way. The roof becomes a main element. The two sections of green roof and photovoltaic panels slope toward a channel, collecting and conveying rainwater into a “water channel” on one side. In this, gray water is collected and filtered with wetland plants. Relating to this space is a sunken classroom with amphitheater, accessed by a ramp, where the students can see light-filtering panels above, water channel to one side, and the river to the other side. The deck level along the edge opposite the water channel is a place for students to stand next to the water and experience the edge of the barge looking out to the Elizabeth River.

Surface / Ground
Section
Structure / Enclosure
Open View
Ramp / Accessible
Compartmentalization
Gather
Path
Amphitheater
Water Channel / Wetland
Photovoltaics
Green Roof

LEARNING BARGE
+9 SITES OUT OF MIND
Taking inspiration from the numerous cranes and loading docks of the port, the challenge was how to transform the flat deck of a barge into a dynamic surface with a sense of motion reminiscent of the busy Elizabeth River.

- Jayme Schwartzberg
LEARNING BARGE
+9 SITES OUT OF MIND
This initial barge design is informed by ideas of **Balance**, in both a literal and philosophical sense. Concepts of balance pervade many aspects of the project, from the equilibrium of water and the physical balance required of a barge, to the theoretical balance of an educational program. Perhaps most importantly, the idea of balance is at the heart of a healthy, functioning natural environment, and is the fundamental goal of ecologically sensitive initiatives such as recycling; the same initiatives and processes about which the students will be educated. This design is based on a 32’ x 94’ barge with a uniform, unchangeable central spine.

**Formal**

Classrooms, one enclosed and one covered, are placed on either end of the barge and linked by perimeter paths. The configuration accommodates two, 25-person classes that rotate between the two rooms. The perimeter paths also function as entry points onto the barge. One path ramps down 3.5 feet to provide low-level access to the barge from a boat. The outdoor classroom consists of 2 16’x24’ spaces, one of which is a terraced seating area sloping down to meet the level of the ramp landing. The enclosed space is approximately 32’x20’. The overall spatial idea was to provide several learning “environments” while promoting even circulation throughout the barge, seeking physical and spatial balance.
Conceptual

The barge organization has a didactic purpose in terms of how it structures the learning process. If we see the educational agenda of the learning barge as a balance between observation and participation, the design must reflect this balance. The enclosed classroom will house the observation component, in which displays, charts, and other “flat” material is exhibited. The outdoor classroom will hold the more participatory components, where students will become physically involved in the processes and get their hands dirty. Furthermore, the central area enclosed by the classrooms and perimeter paths will function as a learning garden of native ecological activity, or a microcosm of the larger surrounding environment.

Thus the perimeter spaces on the barge provide students the opportunity to look outward and observe the existing conditions, while the central space with its reduced scale allows for more immediate participation with the elements that comprise the larger environment. By reducing the scale, the systems at play will become more comprehensible to the students. The central space will contain several native wetland planted areas, a living oyster bed, and a thru-hole to the river for bottom grabs and crab traps.

-Clark Tate
DESIGN 2: four schematic designs
Hopper Barge

Using a hopper barge, this scheme creates an experience of the river both above and below the waterline.

The upper deck is envisioned as an outdoor classroom, a place to experience the horizontal expanse of the river. Rainwater falls between wooden slats of the deck, and is funneled to a filtration tank for use on the barge. PV panels are angled to direct rainwater into a water wall that extends to the space below.

The lower level of the barge becomes a hybrid space: classroom, amphitheater, exhibition hall. The experience is built around the concept of exploring the sectional changes of the Elizabeth River, from the sediment of the benthos to the plants and animals of the marsh, represented in the water wall. Opposite, the wood wall provides an armature for power systems, furniture, etc.

Laura Bandara             Matt McClellan
Katherine Pabody    Phoebe Richbourg
Learning Barge
+9 Sites Out of Mind
Flat Deck Barge

The surface of the flat deck barge becomes a metaphor for exploration, as layers are peeled and punctured, and infrastructure is uncovered to reveal the functions and structure of the barge.

The barge’s structural module establishes chambers that contain infrastructural elements such as wetland plants which filter grey water and batteries used to store energy generated by PVs.

The translucent PVs are inserted into an armature, and provide a canopy for the sheltered classroom while also meeting the electricity needs of the barge.

As the armature rises from the deck, amphitheater seating is built in, and wetland plants puncture these seats in places, providing a rare experience of immersion in wetland grasses.

A retractable shade cloth sits underneath the armature, making the enclosure a sort of nomadic tent during the hot summer months.

Along one side, a ramp permits access at different levels, and allows visitors to experience the water more closely.

Laura Bandara  Katherine Pabody
Matt McClellan  Phoebe Richbourg
LEARNING BARGE
+9 SITES OUT OF MIND
The barge is imagined as a lens that focuses the student’s attention towards the river. Multiple spaces on the barge allow for different learning environments. The deck ramps toward the river, allowing greater engagement with the water. The barge has an upper deck and a lower deck 4 feet below. The lower deck includes a 575 square foot enclosed room, a hole cut to the river below, and “amphitheater” seating steps for 28 children.

An armature that holds the energy and curricular systems of the barge is built to reflect the many trestles and cranes in the region.

An expanse of uncovered deck acts as a void and counterpoint to the enclosure on the barge, promoting an unmediated experience of the sky, (eco/industrial) shoreline, and winds.

Along one side of the barge, an armature engages students with the renewable energy systems and curriculum of the barge. Water storage and distribution, including solar hot water panels and a planting, is at one end, and the other end holds energy generation such as PV’s. Curriculum in the form of large maps of the watershed, and an archive of student drawings, crafts and writing is held within the armature, backlit by the river.
The Components Diagram at right is a visual encyclopedia of the component parts of the barge. Each image represents a line of research to determine the most suitable system or manufacturer.

The sketch below depicts the water cycle on the barge. A sloped roof conducts rain into a suspended cistern that stores the water for hand washing, and plantings are irrigated with any excess. Grey water from the sink flows to the planting, seeps through the planting soil matrix, and exits through the hole cut in the barge to the river below.

The Gathering/Enclosure Diagram shows a range of onboard spaces from fully to partially enclosed. A Circulation Diagram represents how docking on the barge occurs at the 8 foot or 4 foot level. This set of diagrams analyzes and explains the performance of the barge from several points of view, including technological and in terms of human occupation.
Learning Barge Diagram Set: Gathering / Enclosure, Systems, Circulation

Gathering / Enclosure Diagram:
1. 12’ x 30’ Deck - partially covered by roof structure
2. 20’ x 32’ Room - complete enclosure with operable windows
3. 16’ x 16’ Terraced Classroom - partially covered
4. 20’ x 32’ Deck - Uncovered, open air observation

Systems Diagram:
1. Rainwater Collection / Photovoltaic Panels
2. 3 Vertical Wind Turbines
3. Solar Hot water Collection
4. Rainwater Collection Basin
5. Water Filtration Plantings

Circulation Diagram:
1. Entry / Exit access from both sides of barge
2. Entry / Exit access at high (8 ft.) and low (4 ft.) levels
3. ADA Compliant ramp negotiating level change
4. Didactic circulation corridor containing visible energy systems
An enclosed, climate-controlled space is, by nature, not site-specific. A temperature and humidity controlled room is intended to be the same in the desert as it is on a river. The outside may be one condition, but once an enclosed space is entered, only the view is different. This project conceives of the entire barge as classroom that is transformed by its inhabitants rather than prescribed in advance.
Rather than typical walls, there are two cabinets: one devoted to enclosure and one to display. As the enclosure cabinet is opened, it begins to alter the space of the barge. Cabinet doors pull out to become walls that frame views and hint at the separation between barge and river. Moving a cabinet also unfolds the roof, and as the door opens, the sky is screened out. Tables fold down from the interior of the cabinet, creating space for lab experiments. It is an omni-customizable ‘magic box.’ All the boundary you need, ready to be unfurled.

A transparent display cabinet faces this "enclosure cabinet" and modulates views without closing them entirely, allowing stored maps and aquaria to become part of the view and the lesson. The display cabinet contains built-in activity stations and seating that unfolds as needed. When students are finished, their newly created and found artifacts become treasures stored in the cabinet as well. The lesson builds with time, each group of students adding a trace of their experience to the barge so that it becomes richer and more complex with each visit.
In this way, the barge becomes the lesson. Small changes in enclosure, whether a space is in shade or sheltered from the wind, will have great consequences for the quality of the surroundings. This is tied to the notion of the interconnectedness of river, sky, and inhabitant. When the deck is at its most open, the cabinets are closed and inaccessible, and when the deck is most enclosed, all of the cabinets become available for use. Open and closed have inverted their normal relation.
This is tied to the wetland as well. When moored, the interior of the barge is flooded, settling it in the water. Cuts through the sides of the barge allow water to flood through the wetland, reconnecting it to the river. The wetland is less something contained, than the filter that permits river water to pass through the barge. The river has as great a role to play in the barge’s occupation, as the students do in creating the enclosure.

Rather than a place to simply sit and be lectured to about the river, the Learning Barge is a mutable object to be engaged with wonder. Like the river, it is intimately tied in to its surroundings, responding to every change in pressure, light, and wind. Also like the river, the inhabitants provide the final piece, imbuing the surface of the barge with meaning through transformation. It is less a place and more an experience.
DESIGN 3: two final iterations
A fusion of successful elements

A regular steel armature is the physical structure as well as the link between all the barge elements. The Armature creates a spatial promenade, serves as a teaching device, and physically supports the building systems make the barge work. It unites the open wetland of the barge with the more enclosed spaces, as well as the two extroverted spaces that occupy the raked ends. In the wetland ampitheatre, shadecloth is unfurled from the armature and pulled across the terraced steps to create a protective covering overhead. A four-foot deep interstitial space is created within the armature. This space contains cabinetry and houses the environmental system components attached to the armature structure. The systems include water and power collection, as well as water purification in the form of native plant filtration and release back into the river. Wind turbines and solar arrays are integrated into the armature for power production. The fore and aft decks, as well as the processional space through the armature, are built up two feet from the original deck of the barge, with a particular focus on the treatment of the deck and barge surface.
LEARNING BARGE
+9 SITES OUT OF MIND
**Systems: Water flow and activity**
The wetland plan is intended to recall the meander of a tidal creek, while allowing water to flow through the barge according to the tidal currents. An amphitheater allows the wetland plants to be used as a teaching tool, while providing a degree of access for students and visitors.
This iteration of the barge builds upon the idea of the barge as a lens. The housing of this lens is conceived as multivalent and adaptable, with varying degrees of enclosure made possible through layered wall systems, sectional manipulations, and direct physical connections to river and shore. Stitching together diverse elements, an armature contains the infrastructure necessary for making the barge as self-sufficient as possible.

Approaching the barge from land, site is filtered phenomenologically as well as physically. Working with the Money Point site as a staring point, we considered ways of extending an Arm that would allow tactile and visual experiences of the industrial and ecological systems. By inhabiting the margin where land and water converge, analogies are formed between newly regenerated wetland habitat, transformed river, and curricular intentions of the Learning Barge.

Occupying the barge involves shifting experiences as seasons change. Visitors arrive at a place where water and structure converge as the river flows into a constructed onboard wetland. Besides providing a transition from land conditions to barge, there is an opportunity for close interaction with plants and microhabitats without disturbing the endangered river shoreline. Native plants provide a backdrop or foreground for two stages: one directly connected to a gathering place called the Storytelling Stairs, and one occupying the transitional space of enclosure. As the wetland changes over the course of the year, so will the activities in this area, as children plant, harvest, and observe at an intimate scale.

Two open decks of differing sizes are connected by a long space under the Armature. Partially enclosable through shade fabric, this space faces the expanse of the river and addresses the opposite shore. Here students might sketch and write about their surroundings. This space also allows a close look at the solar photovoltaic and hot-water systems, and at the water collection and filtration system. Large windows connect this space to the classroom.
Learning Barge
+9 Sites Out of Mind

left: plan
right top: storytelling stairs and wetland
right middle: armature and systems
right bottom: classroom and storytelling stairs
Gathering on the small deck, one glimpses the Artifact Wall that stores objects students have found on their travels or made on their visit to the Barge. Accessible from two sides, this wall creates another condition of permeability.

Proceeding down the shore-side ramp, the visitor is once again visually joined with the wetland. Depending on the season, the classroom wall on this side will be open or closed. Because the roof structure is cantilevered from the Armature, columns are not necessary on this wall. Entering the space one is protected from wind and sun, but a sense of openness is preserved. Still intimately connected to the river through sight, sound and smell, children can gather around fold-down tables to process what they’ve learned through making and group discussion. Stored inside the walls are microscopes, paintbrushes and paper, buckets, maps and modeling clay.

Looking from the main open deck through the armature and over the wetland.

Longitudinal section.
As the students leave the barge, they will have a new sense of their role within the river ecosystem. Depending on their age and curricular needs, they may have concentrated on ecological awareness, the history of the shipping port, or the role of industrial processes in contemporary life. Visiting the Learning Barge, they will have experienced a unique educational event that will enhance their sense of the river as a crucial element of a set of interconnected systems, one for which we must provide stewardship for as well as ethically inhabit.
Framing the Approach

The barge is a semi-nomadic field station: it stops on the river according to certain criteria that oscillate between what is best for the curriculum and what is practically achievable in terms of students’ embarking and debarking from the barge.

How do students and educators access the barge? This first piece of our site research looked at a “typology of landings.” This drawing is a way of categorizing how the barge would engage the river and be accessed by visitors. Three principle types were classified: Barge as Extension, Barge as Island, and Barge as Adjacency. These are presented with their pros and cons on the facing page.

An important issue concerns the curricular opportunities in the barge approach sequence. Is the barge expected to do “all the work” of the curriculum, or do students often arrive having been immersed in the landscape of their curriculum? In other words, are the students learning as they approach, or do they learn only once they have arrived and stop learning once they leave? This informs in a related way the relationship of the barge as figure to its context or ground. Is it detached or engaged?

The barge was originally intended as a way of occupying the river without using the highly privatized shoreline. Limiting the barge to the river is a missed opportunity to engage more actively in the regeneration of the river and its shore. Stormwater from the urban fabric of the watershed is the primary contemporary pollutant, and people of the region have little experience of the waterfront. This regeneration is as much about bringing people back to the waterfront as it is about ecology. In this scenario, the barge becomes an agent of colonization. We researched the shoreline of the South Branch, looking for parcels that are likely to change ownership or are owned by “RiverStar” industries. The barge anchors off these shores and begins to claim them for public use. The claim operates along a gradient from conceptual to actual; the students may arrive to the barge by boat and then occupy the shoreline briefly, perhaps planting while they are there, or they may arrive at the barge by land.
LANDING TYPES: ARRIVAL AND DEPARTURE FROM BARGE

BARGE AS EXTENSION
(via barge “arm”)

**PRO**
- Self-sufficiency: Barge brings its own landing gear and integrates with land.
- Curriculum opportunities of approach sequence / walk through complex ecologies of river shore. Visceral land experience prompts land/water associations once on the barge.
- Barge planting faces shore, creating a room in between barge and shore.
- Children walk themselves to the barge, through a strong threshold (litoral/liminal) rather than being dropped off.

**CON**
- Private property of shoreline - difficult access.
- Compared to #2, less experience of river.

BARGE AS ISLAND
(via water taxi “Baywatcher”)

**PRO**
- Boat ride introduces kids to environment, river panorama.
- Curriculum begins on Baywatcher.

**CON**
- Potentially short visit (1hr).
- Water Taxi has unrelated architectural program.
- Barge dependent on outside agency + program.
- Objectification of barge.

BARGE AS ADJACENCY
(via traditional dock)

**PRO**
- Easy access.
- Makes use of existing infrastructure.

**CON**
- Context, few curricular opportunities in approach.
- Objectification of barge.
- Identity of barge becomes murky.

Typology of Landings. The graphic suggests the experiences of shore or water per option.
Site: Money Point

We chose a site off Money Point as a case study. Our proposal is grounded in the work of Crisman + Petrus Architects’ Money Point Revitalization Plan, and in our own appraisal of the qualities of the site. The barge would be anchored at a site offshore of a vegetated area on the northern edge of Money Point. This position allows river views up to the Jordan Bridge and across to Blows Creek. The vegetated condition suggested that it is a property that is in transition of use.

The Revitalization Plan calls for a bioswale and possible stormwater bioretention pond in a proposed Citgo (a Riverstar industry) conservation area at the site we have identified. We use the bioswale as a path, connecting Freeman Avenue with the shore line. The school bus would park on Freeman Avenue in the remnant residential neighborhood. The phenomena of impervious surfaces and urban runoff would be discussed. Turning to follow the bioswale to the shoreline, the function of plants in relation to water quality, as well as the function of the Citgo storage tanks, would be clarified. Students arriving at the barge would have visceral exposure to factors that affect the health of the Elizabeth. The onboard wetland and sustainable energy systems of the barge are discussed in context of what students have seen on their approach.
above: The barge with connecting arm leading to onboard wetland.
below: Aerial photo of Money Point with barge moored, bioswale and other proposed trails.
opposite: Sketches of the approach sequence to the barge, beginning on Freeman Avenue.
DESIGN 4: one refined design
Enclosure Designs

Things We Like From Our Explorations:

Artifact wall:
- reflect module of wetland construction
- register the change in deck level, through shadow or bench
- stop short of armature wall to allow walls to read separately
- allow openings for ventilation
- bring wall to ceiling to show expansion upward

Seat wall / Window wall:
- flexible ventilation, multiple openings
- provide seating
- relate to artifact wall, perhaps with storage
- use eight foot rhythm of structure
- maximize transparency

Opening wall:
- maximize connection with wetland
- reinforce longitudinal axis of the barge
- do not block water system or movement on deck

This flexible window configuration will be part of the final design.
The translucent artifact wall was chosen for the final design, as was the flip-up opening wall design.
**d4.2: ARMATURE: STRUCTURE EXPLORATIONS**

**Structure Designs: 6 options**

Things We Like From Our Explorations:
- steel verticals
- not tube steel
- primacy of center columns
- extension of armature structure over line of classroom
- minimize beam transverse to structure at cantilevered side
- roof cant opening outward
- lower classroom floor (two feet lower than armature deck between columns)
- steel deck exposed on upper area (armature portion between columns)
- logically sized structural members
- frame of structure with systems insertions between armature, potentially a second skin making the enclosure
- opaque roof with potential openings for light and air
- primacy of structure over enclosure
- legibility of structure from outside & inside
- lower roof section to articulate gutter
- separation of PV roof from enclosure roof
- design armature wall to hold other elements
- main vertical structure sits outside of enclosure
- separate interior and exterior structural horizontals
- wood armature structure on interior, steel exterior
- roof drains to gutter suspended from armature
- wood horizontal support extends beyond enclosure over ramp
- tension wires supporting wood beams
- truss structure
- second skin for enclosure
- insertions between columns
- transition element at transverse beam
- water draining to channel hung in armature path
- systems possibilities: cabinets, discrete elements, frame
LEARNING BARGE

+9 SITES OUT OF MIND

double column structure to allow reading of armature from both interior and exterior
-built up interior floor for possible change of parti
-creation of interstitial zone between columns that acts as system wall and gutter
-water draining to channel to facilitate collection

-exclusively wood structural members
-allow rain water to enter the classroom through interior rain drainage

-columns are back-to-back channels that allow beam to slide between them
-cantilever held in tension with steel cables
-openings in armature wall allow for seating and possible passage from armature to interior room
-translucent roofing material emphasizes the lightness of the enclosure
Structures Designs

Understanding the visual articulation of the armature structure and enclosure systems became an important detail to resolve. These model studies were used to examine how to both express the structure of the armature and also provide a weather tight enclosure for the classroom.
Ecology and human activity

Hybrid systems which combine designed solutions with natural systems – or the cultivation of ecologic processes – brings restoration efforts and human activities together.

The wetland system on the barge demonstrates how these hybrid strategies might be employed at a small scale.
Principles for design

- Living with and participating in ecologic processes -- wetland should educate
- Ability to access and be in wetland space
- Ability to touch water and touch plants
- Teach plant identification with plant beds
- Wetland should be defined as a volumetric and articulated space
- Integrate spaces with plants and water
- Consider edges and adjacencies and detail them carefully
- Create a nursery bed for *Spartina alterniflora* to be used in shore restoration projects
Filtration and Dissolved Oxygen

The wetland allows visitors to see both the natural filtration function of plants and soil, and the engineered components of scuppers with a roughened surface, which increases the dissolved oxygen level in the water.

The barge wetland acts as a pilot project to demonstrate strategies that can be employed along the river at different scales and in different forms.

The wetland design integrates ecologic systems by making process visible and participatory.

Visitors experience wetland plants in ways that they might not otherwise be able along the shore, and see that plants function to clean, filter and slow water.

This iteration of the design process explored different strategies for inhabiting the wetland, making process tangible and visible, and creating an experience of delight for the visitor.
Prototypical section through wetland beds

Section cut through stairs, with salt marsh wetland beds adjacent to armature

Prototypical section through wetland beds
The Arm

There is great potential for the curricular and phenomenal experience of the barge, in its connection to the shores of the river. The “arm” is a simple, narrow bridge that affords passage between the barge and the shore.

The evolution of the arm stemmed from the belief that the curriculum could reflect a reciprocity between the water of the river and the land it permeates. The physical anchoring of the barge, to land that emerges from beneath the water, makes apparent the relationship between the river and constructions upon it that have significantly altered its disposition in the last century.

The arm is part of the structure of the barge, housed at its side and deployed in certain conditions. The barge may moor where occupation of the shore is both permitted and feasible for The ERP and visitors to the barge, in which case this passage and occupation can become part of the barge curriculum.

Once deployed, the arm becomes a stable structure that is moored at both of its ends with “spuds”, one of these being the very spud that moors the barge itself. This arrangement allows the barge to pivot around this spud, gently rotating as it is swayed by prevailing currents of the river and winds. This phenomenon is one of several afforded by the arm that presents a visceral moment of learning for students of the river’s ecology.
LEARNING BARGE: final design

DETAILS
CURRICULUM
SITES
MODEL
DIAGRAMS

PERSPECTIVES
MEASURED DRAWINGS
The primary purpose of the Learning Barge is to educate the community of Tidewater Virginia about the cultural and ecological landscape of the Elizabeth River, to serve as an outreach vessel for the Elizabeth River Project and their sediment, wetland and oyster regeneration projects, and to enable the regeneration of the river's ecology after a century of impact by heavy industry.

The barge’s general site agenda is two-fold: First, it seeks out marginal and compromised sites - sites out of mind - and identifies them. Second, it aims to engage the civic realm. Anchoring the barge becomes an act of place making.

Unique to the Elizabeth River Project's efforts is the "One Creek at a Time" strategy that avoids a single, big budget remediation effort in favor of multiple, smaller projects that proceed over time as funding becomes available. This approach, which relies on community support and consensus building, is a model of national significance for addressing environmental degradation and contamination at the scale of the region.
The sitelensness and buoyancy of the barge is a great asset within this decentralized context. As ERP cleans the Elizabeth on a project by project basis, the Learning Barge moves to the work site and serves as both a place of observation and as a place for staging the operation, serving as the project’s temporary headquarters. The barge is both nomadic and consistent; it gives a material presence to the common purpose that links together the disparate sites.

Students respond to the regeneration projects by writing, drawing, or collecting, and embedding the records of these activities into the artifact wall. Student responses are complemented by photographs and maps that documents each regeneration project. Over time, the artifact wall becomes an archive of the Elizabeth River Project’s river clean-up, the place where one goes to see the work of the organization.
final design: SITES
final design: SITES
The educational mission of the Learning Barge is its primary focus, including school children in Kindergarten through twelfth grade. The barge will be occupied by many types of constituents, including project facilitators and volunteers in the staging of regeneration projects, the Elizabeth River Project Board of Directors, adult education classes, summer camp field trips, or any “Walk-on” public agenda.

We propose a flexible curriculum for the school groups that draws on the unique qualities and events of specific sites. The site includes everything that can be seen or perceived from the barge, as well as land conditions that are accessed by the barge’s gangway and extended approach sequences via watercraft, such as the Chesapeake Bay Foundation’s Baywatcher or the barge’s own outboard watercraft.

The sites, in addition to addressing specific projects, will act as prompts for teaching from a modular curriculum. The modules include but are not limited to:

- Navigation and Shipping
- RiverStar efforts
- Cultural History of the River
- Renewable Energy and Weather
- Wetland Ecology
- Pollution Prevention and Remediation
- Oyster Restoration

Our strategy is to situate these modules in the spatial and temporal context of the Elizabeth River. A module on the role of oysters in the river, for example, would ideally be taught at sites where a constructed oyster reef is visible. The Learning Barge educator and visiting teacher would discuss together the curriculum for each visit based on class needs and the “formula”:

Curriculum = Site + Module + Sequence

The “Navigation Drawing” shown on the preceding pages is our attempt to register and construct a possible macro-sequence for moving the barge over a three year period. A climate and events timeline, including regeneration projects, runs along the top of the drawing. The barge is moved opportunistically to take advantage of these events. Placed below the timeline are several informant conditions about the sites themselves: a description of the strategic and curricular opportunities of each given site, a typology of its accessibility and the anchoring conditions it offers, its spatial condition, and a “benthic layer” that evokes the material and phenomenal qualities of the site. A sequencing of the Learning Barge’s siting based upon these rhythms and characteristics will help to reveal a more complete understanding of the river’s ecological complexity.
Paradise Creek
March 21st
10th Grade Earth Science - 24 students
SOLs:
Geography (map making, recording information)
Earth science (weather, hydrologic cycle, ecosystem, flora/fauna identification)
Physics (fluid properties, buoyancy)
Civics

9:00  There are a number of possibilities for the students’ arrival to the site. One
      would be to arrive via boat and walk onshore from an existing dock. Another,
      perhaps in the case of a summer camp group, would be to canoe to the site
      from a point further upstream. A third would be for the students to arrive
      from land; their buses could park at varying possible distances from Giant
      Cement, with each distance affording them a different sort of approach to
      the site.

9:20  Students arrive at Giant Cement and meet with a company representative.
      Discuss Giant Cement’s presence in the area and walk along shoreline. What
      is the environmental impact of cement making? What does it mean to be a
      River Star and in what projects do they engage?

10:00 Students guided to landing arm and board the barge.

10:10 Armature: Conversation about sustainable power generation, tied to notions
      expressed by Giant Cement (i.e. lesser environmental footprint, resource
      conservation, land use and groundwater infiltration, conversion of natural
      energy). Discuss the U.S. Naval Yard Superfund Site and Landfill.

10:30 Small group activity: Each group on the barge develops a speculative map
      of the Chesapeake Bay watershed, after short discussion of how the creek
      plays a role within this boundary. Further discussions: How does water
      infiltrate into natural and man-made sites? How much surface on the drive
      over was paved, how much was permeable? Where does that water go?
      Discuss together and develop a common class map on the barge surface
      with chalk.
<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:30</td>
<td>Lunch on barge at story telling stairs facing wetland.</td>
</tr>
<tr>
<td>12:00</td>
<td>Wetland and ecosystems: Discuss engineered solutions to water regeneration, including constructed wetland ecology. Discuss local ecosystem, including focus upon the process of a wetland “waking up” from its winter dormancy. Discuss how one recognizes the different parts of the shoreline (i.e. its various layers and buffers, endemic plant and animal species, etc.). Possibility of student participation in cultivation tasks for the barge wetland.</td>
</tr>
<tr>
<td>12:40</td>
<td>Habitat/endemic species: oyster reefs and life cycles, oysters’ natural ability to cleanse the river, present the oyster reef at Paradise Creek. Discuss the Atlantic flyway/spring and fall migrations, osprey nesting. Present other native species. Discuss plants being the most important element of maintaining healthy wildlife habitat. Possibility of student participation in building osprey nests or an activity that could be contribute to oyster regeneration efforts.</td>
</tr>
<tr>
<td>1:15</td>
<td>Students given sketchy maps of the area and divided into teams. Each chooses a tool (i.e. core sampler, etc.) to map the character of a part of the shoreline. Where are the sediment and vegetative layers discussed on the barge, what is the profile of the land at the site, how does one represent this? How has local industry affected the profile of the land?</td>
</tr>
<tr>
<td>1:50</td>
<td>Develop a common map defined by the various types of information gathered. Students show samples collected during their shore trip and explain what these say about the shoreline. Discuss the geography of the Chesapeake Bay area, Portsmouth, and how the scale of the creek shore relates to larger geographical frames. Collective map stored in artifact wall for later students to see and compare to their own.</td>
</tr>
<tr>
<td>2:30</td>
<td>Leave by bus (with copy of map for in-class use).</td>
</tr>
</tbody>
</table>
### Scotts Creek

**September 22nd**  
Volunteer Wetland Workers - 15 adults

**Community Work:**  
Regenerating Wetland  
"At Home" Projects (Bird Sanctuary, Butterfly Sanctuary, Oyster Nursery)  
Partners (Community Groups, River Stars, Public Institutions)

This day looks at the barge's potential as the base of operations for a wetland regeneration partnership between ERP and local community members. This day is a catalyst for more regenerative work along the Elizabeth River. As community volunteers experience the barge and the replanting process, awareness of issues along the Elizabeth River increases, along with community sponsored regeneration efforts. The volunteers arrive by boat, but as with the 10th grade earth science class, it is also possible for volunteers to arrive on land and use the arm to enter the barge.

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30</td>
<td>ERP project managers arrive, prepare barge for volunteers by letting out landing arm and opening up classroom doors. Plants and supplies should have arrived the previous night and been stored on the upper deck. Plants prepared and laid out for volunteers.</td>
</tr>
<tr>
<td>9:00</td>
<td>Upper deck: Volunteers arrive by boat and are greeted by ERP managers. ERP gives basic introduction to the wetland regeneration effort and shows the plants that have been stored and prepared for planting.</td>
</tr>
<tr>
<td>9:15</td>
<td>Classroom: Begin to discuss planting of wetland. (requires maps of what has been accomplished, and future work, including work for that day) What needs to be planted, where and how. Volunteers given room to put on waders, hip boots, prepare for work.</td>
</tr>
<tr>
<td>9:15</td>
<td>briefing of day's activities</td>
</tr>
<tr>
<td>9:45</td>
<td>moving plants along the arm</td>
</tr>
<tr>
<td>10:30</td>
<td>planting the wetland</td>
</tr>
<tr>
<td>12:30</td>
<td>lunch, rest, discussion of ERP projects</td>
</tr>
<tr>
<td>2:00</td>
<td>planting again</td>
</tr>
<tr>
<td>5:30</td>
<td>volunteers leaving, materials placed in artifact wall, classroom wall</td>
</tr>
<tr>
<td>Time</td>
<td>Activity</td>
</tr>
<tr>
<td>-------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>9:45</td>
<td>Arm: Volunteers carry wetland plants down arm and begin regeneration project just off edge of landing. Water, plants, and supplies are placed on the end of the folded arm for easy access.</td>
</tr>
<tr>
<td>10:30</td>
<td>Planting the wetland</td>
</tr>
<tr>
<td>12:30</td>
<td>Lunch/rest. Volunteers learn about artifact wall and see the project status of other wetlands in the area. They see artifacts held in wall from class visits and other ERP regeneration efforts. Discussion also of local community wetlands (Birdsong, etc.) and what kinds of work can be done at home (i.e. building migratory bird/butterfly sanctuary, oyster farming, etc.)</td>
</tr>
<tr>
<td>2:00</td>
<td>Begin afternoon planting with renewed vigor.</td>
</tr>
<tr>
<td>5:30</td>
<td>Volunteers gather on barge to prepare to leave. Project reports/artifacts from the day are placed in the artifact wall before reboarding the boat to return home. Waders and hip boots are removed and stored in classroom wall. Short discussion of what will be accomplished the next day, as well as possibilities for future community partnership.</td>
</tr>
<tr>
<td>6:00</td>
<td>ERP project managers lock up classroom, put remaining plants to bed for the night, and depart.</td>
</tr>
</tbody>
</table>
The learning barge was conceived as an integrated experience, where the goals of the Elizabeth River Project are advanced by the physical spaces dedicated to them. The indoor and outdoor rooms are stages, staging areas and laboratories used to facilitate and explain ERP’s work “one creek at a time”.

The barge mediates the vast scale differences that define the Elizabeth River. The higher deck focuses views and activities outward to the industrial and natural landscape; the lower deck supports internal activities that focus on the water, plants and habitats. This narrative for the design creates multiple areas for activities and organizes the use of the barge while still allowing for flexibility based on different sites and groups on board.
final design: MEASUREMENT DRAWINGS

Plans

Roof Plan

1. Classroom roof collects water.
2. Photovoltaic panels produce electricity.
3. Solar hot water panels heat water for radiant heating system.
LEARNING BARGE
+9 SITES OUT OF MIND

Barge Plan

1. Upper deck
2. Armature gallery
3. Artifact deck
4. Ramp
5. Classroom
6. Toilet
7. Wetland
8. Storytelling stairs
final design: MEASURED DRAWINGS

Longitudinal Sections

Section cut through armature gallery
Section cut through ramp and lower deck
final design: MEASURED DRAWINGS

Longitudinal Sections

Section cut through classroom, planted filtration basin and story telling stairs
final design: MEASURED DRAWINGS

Cross Sections

Section cut through classroom looking towards artifact wall

Section cut through armature gallery and planted filtration basin (next page)
As the barge takes up residence at a remediation site, it reaches out to connect to the land. This connection becomes the approach to the barge and a threshold between the existing land and visiting land of the barge. Along this approach the barge landscape is seen in contrast with the river. Discussions along this route explore the connection between what happens on land and the health of the river.

Arriving at the barge, visitors can gather on the lower deck, or move up from water level to expand their view of the site. Ascending, the top deck is the most open space on the barge; this deck allows an uninterrupted 270° view of each site. As the most open space, the flexibility of uses here include: map making for school groups, staging area for planting days, or gathering space for fundraising events.
Continuing to navigate the barge, visitors move through the armature. This is the exo-skeleton of the barge; it organizes all the systems on board and supports the materials that create enclosure. Running completely off the power grid, the systems of the barge are models for sustainable infrastructure. These mechanical systems are exposed to provide a counterbalance to a discussion of natural systems that are at work in the river.

Moving from the upper deck down, the outside of the artifact wall catalogs ERP’s projects and displays treasures that have marked milestones in their work.
The seating steps provide an area for focused learning, such as lectures or story telling, and casual interactions as students take lunch breaks or volunteers work. Presentations here have the native plants of the water filtration basins as a stage set.

Moving within the filtration basins, and over the water collection pool there are opportunities to work within the filtration system. Water samples taken here show how plants in a wetland work to filter contaminants in the river water. The filtered water also nourishes the on board nursery in which native plants are grown to populate the banks of the river. These plants are moved from the barge to the land at each site.

The filtration basins are used to connect the outdoor rooms of the barge with the most enclosed space on board. This classroom and laboratory maintains a connection with the site through highly
operable windows and fully openable walls. In the classroom, fold down tables and flexible storage areas allow the room to work during the day as a classroom, or in the evening for board meetings and community barge-parties.

Work done on the barge can be displayed in the artifact wall so that a piece of the barge grows and changes with time as the river restoration proceeds.

Moving back out of the classroom, visitors look back to the land and consider how what has been learned on the barge can be applied to each visitor’s daily life on the land.
### What goes in the armature?

<table>
<thead>
<tr>
<th>System</th>
<th>Equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELECTRICITY</strong>: run the barge entirely off the energy grid, minimize the power needs of the barge using passive strategies</td>
<td></td>
</tr>
<tr>
<td>Solar</td>
<td>• PV panels</td>
</tr>
<tr>
<td></td>
<td>• batteries in 2hr fire rated enclosure</td>
</tr>
<tr>
<td></td>
<td>• inverter: 14”x24”x36”</td>
</tr>
<tr>
<td></td>
<td>• electrical panel</td>
</tr>
<tr>
<td>Wind</td>
<td>• turbine</td>
</tr>
<tr>
<td></td>
<td>• pole</td>
</tr>
<tr>
<td></td>
<td>• batteries in 2hr fire rated enclosure</td>
</tr>
<tr>
<td></td>
<td>• inverter: 14”x24”x36”</td>
</tr>
<tr>
<td></td>
<td>• electrical panels</td>
</tr>
<tr>
<td><strong>WATER</strong>: collect and use rainwater that falls on the barge for handwashing, cleaning, and possibly watering plants</td>
<td></td>
</tr>
<tr>
<td>Rainwater collection</td>
<td>• metal roof surface</td>
</tr>
<tr>
<td></td>
<td>• collection tank: 400 gal, gravity fed</td>
</tr>
<tr>
<td></td>
<td>• sediment charcoal filter</td>
</tr>
<tr>
<td></td>
<td>• bathroom sink for hand washing</td>
</tr>
<tr>
<td></td>
<td>• classroom sink for experiments</td>
</tr>
<tr>
<td></td>
<td>• outside sink in wetland</td>
</tr>
<tr>
<td></td>
<td>• spigots for deck washing</td>
</tr>
<tr>
<td><strong>WASTE</strong>: manage all waste on the barge</td>
<td></td>
</tr>
<tr>
<td>Greywater treatment</td>
<td>• manual pump</td>
</tr>
<tr>
<td></td>
<td>DC pump: automatic backup</td>
</tr>
<tr>
<td></td>
<td>• holding tanks</td>
</tr>
<tr>
<td></td>
<td>• planted filtration basins</td>
</tr>
<tr>
<td>Composting toilet</td>
<td>• self-contained toilet unit</td>
</tr>
<tr>
<td></td>
<td>• wind powered fan</td>
</tr>
</tbody>
</table>
### System

**HEATING:** use heated water from solar hot water collectors to radiantly heat enclosed classroom, block wind for added comfort inside and outside, provide opportunities for passive solar heating.

| **radiant floor** | • continuous plastic piping in floor  
|                   | • 2 pumps: DC rated  
|                   | • manifold: 36"x36"  
|                   | • storage tank: 180 gal  
|                   | • solar hot water collectors: 180 sf  

| **wind block** | • movable elements to block wind  
|               | • rolling shutters for hurricane lockdown on classroom window wall  

| **passive solar** | • exposure to sun  
|                  | • select appropriate building material to reflect, absorb or retain heat  

### Equipment

| **natural ventilation** | • cross ventilation via operable windows on all walls  
|                       | • stack effect  
|                       | • windows act as wind scoops  

| **evaporative cooling** | • air is cooled as it blows across the wetland’s planted filtration basins and water collection pool  

### COOLING: design barge to promote natural ventilation and evaporative cooling.

### SAFETY: provide a safe learning environment on the Elizabeth River through careful design and incorporation of safety features.

| **42” high guardrails at perimeter** |  
| **life vests for all occupants** |  
| **fire extinguishers** |  
| **first aid kits** |  

As a platform for ecological education it is vitally important that the barge itself exemplify environmental responsibility in both its construction and operation. To this end the barge will employ heating, energy collection, water collection, and water filtration systems that utilize the abundant natural resources of the region. The systems, while minimizing the environmental impact of the barge, will be clearly visible to the students and embody educational opportunities, allowing for close observation of the various processes.

**Wetland: river filtration (1)**

- Water is manually pumped from river into collection basins
- River water flows through tiered plant basins
- During 24 hour residence in filtration basins, water is oxygenated, sediment drops out, and minute toxins are consumed by plantings
- Naturally filtered river water flows to collection pool
- Collection pool feeds nursery beds with filtered water and overflows to river
**Water:** rainwater collection / filtration (2)

- rainwater falls on sloped roof
- rainwater is directed towards large gutter running the length of the building
- rainwater is collected in basin at the end of building
- rainwater is gravity-fed across the bathroom to water filtration unit
- filtered water is gravity-fed to bathroom sink and outdoor utility sink
- greywater is deposited into planted filtration bed

**Energy:** photovoltaics / wind turbine (3)

- Photovoltaic panels collect sun energy
- 2 wind turbines rotate with wind movement and generate wind energy
- both energy sources connect to battery cabinet
- 5 12V DC batteries collect and store all energy received
- usable electricity is channel through an electrical box
- electricity is disseminated to various parts of the barge

**Heat:** solar hot water / radiant floor (4)

- water is circulated through tubes exposed to the sunlight, warming it
- warm water is pumped to storage tank equal to capacity of solar array
- warm water is pumped through manifold which connects piping from storage to piping for sub-floor circulation
- warm water is circulated through coils embedded in flooring, radiating heat
- expended water is pumped back up to the solar array of tubes in a closed loop
Gathering Spaces

Circulation
Gathering Spaces
1. Observation Deck  (19' x 32')
2. Story-telling stairs  (9' x 17')
3. Wetland and work area  (46' x 24')
4. Armature Path  (8' x 120')
5. Systems Wall  (3' x 32')
6. Classroom  (35' x 14')
7. Regeneration Deck  (11' x 32')

Circulation
1. High entry access (+/- 4' above water)
2. Armature Path
3. Ramp
4. Low entry access (+/- 2' above water)

Structure
1. Upper deck
2. Cantilever for sun-shade
3. Armature beam (supporting systems)
4. Exterior steel column
5. Interior steel column
6. Window-wall support
7. Armature beam (supporting roof)
8. Lower deck
Exterior Articulation:

- Water, heat, and energy system components are located on the exterior wall and visible along the armature path.
- System components are color coded to emphasize their interconnectedness and indicate which barge elements are served by which systems.
- Large windows are placed to reveal vertical columns of the interior space, emphasizing the armature structure.
- Smaller box windows protrude into system wall, displaying relevant artifacts, viewable from interior or exterior.
- Bathroom is accessed from exterior armature path.
Interior Articulation:

- Low cabinets run the length of the wall below datum line created by the level of the upper barge deck.
- Wall is pulled back slightly from interior columns so as to isolate and emphasize armature structure.
- Open shelves with adjustable translucent sliding panels are stacked vertically for more accessible storage and placement of found artifacts.
- Irregularly placed apertures within the shelves allow for displays visible from both interior and exterior.
- Large windows allow view to outdoor path activity, as well as observation of color coded systems conduits.
- Murphy tables fold down from the wall allowing for adaptability of space.
The Arm: a landing device

The Learning Barge arrives at site and is pushed into place by a tug operator. One person then goes to the arm/barge spud and sinks it by releasing the winch. They then walk along the length of the barge, unhooking the locking mechanisms for the arm, which could be small and simple. At this point, another person could help by getting into the ERP skiff and towing the arm out until it's about perpendicular to the barge, but it's more a convenience than a necessity to have more than one person. Once the arm is towed out, the arm's spud needs to be dropped just as the barge's spud was by released the winch. At this point, one can then throw out the folding section of the arm (by opening the trapdoor at the edge of the barge and resting it against the guardrail, then pulling the gangway out of the cavity in the deck and pushing it up and over the edge; at this point, the second piece can then be unlocked and also pushed over), or it can be left in until actually needed, or for security reasons. The whole process should take no longer than 15 minutes, and each of the pieces is designed in such a way as to make it a much easier process (there are handles in the folding gangway door to make it easier to grip, the gangway itself is counter-weighted to make it easier to move, etc.) There is no part of the process that requires more than one person, though obviously it's easier if one operates the boat and the other operates the various pieces of the arm itself.
Water Filtration Basin: native plants & prototype system

- Visitors are able to learn about and experience native salt marsh plants up close.
- The cascading system of basins teaches about the filtration process, so that the benefits of wetlands are visible and measurable.
- The windows let students view benthic layers and see how water infiltrates and flows through the root system.
- The rough surface of the scuppers aerate the water, increasing dissolved oxygen content.
- Plants in the nursery receive cleansed, oxygenated water.
- Filtered water is returned to the river.
- Plants will need to be thinned once they mature, but will require minimal maintenance.
- Basin can be drained in winter.
Artifact Wall: display & timeline

- The artifact wall displays elements that visitors to the barge have found or made during their visit to the barge.
- The display on the artifact wall creates a visual history of the barge, and links it to the people who inhabit it.
- The wall is a timeline of the barge’s progress, and allows visitors to participate in the life of the barge even after they have left it.