America’s Greenest Vessel
Sustainable Design & Operation of The Learning Barge

PARTNER LAUNCH

East Coast Steel Fabrication, located on the river’s southern branch, constructed the steel components of the barge for ERP while UVA students built and installed the classroom, wetland basins, and the custom designed “green” systems. On September 14, 2009, The Elizabeth River Project christened The LEARNING BARGE.

EDUCATION

Over 10,000 students have participated in LEARNING BARGE field trips! The barge is a one-of-a-kind platform for hands-on, place-based exploration and discovery lessons about river science, environmental stewardship and renewable resources. About sixty students rotate through six learning stations during a 1.5 hour program. Initial program was developed by local teachers and targets Virginia Standards of Learning in science, math, language arts, history and art. 21st century skills and cutting edge topics are included.

FLOATING WETLAND

This award-winning vessel owned and operated by The Elizabeth River Project is the world’s first floating wetland classroom. The 120’x 32’ steel deck barge’s mission is to teach how to help make the Elizabeth River swimmable and fishable by 2020.

AWARD-WINNING DESIGN

In 2006, University of Virginia School of Architecture’s Phoebe Crisman had the idea of making a mobile education center for citizens to get a closer look at the river’s restoration sites. She envisioned offering access to an urban river with a sustainable vessel that included green systems that harness energy from the wind, sun and reuse-rain. The unique design would also include a living wetland with native plants and observation pool, an enclosed classroom, composting waterless toilets and habitat cubes for a closer look at river life. The Elizabeth River Project rallied for the public to gain access to their home river where little is available and developed an award-winning education program to build a community of river stewards.
**LIVE WETLANDS**

**Concrete basins:** The custom-made basins contain salt and fresh water plants that assist in filtering the river and rain water. They were cast in place with exterior plywood formwork. Basins are varying heights encouraging water to flow from basin to basin, into the observation pool and into the river if one opens the drain.

**Wetland pool:** The 16’x16’ observation pool captures the river and rain water filtered by the plants. The shallow six-inch pool is the first place water from the freshwater and saltwater basins meet. From there, the water settles and creates a concentrated ecosystem. Live oysters, algae, worms and more provide exploration activities for students and teachers.

**Cast iron hand pumps:** The two black cast iron hand pumps are used to pump river water into each of the basins, irrigating the plants and filling the pool. Water is hand-pumped while creating suction in the pipe opened to the Elizabeth River.

**Plants:** Basins house salt and fresh water plants native to the river and serve as a resourceful learning station for plant identification, habitat, life cycle and photosynthesis. One of the students’ favorite activities is running their fingers up the blades of grass noting the gritty salt crystals from the plant’s river water uptake.

**Live oysters:** The salinity of the water measures above ten parts per thousand creating a perfect habitat for oysters. Worms, small crabs and oyster toads also frequent the pool. Hundreds of oyster shell also can be found in the pool demonstrating their value as habitat for over 350 species as an oyster reef.
WIND & SUN

The barge is off-the-grid and powered solely by wind and sun.

**Wind energy:** Two AirBreeze 200 watt wind turbines aboard the barge convert wind energy into electricity. Wind speed is compared to anemometers and nature. The combination of wind and solar provides the potential of harnessing 2,000 watts or 2 kilowatts of energy. The marine-grade wind turbines have a 5 mph start speed so even small breezes can generate energy.

**Solar power:** Eight 200 watt photovoltaic panels produce 1,600 watts of energy for the barge by converting the sun’s energy into electricity. The panels are most efficient when oriented perpendicular to the sun. Students compare the temperature of dark surfaces with light surfaces gaining an understanding of absorption of heat. A digital-laser thermometer is used to measure various surfaces including tops of students’ heads!

**Evacuated tubes:** Used for solar heat collection, glass tubes are sealed and contain a thin copper tube filled with a very small amount of glycol and water. When heated by the sun’s energy, the liquid in the copper tube flash boils. The hot liquid is then pumped through insulated copper tubing to the hull of the barge, through the thermal mass of two hot water tanks. Hot water heat can then be utilized in the classroom.

**Batteries:** Four sealed East Penn AGM solar batteries are stored in individual containers within the white, watertight dock box. The energy is collected from the photovoltaic panels and wind turbines. These batteries supply constant and steady current over long periods of time with constant drain/charge cycles while retaining high-energy efficiency. The battery capacity can provide power for 3 days without sun or wind.
RAIN WATER

Rainwater Collection: The barge collects 1,200 gallons of rainwater from the roof and filters it through a sand filtration system. Through the use of a hand pump, water goes through a second flush to use for hand washing. Visitors pump rainwater into a five-gallon translucent tank that can be viewed in bathrooms to observe how much water is consumed during hand washing. Sink water runs into the floor, into freshwater plant wetland basin and into the observation pool.

RIVER LIFE

Habitat Cubes: A dozen habitat cubes hang off the side of the barge for students to catch and release river life. Life viewed includes eel, crabs, fish, oysters, worms, tunicates, grass shrimp and snails. Vertebrates and invertebrates illustrate a living river.
UNIQUE FEATURES

Composting Toilets: The two restrooms include waterless composting toilets. Below each toilet in the hull is an aeration fan powered by the energy harnessed from the wind and sun and a collection unit that produces beautiful compost.

Concrete Sinks: The concrete sinks were custom designed and fabricated by UVA students. They were cast with smooth forms and a charcoal-colored pigment was added to the concrete mixture before it was cast to make the dark color. One sink is a trapezoidal shape while the other represents a topography model of the Elizabeth River.

Wetland Bridge: The bright yellow grating used for the bridge over the wetlands is made of reclaimed materials found in a UVA facilities storage unit. The reclaimed DURAGRIDGE grating is flame retardant, corrosion resistant and provides a non-skid surface with low thermal conductivity. The fiberglass grating is virtually maintenance-free, lightweight, and will outlast steel in even a submerged or saline environment.

Artifact Wall: Twinwall Thermoclear GE Lexan often used for bus stops was used to create a wall to display found objects and artifacts in the classroom. The lightweight ribbed fabric diffuses light and blocks harmful UV rays. Cables span the wall for hanging charts, maps and artwork.

Woods: Ipe’, a fire resistant Brazilian hardwood is used on the railings and stairs for it naturally resists decay, insects and mold and isn’t treated with toxic chemicals. Naturally resistant to rot, white oak was used on exterior walls. The wood was sustainably harvested from dead or dying trees and is treated with eco-friendly natural oil. Laminated Birch plywood was used on the custom-designed cabinetry for its excellent strength and resistance to warping in a marine environment. Borite-treated lumber was also used and was treated with mineral salts instead of harsh chemicals.
**THE SUNNY BARGE**

**Barge Color Scheme:** The bright yellow and orange palette of The LEARNING BARGE models the colors viewed up and down the river at local industries. During the hot summers, the light gray deck and roof help keep the vessel cooler while golden hues create a cheerful atmosphere.

**Keeping Cool:** Umbrellas, shade cloths, overhangs and solar panels are utilized for shade. The Polysack fabric used over the storytelling stairs and the classroom blocks 95% harmful UV rays and is easily retractable using a simple cable system. Sail cloths are also used at the stern demonstrating possibilities of repurposing materials.

**Natural Air:** Operable windows and a garage style door utilize natural ventilation in the classroom maximizing airflow for cooling. During the winter large windows keep the room warm utilizing direct solar radiation. Laminated glass was chosen to avoid dangerous shattering if broken and creating a web affect.

**Storage:** The storytelling stairs provide space for tools while benches on the starboard house 30,000 lbs of scrap iron trimming out the barge so she is level. The port side is heavier. Overall weight of the barge DWT (Dead Weight Tonnage) is approximately 175 Tons.

**Hydronic heaters:** Beneath the benches is a Heatercraft 900h hydronic hot water system. Water is heated during the summer with the assistance of the thermal evacuated tubes outside the classroom. Through a closed-loop glycol water mixture, water stored in two 28'x 2' tanks in the hull under the wetlands is heated. If needed, heaters can be switched in order to draw the hot water to heat the classroom.
RIVER ART

**Barge:** During the design phase UVA won over a dozen awards including the Education Award from the American Institute of Architects. The barge’s artistic design mirrors the lines of the river and is breathtaking on starry nights. In addition, the starboard is lower than port offering easy entry for kayaks and canoes and giving the illusion of walking on water. Students create art with river and rain water, recycled materials and items from nature.

**Laser:** The Elizabeth River’s little benthic mummichog fish were engraved with The University of Virginia’s laser machine into durable material resistant to high heat, cold, water and flame and used to create unique light fixtures in the enclosed classroom. Etchings are sepia in color due to UV protectant.

**Cushions:** UVA art students created seat cushions made from recycled fabrics. These are used on benches and storytelling stairs.
GETTING AROUND

Cleats & Bits: Four yellow steel cleats provide a secure point to tie line to a dock. The barge is not self-propelled, therefore the bright orange bits on the four corners are used for tugs to tie to in order to push or pull the vessel to its next docking site.

Tugs: Barge is moved by the generous tug companies; Norfolk Tug, Ireland Marine, Robbins, Crofton that donate assistance.

Spuds: Barge is equipped with two spuds for anchoring in shallow areas less than 18 ft. Dropped by a manual hand crank they assist from drifting and relieving docks from stress as tides change or foul weather.

Fenders: Three large fenders are used to protect vessel from rubbing.

Gangways: Two gangways can be attached to either side. Manual pulley system lowers and raises each 300 pound gangway.
AWARDS

April 2011 ~ Elizabeth River Project won the national SeaWorld Busch Gardens Environmental Excellence Award.

May 2009 ~ UVA won University of Virginia’s Sustainability Project Competition.

Sept. 2008 ~ Professor Phoebe Crisman received the Design and Research Award from the Virginia Society American Institute for Architects.

March 2008 ~ UVA won education award, American Institute of Architects.

April 2007 ~ Learning Barge was one of six winners of the EPA P3 competition.

Learning Barge won $1,000 from the Institute for Sustainability Youth Council on Sustainable Science and Technology.

Go Green Honor Award from the James River Green Building Council.

March 2007 ~ Learning Barge won National Council of Architectural Registration Boards Prize.

July 2006 ~ American Society of Landscape Architects National Student Collaborative Design Award.
KEEPING THE BARGE AFLOAT

Once the barge construction was complete we received an overwhelming response of generosity from maritime river industries who “adopted” the Learning Barge to help with vessel maintenance and operations. These are true river heroes that care about the Elizabeth River, student education and the barge. Members represent local businesses, Virginia Ship Repair Association, ship building/repair industries and tug boat companies.

Maritime Maintenance Partners
Auxiliary Systems, Inc.
BAE Systems Norfolk Ship Repair
Beach Marine Services
Colonna’s Shipyard
Crofton Diving & Construction Services, Inc.
Earl Energy, Inc.
Earl Industries/UCC
East Coast Steel Fabrication, Inc.
Ireland Marine, Inc.
Kevin Cosgrove, Esq.
Hunton and Williams, LLP
Lowe’s
Main Industries, Inc.
Marine Chemist Atlantic, Inc.
Matherne Marine Design, Inc.

Metro Machine Corporation
MHI Ship Repair Services
Michael Petrus and Phoebe Crisman
Norfolk Tug Co Inc.
Ocean Marine, LLC
PPG Protective Marine Coatings
Robbins Maritime, Inc.
Solar Panel’s Plus
Solar Services, Inc.
Virginia Ship Repair Association
Walker and Laberge
Zentz, Bob

The Learning Barge is made possible by: Dominion Virginia Power and Lowe’s Charitable and Educational Foundation, and other generous donors like you! Join The Elizabeth River Project today.