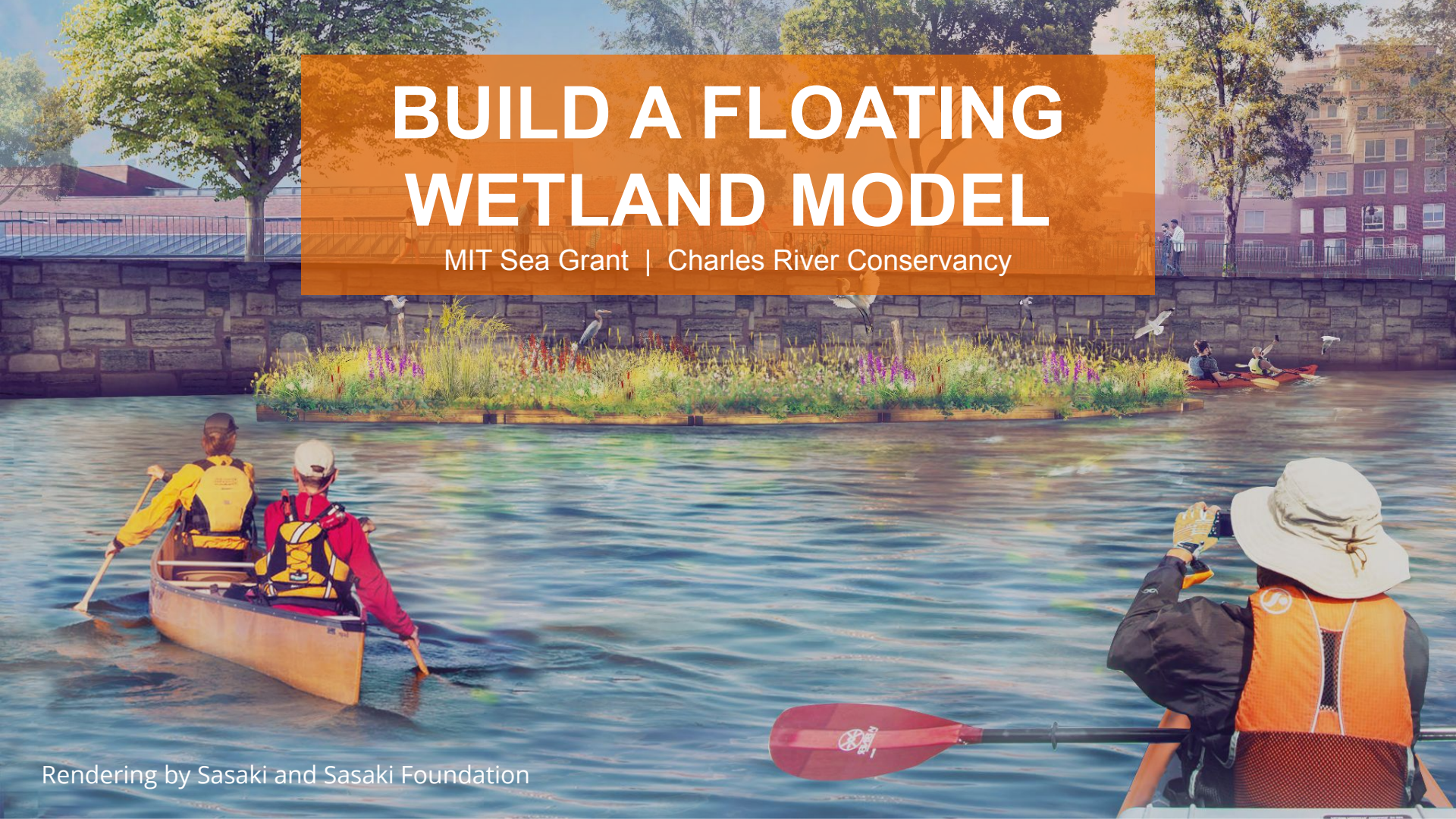


BUILD A FLOATING WETLAND MODEL

MIT Sea Grant | Charles River Conservancy

Rendering by Sasaki and Sasaki Foundation

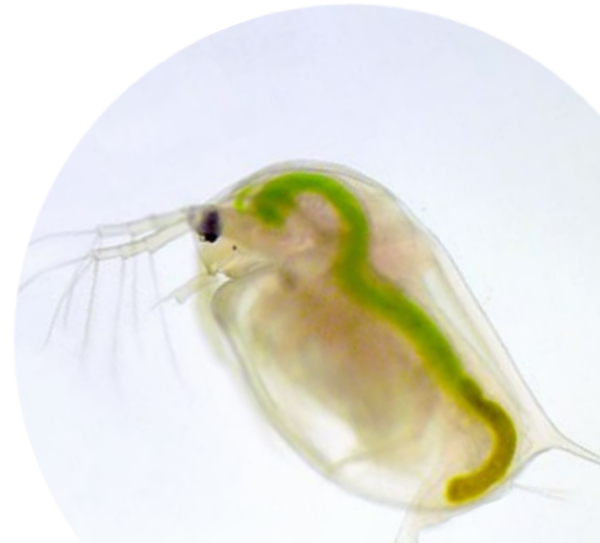


Over the next 4 weeks...

We'll learn about the **Charles River Floating Wetland** and build our own mini living floating wetland model! Your **STEAM kit** has everything you'll need to grow your wetland and hatch tiny creatures called daphnia. **Let's get started!**

Day 1 - Today, we're going to:

1. Get to know each other
2. Learn about the Charles River & Floating Wetland
3. Set up our trays, release daphnia eggs, and prepare nutrients for the daphnia



Icebreakers

Let's introduce ourselves!

What have you done outside this spring? What did you see?

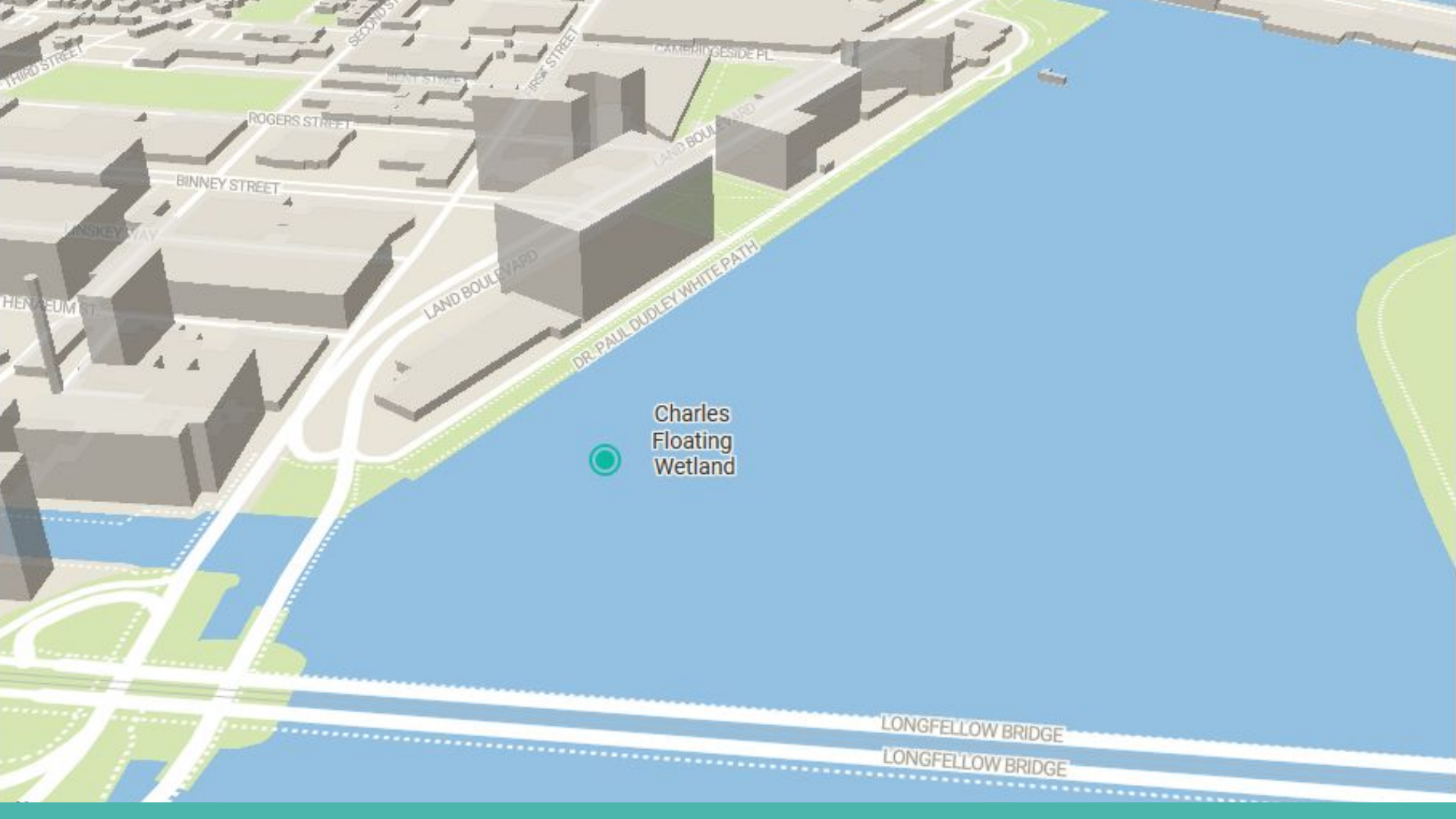
The Charles River

Have you ever been to the Charles River?

What are some **animals** you might see there?

What about **activities**, like kayaking?





Charles
Floating
Wetland



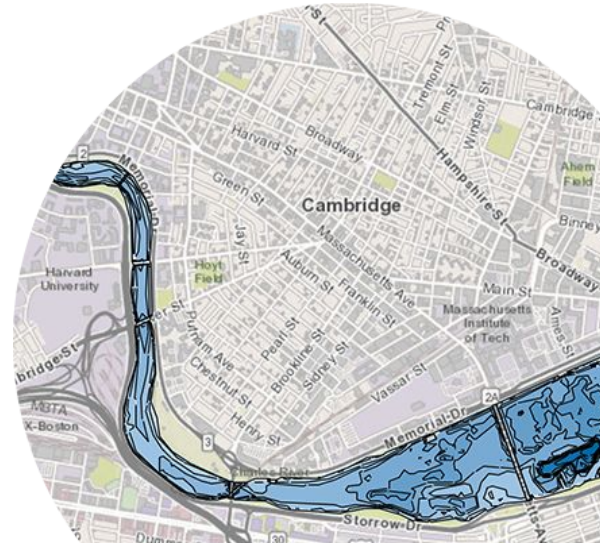
LONGFELLOW BRIDGE
LONGFELLOW BRIDGE

Charles River Fun Facts

How many miles long do you think the Charles River is?

The Native American name for the Charles River is **Quinobequin**, which means *meandering*.

The Charles River travels through **23 cities and towns** before reaching the **Atlantic Ocean** at **Boston Harbor!**



Charles River Challenges

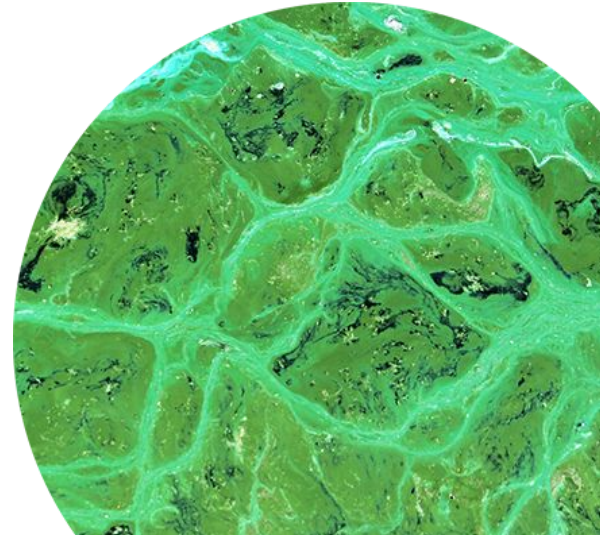
EPA | Environmental Protection Agency

mywaterway.epa.gov

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



Despite these challenges, the Charles is still one of the **cleanest urban rivers** in the US, thanks to the work of government and advocates!





CHARLES RIVER
conservancy

An Introduction
to the
**Charles River
Floating Wetland**

Credit: Sasaki and the Sasaki Foundation

The Charles River Floating Wetland

Let's learn more about the Floating Wetland with...

Vanessa Nason

Associate Director
Charles River Conservancy



Let's get set up!



1. Find a sunny spot on a table or a flat, stable surface.
2. Place the clear tray on top of the waterproof placemat poster of the Charles River Floating Wetland.
3. Carefully fill the tray almost to the top with 2 spring water bottles.

Release the eggs and prepare the food!



1. Check the water temperature in the tray (it should be at least 65°F).
2. Carefully pour the daphnia eggs into the water in the tray.
3. Fill the small nutrients container with spring water, close the lid, shake, and refrigerate.

This week...

Check your tray!

Daphnia can take several days to hatch.

Every day, look closely to see if you can spot any movement.
They will look like swimming fleas!

Start feeding!

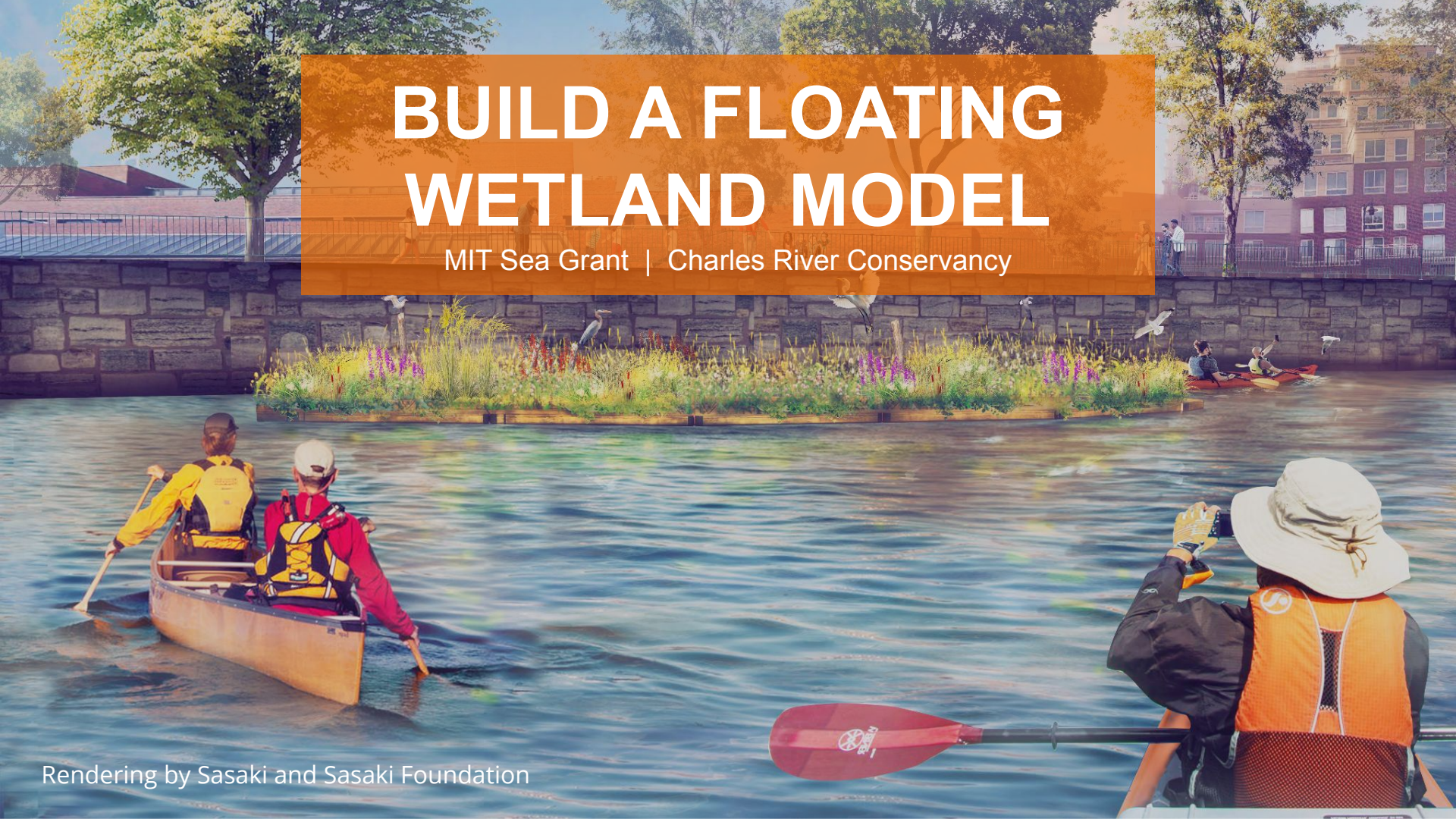
The day after you spot swimming daphnia, you can start feeding.
Every day, use a straw to add one drop of nutrients.



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Last week...

We learned about the **Charles River!**

- **80 miles long**
- **Runs through 23 cities and towns**

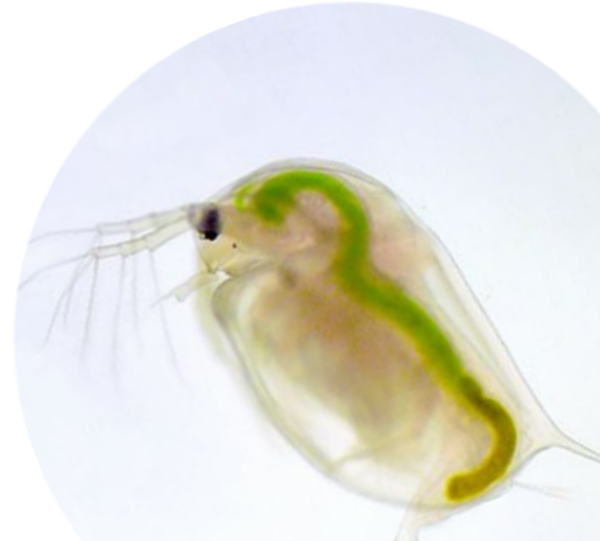
We explored the **Charles River Floating Wetland** with Miss Vanessa!

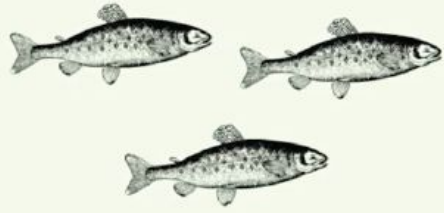
We looked at **current challenges:**

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

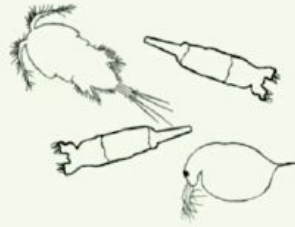
Day 2 - Today, we're going to:

1. Check in on our daphnia trays
2. Watch the Making of the Charles River Floating Wetland
3. Learn about benefits and functions of wetlands
4. Soak seeds and prepare your grow mats

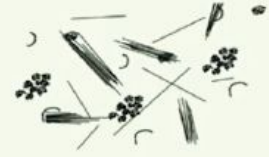




Fish

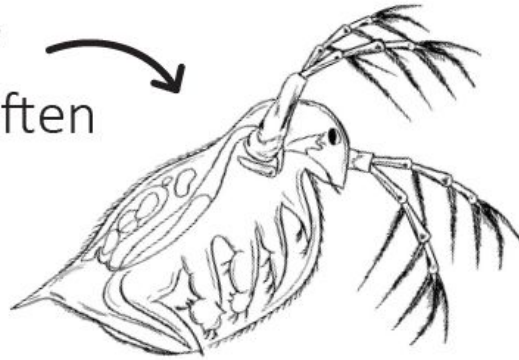


Zooplankton



Cyanobacteria

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



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



Play (k)

▶ ⏪ 🔊 🔍 2:22 / 6:16

⏸ ⚙️ HD 🗨️ 🏠

Wetland Benefits

Wetlands provide beneficial services for people and for fish and wildlife. Some of these functions include:

- **Cleaning and filtering the water, improving water quality**
- **Providing habitats and protection for fish and wildlife**
- **Storing floodwaters like a sponge**

Fun Fact: One acre of wetland (smaller than a football field) can store **1.5 million gallons** of floodwater!

Wetlands and Water Filtration

Nutrient pollution from fertilizer, city sewage, etc. often make their way into the Charles River through storm drains.

Roots and soil from plants and wetlands absorb these nutrients from the water through a natural **filtering process**.

Wetlands are so good at this that **environmental managers** build artificial wetlands to filter and treat stormwater and wastewater.



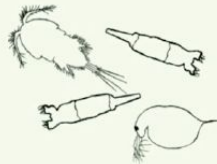
Wetlands as Habitats

Often called **“nurseries of life,”** wetlands are comparable to **tropical rain forests** and **coral reefs** in their productivity and diversity of species they support, from plants to fish and other wildlife.

The Floating Wetland also provides protection for daphnia and other zooplankton from fish:



Fish



Zooplankton



Cyanobacteria





Soak the seeds!

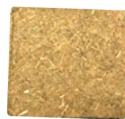
- 1 Fill the container of wheatgrass seeds with water and put the lid on.
- 2 Let the seeds soak in the water for about **8 hours**. This will soften their seed coat and help them to sprout!
- 3 Create a reminder for yourself to place the seeds on the grow mat later tonight (see next page). Set an alarm, write a note, or ask someone to remind you!





- 1** **After 8 hours** of soaking the seeds, place the grow mat on the bamboo plate and dump the seeds and water 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.
- 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**.

Instructions for the Week



Check your tray and feed your daphnia!

Your daphnia may still be hatching. Make sure to feed your daphnia every day, using the straw to add one drop of nutrients.

Spray your seeds!

Spray the paper towel every day with water, and observe your seeds. When you start to see those green sprouts appearing on the seeds, uncover the seeds and spray the seeds – without the paper towel covering them – every day.

Last week...

We watched a video on how the **Charles River Floating Wetland was built!**

We learned about this important food chain in the Charles River:

Fish >> Zooplankton (daphnia) >> Cyanobacteria (algae)

We explored the benefits and **functions of wetlands:**

- **Cleaning and filtering water**
- **Providing habitats for fish and wildlife**
- **Storing floodwaters like a sponge**

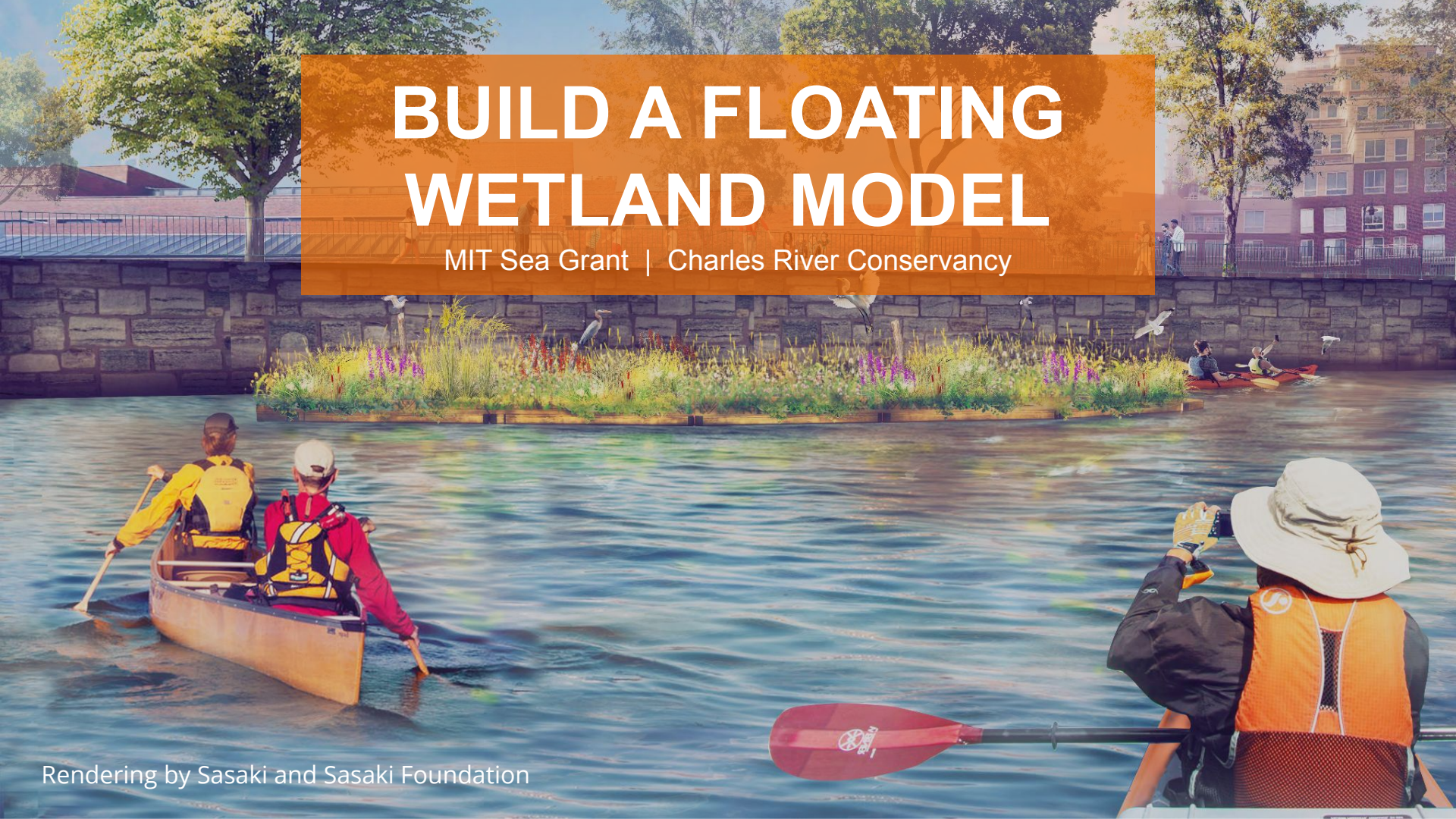
And we **soaked our seeds** and **prepared the grow mats!**



BUILD A FLOATING WETLAND MODEL

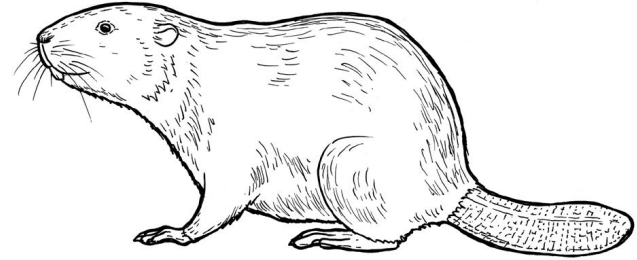
MIT Sea Grant | Charles River Conservancy

Rendering by Sasaki and Sasaki Foundation



Day 3 - Today, we're going to:

1. Check in on our daphnia and wheatgrass seeds
2. Watch a video and learn about daphnia
3. Color and cut out species to add to your wetland
4. Add our grow mats to the tray model



Daphnia

200x



100 μm



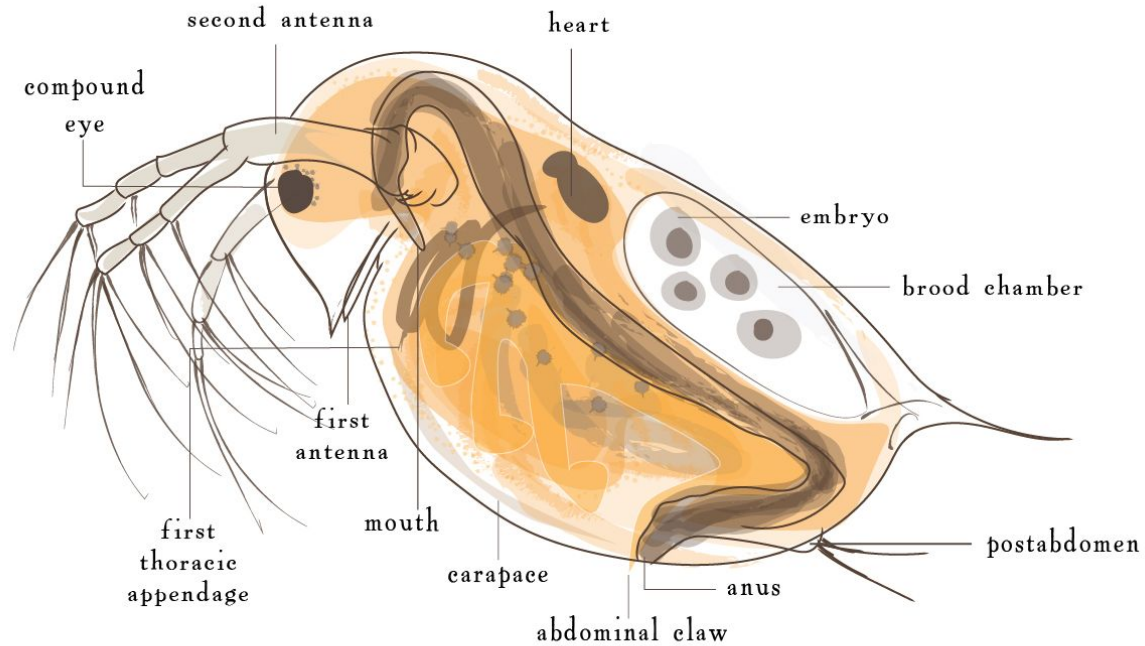
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Daphnia 101

1. **10 sets of appendages** (arms, antennae) distributed around their body:
 - **2 sets of antennae**, one for sensing, the other for swimming
 - **5-6 limbs** that form a feeding and respiratory apparatus
 - **1 pair of claws**, which they use as a filtering tool or for defense
2. Daphnia have **one large eye** and a small photosensitive organ called the **naupliar eye**, which help orient them to light and dark while they swim.
3. There are **over 100 species** of Daphnia!

(Optional anatomy slide)



Daphnia 101

Daphnia use several strategies to avoid predators:

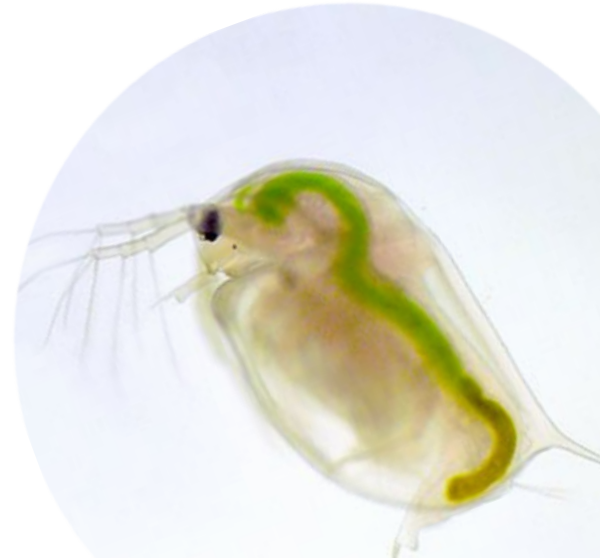
1. **Hiding** in vegetation and roots
2. **Swimming away** using their appendages
3. **Diel vertical migration:**
During the day: they go to deep, dark water where predators can't see well.
At night: when predators can't see them, they move up to the surface to eat.

Daphnia 101

Daphnia are filter feeders!

They use **phylopods (flat legs)** to move water from the front of their body towards the back to filter and collect algae. Because they are **transparent**, we can see what they've been eating:

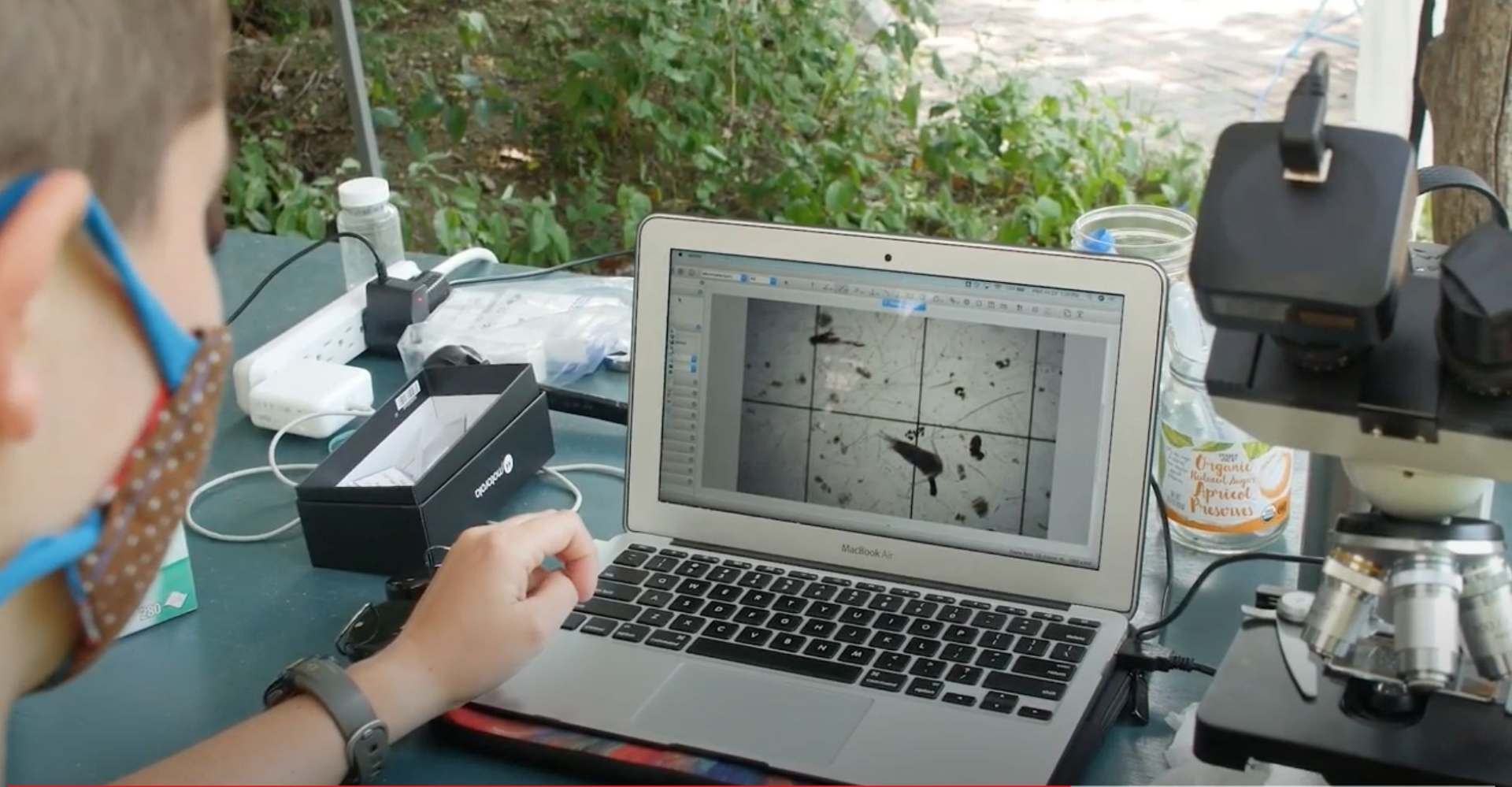
- If they ate **algae**, they'll look **green**.
- If they ate **bacteria**, they might look **pink**.



The Big Question for the Charles River Floating Wetland:

Can the Charles River Floating Wetland
increase the size and number of zooplankton
and reduce algae in the river?





Let's color and cut out the animals and plants!

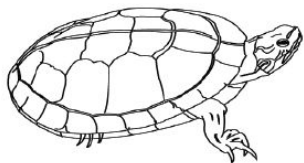
Great Blue Heron



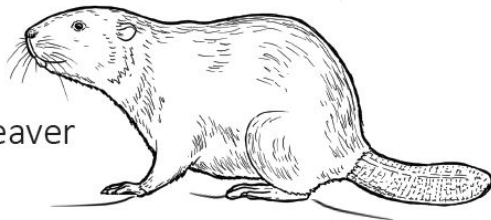
Blue Flag Iris



Painted Turtle



Beaver





What do they eat?

Guess the animal!



1. I eat aquatic plants - water lilies are my favorite! I also eat twigs, leaves, roots, and the bark of woody plants.
2. I mostly eat fish, but also frogs, salamanders, turtles, snakes, insects, rodents, and even birds.
3. I eat aquatic plants and algae, and also enjoy tiny fish, crustaceans, and water insects.

Let's take a look at your daphnia and grow mats!

Have your daphnia continued hatching?

We'll need to add spring water into the tray until it reaches where it originally was at the end of Day 1 – almost to the top of the tray.

How are the plants on your grow mat?

You should be seeing sprouts on your seeds by now, or they might even be growing into longer shoots!



Build the floating wetland model!



The straws are the perfect length to fit snugly across the inside of the tray.

- 1** Position four straws in the tray near the rim, above the water, as shown above. The ends of the straws will touch the inside of the tray. The straws should be about an inch apart and parallel to each other.
- 2** Using both hands, pick up the grow mat from the plate and carefully lay it on top of the straws.

Make the spirulina paint!



Add spring water to the container with spirulina (green algae powder).
Keep it in the refrigerator until we meet again next week!

Remember: don't shake your container at all, even when you take it out of the fridge next week! This will keep it the color we want for painting.

Instructions for the Week



Check your tray and feed your daphnia!

Make sure to feed your daphnia one drop of nutrients every day.

Keep spraying your seeds!

Spray your seeds lightly every day. Don't oversoak the mat though: otherwise your mat will get too heavy and sink down!

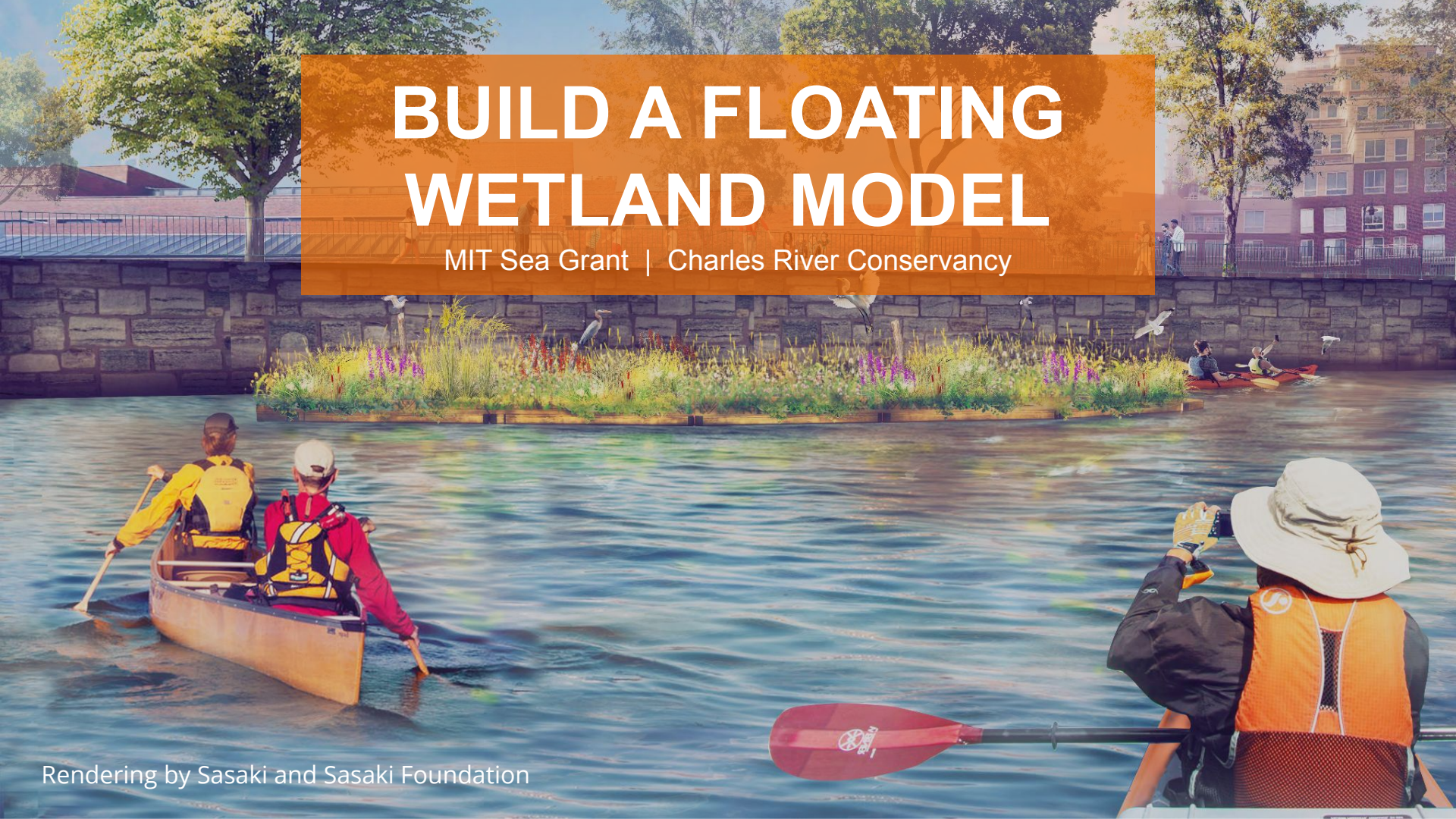
Watch your wetland for any roots!

As your plants keep growing, their roots will also grow longer. Eventually, they should be touching the water!

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Rendering by Sasaki and Sasaki Foundation



Last week...

We **completed our models** by adding animals and our grow mats to the tray

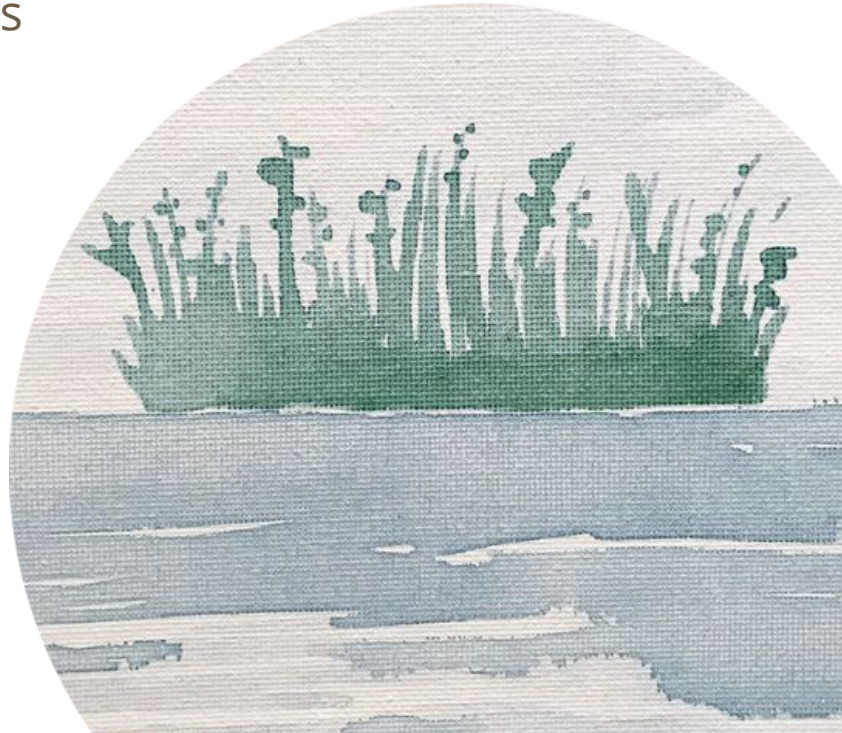
We learned more about **daphnia**:

- **10 sets of arms, claws and antennae** for sensing, swimming, feeding, and defense, **1 large eye**, and an organ to orient them to light and dark
- **100+ species** of daphnia
- Daphnia avoid predators by hiding, swimming, and **vertical migration**
- Daphnia eat **algae** and **bacteria**

We learned what other Charles animals eat: **beavers, herons, and turtles**

Day 4 - Today, we're going to:

1. Check in on our daphnia and wheatgrass
2. Watch a video about cyanobacteria
3. Identify algal blooms
4. Paint with algae
5. Wrap up and clean up!



**Cyanobacteria have
existed for billions
of years.**



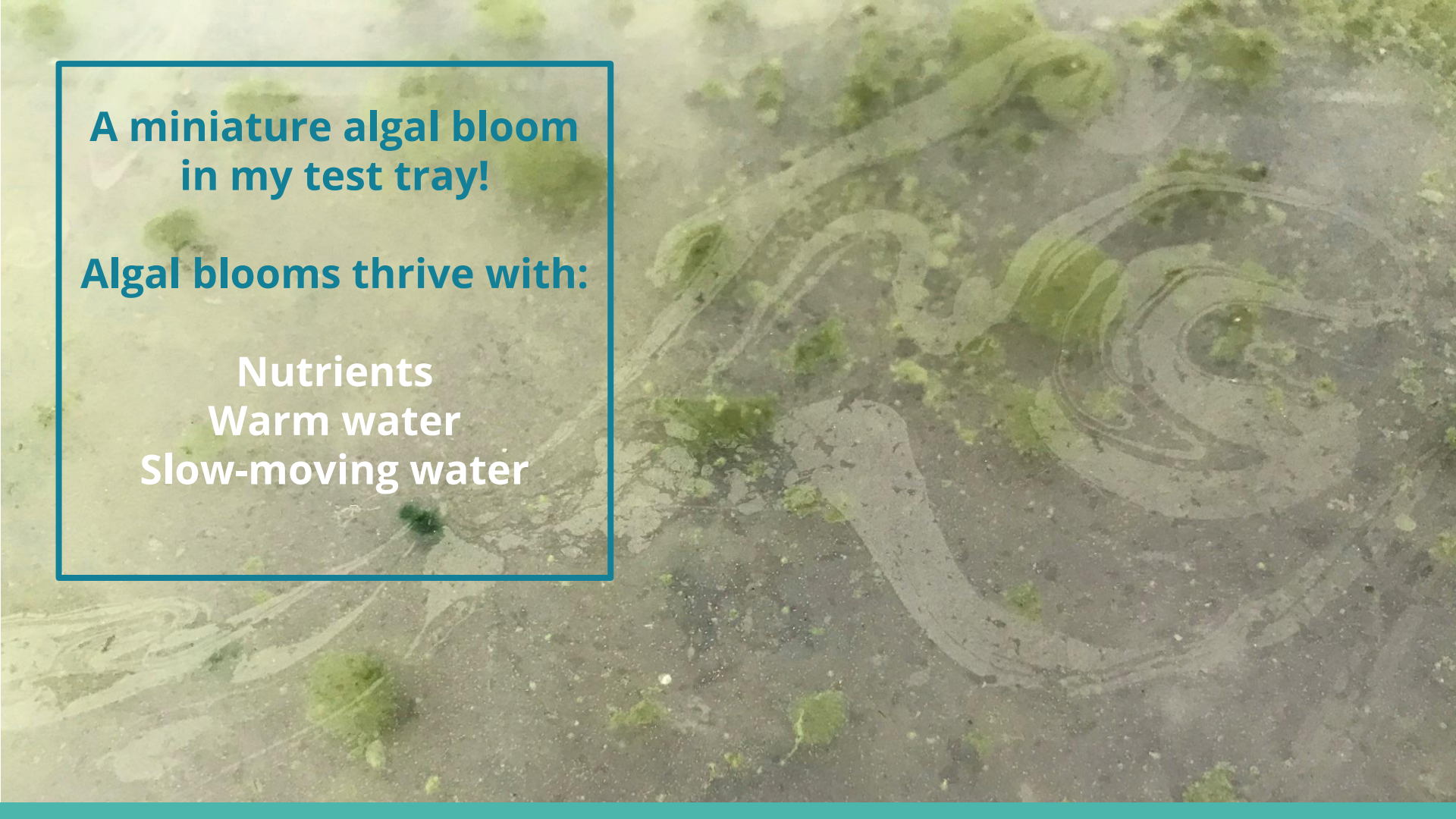
Cyanobacteria and algal blooms



Cyanobacteria cause algal blooms, an increasing threat to the river.

- Have existed for **billions of years**, long before dinosaurs!
- First **photosynthetic** organisms helped create oxygen for our atmosphere.
- Over time, they **developed unique behaviors** to help them survive:
 - Buoyancy regulation** (ability to change depth to reach sunlight)
 - Allelopathic** (create biochemicals that slow growth of other organisms)

These advantages help cyanobacteria to **grow rapidly**, turning the water green and scummy, and can release **toxins** that are harmful to humans and animals.



**A miniature algal bloom
in my test tray!**

Algal blooms thrive with:

Nutrients

Warm water

Slow-moving water

Hundreds of years ago, the river looked very different than it does today.



*Graphic created by CRC staff from historical documents

Why does cyanobacteria thrive in the Charles River?

Hundreds of years ago, **ocean tides flowed in and out** of the river, a marshy **estuary** (where freshwater mixes with saltwater) supporting a rich ecosystem.

Urban development altered this ecosystem with lasting effects on the river:

- **Nutrient pollution** from urban infrastructure, car exhaust, fertilizers
- **Walls replaced plants** along the natural edge of the river, which used to filter out pollutants (**Mid 1800s**: hundreds of acres of estuary filled in)
- **Slower, warmer waters due to damming** (**1910**: Charles River Dam built)
- **Climate change** intensifies these impacts from warmer temps and more rain from storms carrying more nutrients into the river

Why do populations crash?

A **population crash** happens when there is a **sudden decline** in the number of members of a population.

Cyanobacteria blooms are just one reason why daphnia populations crash:

- **Lack of nutrients** like oxygen and sunlight cause populations to starve and compete.
- **Predation** from larger creatures like fish
- **Habitat loss** means that daphnia aren't protected and hidden in roots of plants
- **Pollution from urban runoff** releases nitrites and other harmful nutrients that can harm daphnia.

And the decline in daphnia populations allow cyanobacteria to continue blooming!

Let's ID algal blooms!

Charles River Watershed Association

scientists collect water samples and use microscopes to check for algal blooms in the Charles River.

With some practice, **cyanobacteria blooms** can be visually distinguished from healthy **green algae** and **duckweed** without using a microscope. Cyanobacteria blooms can also **smell** like a swamp or freshly cut grass!



Credit: Robin Lubbock/WBUR

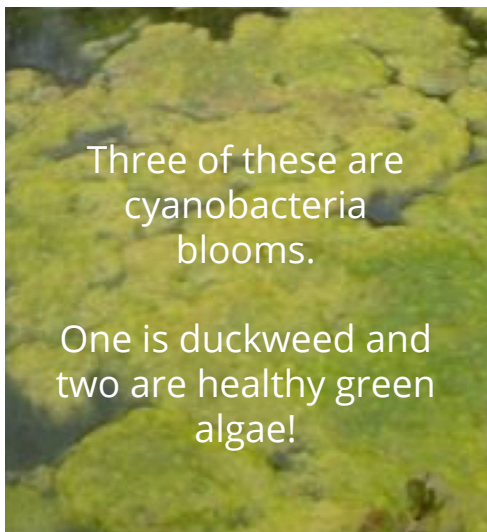
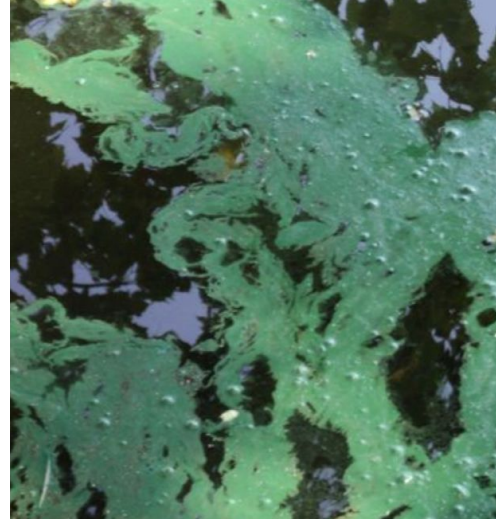
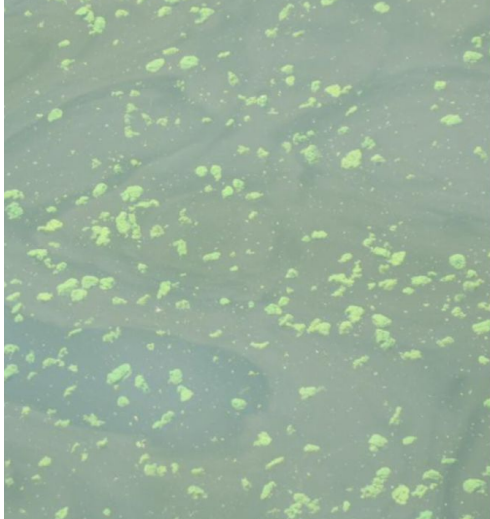
Cyanobacteria blooms can look like:

scum on the surface

slicks of green paint

grainy sawdust

pea soup

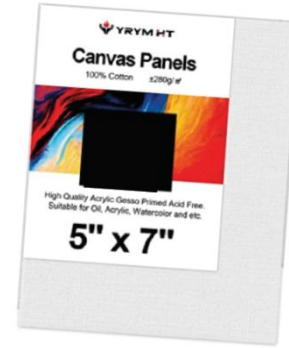


Healthy green algae





Art with algae activity



1

Last week, we mixed our blue-green algae powder with water. Take your paint out of the refrigerator - be careful not to shake it!

2

Let's paint a wetland on our art boards! First we'll paint the blue sky and water. Then, we'll shake our paint for a green wetland.

Wrap up and clean up!

By now, any daphnia that hatched will have likely completed their life cycle.

They typically live only 10-30 days.

- If your daphnia are still thriving, feel free to keep feeding them this week!
- Or, you can end the experiment today and dispose of the tray water with an adult (see **page 15** of your booklet).

The bamboo paper towels and plate, grow mat with grass, and the straws are all **biodegradable**. Please **recycle** the water bottles and reuse the rest!

Explore the Charles River!

Remember to plan your **FREE** canoe or kayak adventure on the Charles River this spring or summer - find the pass in your kit!

Special thanks to **Paddle Boston - Charles River Canoe & Kayak** and the **Charles River Conservancy!**

