

Rendering by Sasaki and the Sasaki Foundation

BUILD A FLOATING WETLAND MODEL

A STEAM ACTIVITY KIT EXPLORING THE CHARLES RIVER FLOATING WETLAND



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KIT CONTENTS

- Clear tray
- Baker's yeast
- Chopsticks
- Daphnia eggs
- Grow mat
- Net
- Paintbrush
- Paper towels
- Placemat / Charles map
- Plate
- Spirulina powder
- Spray bottle
- Spring water
- Thermometer
- Toothpicks
- Wheatgrass seeds

THE CHARLES RIVER

MIT Sea Grant worked with the Charles River Alliance of Boaters to develop this bathymetric (depth) map.

80 MILES LONG

8,000 ACRES OF WETLANDS

Despite being the most densely populated **watershed** in Massachusetts, the Charles River is home to many thriving **ecosystems** preserved by the government and advocates like the Charles River Conservancy.

The Charles River used to be a free-flowing tidal **estuary**. A complex habitat of **wetlands** and **mud-flats** supported a diversity of species including shellfish, birds, and **anadromous fish**.

Today, dams maintain a near-constant water level. **Hardscape** covers much of the river, and **nutrient pollution** carried by rainwater from the city streets acts as fertilizer fueling the growth of **algae**.

CHECK THE GLOSSARY FOR ALL ORANGE WORDS!



THE FLOATING WETLAND

700 SQUARE FEET

INSTALLED SUMMER 2020

CURRENT CHALLENGES IN THE CHARLES RIVER

The Charles River Conservancy installed the Floating Wetland on the Cambridge side of the river between the Museum of Science and the Longfellow Bridge.

- Lack of vegetation
- Loss of habitat
- Broken food chain
- Nutrient pollution
- Algal blooms
- Water quality

PROJECT GOALS IN THE CHARLES RIVER

- Create a visually impactful wetland installation that will enliven the river.
- Research the impact of improved habitat on zooplankton species distribution and body size.
- Engage and educate the public about the relationship between river ecology, pollution, and water quality.

The Charles River Floating Wetland reintroduces native plants to increase habitat diversity and support the tiny animals, **zooplankton**, that graze on fast-growing **algae**.

Algal blooms in the Charles River can be understood as a symptom of a broken food chain. The Floating Wetland is an **ecological intervention** that aims to restore balance.

Northeastern University scientists working on this project hypothesize that the roots of the Floating Wetland will provide a protective habitat for zooplankton to grow, eat more **cyanobacteria**, and reduce algal blooms.



CHARLES RIVER ANIMALS

Photo: Aaron John Bourque

NATIVE PLANT SPECIES

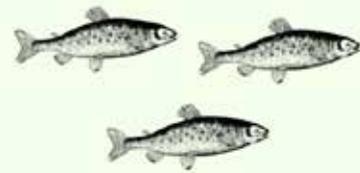
A THRIVING ECOSYSTEM

20+ SPECIES OF FISH

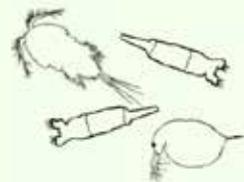
19 NATIVE PLANT SPECIES ON THE FLOATING WETLAND



Each spring, millions of river herring migrate into the coastal waters of Massachusetts to begin their annual trek up dozens of streams and rivers to **spawn**.



Fish

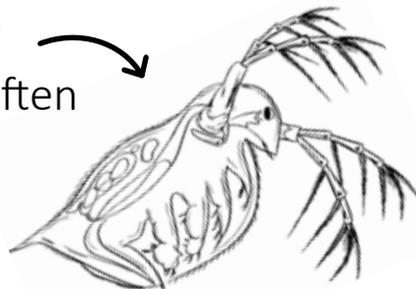


Zooplankton



Cyanobacteria

Daphnia are one type of **zooplankton**. They are often called water fleas due to their jerky swimming movements.



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These tiny creatures eat **cyanobacteria**, algae that grows in the Charles River.



Planting plan used for the Charles River Floating Wetland

- Sweet Flag
- Lurid Sedge
- Tussock Sedge
- Canada Rush
- Soft Rush
- Hard-stem Bulrush
- Soft-stem Bulrush
- Seaside Goldenrod
- Swamp Milkweed
- Boneset
- Swamp Rose Mallow

- Swamp Rose
- Arrow Arum
- Spotted Joe Pye Weed
- Great Blue Lobelia
- Monkey Flower
- Common Elderberry
- Buttonbush
- Blue Flag Iris



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[WEEK 1] SET UP THE TRAY

HATCH THE DAPHNIA



In the dark, try shining a flashlight on the tray! Daphnia are attracted to light.

WHAT YOU'LL NEED:



- 1 Clean your tray with soap and water. Rinse well and dry. Stick the adhesive thermometer to the outside of the tray, parallel with the length of the tank (see above).
- 2 Find a sunny spot on a table or a flat, stable surface by a window to set up your mini **ecosystem**. Your Daphnia eggs and wheatgrass seeds will need plenty of sun.
- 3 Place the tray on the placemat. Fill almost to the top with spring water (50 oz/1.5L) leaving 1/2 inch between the water's surface and the top of the tray. If possible, let the water rest in the tray 24 hours before hatching.

WHAT YOU'LL NEED:



- 1 Check the water temperature (it should be at least 65°F for hatching). Morning or early afternoon is best for sun! Carefully pour the **Daphnia** eggs into the water in the tray. Slowly stir with a chopstick. It's normal for eggs to float.
- 2 Daphnia can take several days to hatch. **Every day**, look closely to see if you can spot any movement. They might look like swimming fleas!
- 3 If water evaporates from the tray, slowly pour more spring water in to maintain the original water level. This will also help keep the water oxygenated for the Daphnia.

**SEE PG. 8 FOR MORE
HELP WITH HATCHING!**

[WEEK 1] PREPARE FOOD



MY DAPHNIA AREN'T HATCHING

Daphnia usually hatch within **1-2 days**, but it can take up to 10 days, and sometimes they never hatch at all! Here is a **checklist** to review if your Daphnia are not hatching:

- The tray was washed and rinsed well
- The spring water in the tray is at least 65°F
- The tray is in a sunny spot
- The tray does not contain any nutrients yet
- The eggs were added to the tray in the morning or early afternoon to receive sun

Why can't we use municipal tap water? Daphnia are extremely sensitive to metal contaminants that they are used to monitor the water quality of rivers and lakes. Daphnia are also sensitive to temperature, pH, and other water quality parameters, and will not hatch if there is an excess of algae or nutrients present.

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WHAT YOU'LL NEED:

Nutrients



Chopstick



- 1 Now, prepare the Daphnia food! Add a small pinch of **spirulina** powder to the container with dry yeast. Fill the container with spring water, close, shake, and refrigerate.
- 2 Daphnia are filter feeders with voracious appetites. Once you can see that many Daphnia have hatched, use a chopstick or paintbrush to add one drop of nutrients to the tray **every day**. Do not add more nutrients if the water is still cloudy or green.
- 3 Remove any floating egg cases from the tray using the net included in your kit.

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Daphnia are transparent, so those feeding on algae will look green or yellow (vs. pink if feeding on bacteria).

[WEEK 2] SOAK THE SEEDS

[LATER] MAT THE SEEDS

WHAT YOU'LL NEED:



WHAT YOU'LL NEED:



- 1 Fill the container of wheatgrass seeds with water. Rinse and refill a couple of times, and then put the lid on.
- 2 Let the seeds soak in the water for about **8 hours**. This will soften their seed coat and help them to sprout!
- 3 Create a reminder to place the seeds on the grow mat later today. Remember to also keep feeding your Daphnia one drop of nutrients each day.

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- 1 **After 8 hours**, place the grow mat on the plate and dump the seeds and water from the container onto the mat. Use your fingers to spread the seeds out.
- 2 Cover the mat and seeds with a folded paper towel and use the spray bottle to wet the towel completely. This cover signals the seeds to sprout.
- 3 **Every day**, spray the paper towel to keep it wet, and check the seeds. After **2-3 days**, once you see sprouts, uncover them and spray with water **every day**.

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[WEEK 3] BUILD THE MODEL

ADD PLANTS AND ANIMALS

WHAT YOU'LL NEED:

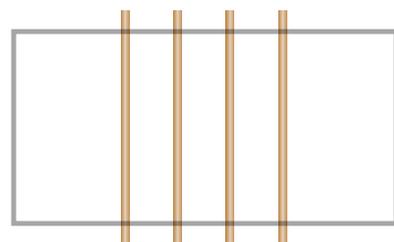


Chopsticks



1

Place four chopsticks across the top of the tray parallel to each other as shown here:



2

Using both hands, pick up the grow mat from the plate and lay it gently on top of the chopsticks. Be careful, especially if your wheatgrass has already begun to grow roots on the underside of the mat.

- * Direct sunlight should prevent any mold growth.
- * Baking soda helps if you do see mold on your mat.
- * The grow mats are biodegradable + compostable.

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WHAT YOU'LL NEED:

Toothpicks



Color these species, cut them out, and add them to your wetland!

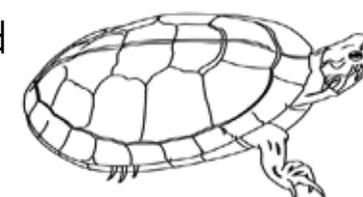
Great Blue Heron



Blue Flag Iris



Painted Turtle



Beaver



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OBSERVATIONS LOG



Week 1 Observations:

Week 2 Observations:

Blank for the
Charles River animals
on the back.

Week 3 Observations:

Week 4 Observations:

ENGINEERING & EXPERIMENTS

ENGINEERING CHALLENGE

The real Charles River Floating Wetland floats on the surface of the water, anchored to the bottom of the river. The Charles River Conservancy worked with marine engineers and ecological designers to plan, build, install, and anchor the wetland.

Can you engineer another way to suspend your floating wetland? Some materials you can try include:

Aluminum foil

Corks

Paper clips

Ping pong balls

Popsicle sticks

Straws

GROWING MULTIPLE MODELS?

Growing multiple models as part of a class? Consider feeding each population of Daphnia varying amounts of nutrients. How much can they filter? If a tray does not have any Daphnia, keep adding the nutrients and compare how the algae builds up.

ENDING THE EXPERIMENT

Time to say farewell to the Daphnia and mini floating wetland? Here are a few ways to end your experiment:

- **Add salt.** Daphnia are best adapted for freshwater.
- **Cause a simulated harmful algal bloom (HAB)** by adding the remaining spirulina and yeast nutrient solution.
- **Simulate pollution** by adding detergent or dish soap to the tray. Detergents bind to the oxygen Daphnia need to thrive, and contain phosphates that can lead to HABs.
- **Wait for a population crash** from a natural accumulation of waste from the Daphnia or by reaching the end of their life cycle, which can be over 30 days.



However you decide to end your experiment, the contents of the tray should be disposed of the same way: Ask an adult to help add **a small amount of bleach to the tray** and pour the contents down the drain with plenty of water.

CONNECT WITH THE CHARLES!

ART WITH ALGAE

EXPLORE THE CHARLES!

Have a canoe or kayak adventure and explore parks along the Charles River: (thecharles.org/about/visit/)



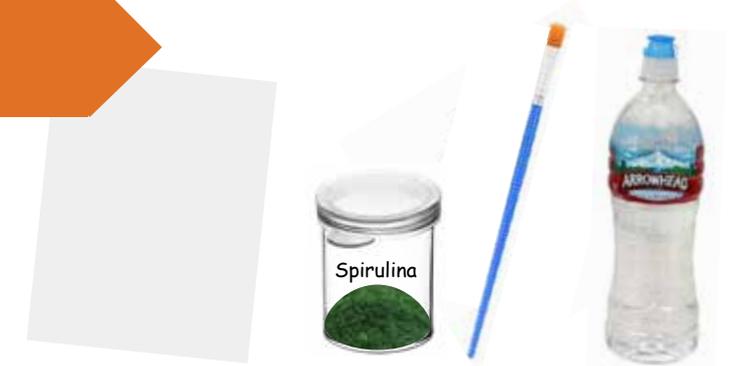
Christian A. Herter Park
North Point Park

Magazine Beach
Riverbend Park
Pathways

SHARE YOUR PHOTOS!

Share photos of your floating wetland model, **Art with Algae** activity and your Charles River adventures!

WHAT YOU'LL NEED:



Use the spirulina powder like watercolor to paint a floating wetland. Add water to the container of spirulina and mix with the paint brush. This is your natural green paint! If you want a blue color, let the mixture rest in the refrigerator for 1-2 days. The algae will turn blue due to a pigment-protein **phycocyanin**.

Tip: Paint the sky and water first with the blue mixture. Shake it to turn the “paint” green again. Now, paint your wetland!

SOCIAL MEDIA:

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* Spirulina powder is non-toxic, a non-living form of algae.



GLOSSARY OF TERMS

Algae: organisms like seaweed that live in water and make their food by using sunlight to turn carbon dioxide and water into food through photosynthesis

Algal bloom: an overgrowth of algae or cyanobacteria that often results in scum on the surface of water, which can be harmful to other organisms

Anadromous fish: a type of fish, such as river herring, that migrates from saltwater to freshwater to release eggs

Cyanobacteria: microscopic organisms (blue-green algae), which can create algal blooms on the water's surface

Daphnia: small swimming zooplankton known as water fleas that live in aquatic environments and eat mostly algae

Ecological intervention: habitat restoration and other environmental solutions to help improve ecosystem health

Ecology: a branch of science focusing on the relationships between living things and their environment

Ecosystem: a community of living organisms interacting with one another and their environment

Estuary: the mouth of a river where fresh and saltwater mix, home to unique plant and animal communities and wetlands



Floating Wetland: a human-made island of plants; the Charles River Floating Wetland aims to restore zooplankton habitat and help improve river health

Hardscape: man-made features in landscape architecture like paths or the concrete walls lining the Charles River

Mud-flats: an area of land that lies just below the surface of water or repeatedly covered by the tide

Nutrient pollution: too many nutrients running from urban areas into a body of water, causing an overgrowth of algae

Organism: a living thing - a person, plant, or animal

Spawn: the process of aquatic animals releasing eggs in water; river herring migrate to the Charles River to spawn

Spirulina: a type of blue-green algae (cyanobacteria)

Watershed: an area that drains streams and rainfall to a common body of water

Wetlands: areas and ecosystems flooded by water, such as marshes or swamps, supporting aquatic and land species

Zooplankton: tiny creatures living in oceans, seas, and bodies of fresh water, which are an important part of the food chain

Learn more about the Charles River Conservancy's
Floating Wetland project and MIT Sea Grant:



thecharles.org/floating-wetlands/
[@CharlesRiverCRC](#)



seagrants.mit.edu/floating-wetland-resources/
[@MITSeaGrant](#)

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