Supplement A

Water Quality Testing Instructions

Salinity Meter

Take the cap off of the salinity meter. Place in the water and gently move back and forth until the meter reading stabilizes. This may take a few minutes. Record the number. The reading should be in PPT (parts per thousand).

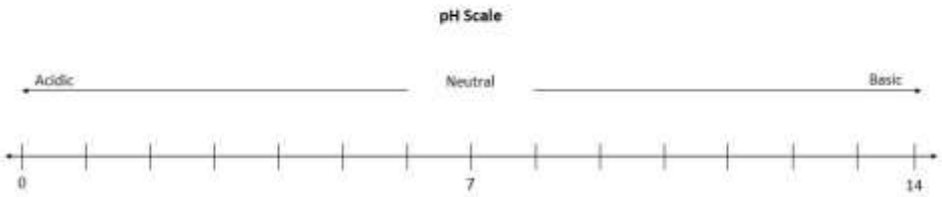
Water thermometer:

Allow the water thermometer to fill with water so it sinks into the creek. Hold the line so you don't lose the thermometer. Allow 3 to 5 minutes to get an accurate temperature reading.

Dissolved oxygen tablets:

Fill the small glass vial with water. Add 2 DO tablets and shake until completely dissolved (approximately 5 min). Compare water color to the DO chart to determine the oxygen levels in the water.

pH: Pull off a piece of Hydrion pH paper. Dip into water and pull out immediately (no more than 5 seconds). Read and compare the color of the strip to the color chart on the meter. Then flip it over to the back and compare the colors to determine how acidic or basic the water is.



Supplement B

Background - Frogs

History:

Amphibian ancestors appeared around 400 million years ago. Fossil records show that they lived most of their life in water, did not jump, and had longer backs and tails in adulthood to navigate the waters. Around 196 million years ago, we begin to see a glimpse of our modern day frog with shortened backs, no tails, and the ability to jump. These frogs shaped the frogs we see today in that their adult life was out of water. The evolutionary drive to make half of their life cycle on land and half in water was due to a reduction in large amounts of freshwater that would be able to support not only tadpoles, but large adult frogs as well. Amphibians means "double life", which defines their life cycle of half in water and half out of water.

Importance:

Frogs have a very important niche in their ecosystems. Frogs, especially tadpoles, help to clean the water in surrounding environments as they feed on algae and decaying organic matter. As adults, frogs help to control insect populations, including those that may transmit disease to humans and other animals. Frogs are also vital to their food webs. A wide variety of predators depend on frogs as a major food source, including fish, snakes, and birds. They are also important indicators of environmental health and stress; healthy and plentiful frogs are indicative of good water quality (and a healthy habitat in general). Similarly, when the health of a stream or other water source declines, so does the success of frogs in that habitat.

Threats:

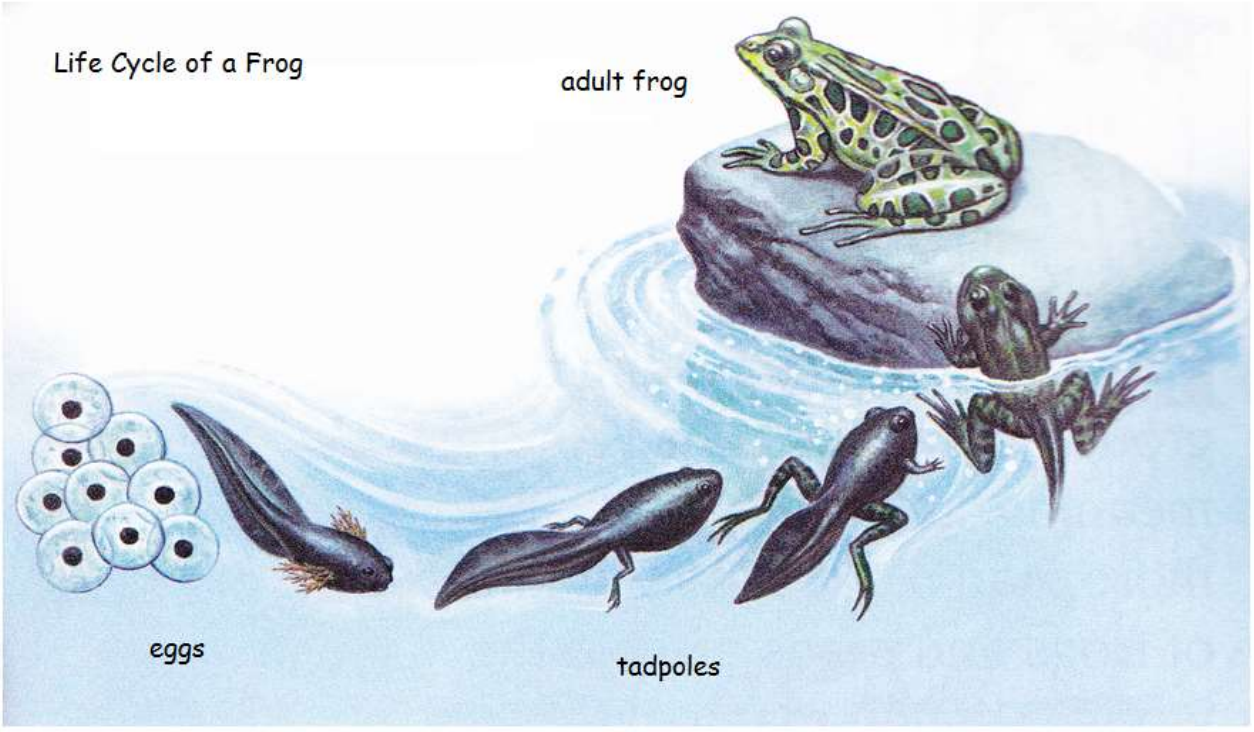
Despite their importance, human activity poses many threats to frog populations. Pollution is a large factor in the decline of healthy frog habitats. The largest source of pollution comes from agricultural runoff. Stormwater runoff and septic system pollution also threaten healthy frog habitats. Each day, 100 acres of habitat in the Chesapeake Bay watershed is lost to development. Due to this increasing development, forest buffers are declining. These forest buffer zones are extremely important to the health of frog habitat. They act as filters to slow and absorb excess pollution, sediment, and nutrients before it makes it to the Bay or its surrounding wetlands. Humans also have a negative effect on frog populations by over-harvesting, both for food and for pets.

Supplement C

Characteristics of Frogs

- Habitat
    - Must sustain life of diet (insects, fish, larvae, tadpoles)
    - Shelter – banks, vegetation, and shallow, slow moving water
    - Territory/space – multiple square yards, depending on species
- Life cycle
    - Eggs – still/slow moving water; rocks/stems to attach; 72-90 degrees F; and will tolerate pH as low as 5.
    - Tadpoles/froglet metamorphosis – subaquatic vegetation for dissolved oxygen, food, and shelter; will tolerate a pH as low as 5; decaying organic matter; small insects and larvae
        - Breathe with gills – dissolved oxygen: 4-7ppm, some species can live in lower dissolved oxygen areas.
        - 70-90 degrees F
    - Adult – proper living conditions for insects/larvae; still/slow moving water; mud/decaying organic matter; subaquatic vegetation and embankments for shelter
        - Breathe through skin, lungs, and nostrils within the lining of the mouth cavity.
        - Dissolved oxygen: 4-7ppm some species can live in lower dissolved oxygen areas.
        - 65-90 degrees F

Supplement D



Eggs: are the first stage of the life cycle. They are laid in calm water and covered in a jelly-like coating for protection.

Tadpoles: are the second stage of the life cycle. They have a tail, but do not have any legs. They breathe using gills, eat algae, and only live in the water.

Froglets: are the third stage of the life cycle. They start growing their legs and lungs while the tail starts to shrink. This is when they begin eating insects and worms.

Adult frogs: are the final stage of the life cycle. They have fully grown legs and lungs and no longer have a tail or gills. They live both on land and swim in the water. One frog can lay up to 4,000 eggs at a time!

Supplement E

Wetlands Types and Classifications

Wetlands have different characteristics. The most common feature of all wetlands is that the water table (the groundwater level) is very near to the soil surface or shallow water covers the surface for at least part of the year. The main characteristics of a wetland are determined by the combination of the salinity of the water in the wetland, the soil type, and the plants and animals living in the wetland.

- **Marsh** – a type of wetland ecosystem characterized by poorly drained mineral soils and by plant life dominated by grasses. Marshes are common at the mouths of rivers, especially where extensive deltas have been built. The marsh plants slow down the flow of water and allow for the nutrient enriched sediments to be deposited, thus providing conditions for the further development of the marsh.
- **Swamp** – a wetland ecosystem characterized by mineral soils with poor drainage and by plant life dominated by trees. Swamps are found throughout the world, most often in low-lying regions (with poor drainage) next to rivers, which supply the swamp with water. Some swamps develop from marshes that slowly fill in, allowing trees and woody shrubs to grow.
- **Bog** – a type of wetland ecosystem characterized by wet, spongy, poorly drained peaty soil, dominated by the growth of bog mosses, and heaths, Bogs are usually acid areas, frequently surrounding a body of open water. Bogs receive water exclusively from rainfall.

  What is a Bioretention Area?What is a Bog?

- Bio-retention areas are man-made, shallow stormwater retention facilities designed to mimic natural wetlands by controlling stormwater through holding, slowing down, soaking in, and evaporating the water.
- Bogs are natural, slow-draining, acidic areas that are rich in accumulated plant material. They frequently surround open bodies of water, and have distinct vegetation and animals.

Supplement F Journal Page

Hopping Through Time

How healthy is the bog for a frog?

Test	Picture	Healthy Range	Results	Healthy, Y or N
Temperature (°F)		75°F to 90°F		
Salinity (ppt)		0 ppt		
pH		5 to 8.5		
Dissolved Oxygen (ppm)		> 0 ppm		

Visual Assessment: Draw something you found in the bog that is good for frogs.

How have frogs adapted in order to survive in this type of habitat?

_____

_____

_____

Supplement G- How do Humans affect…

How do humans affect:

Salinity?	• Erosion can cause a rise in salinity • Storm water runoff can have high levels of salt • Salt put on the roads in the winter will wash into nearby bodies of water
pH?	• Pollution from cars and factories make acid rain • Algae blooms can decrease oxygen levels, raising the pH
Temperature?	• Loss of bank vegetation reduces shade and causes temperatures to rise • Heated water from factories and power plants • Varying the depths of water sources (dredging, damming, etc.) leads to colder deep water and warmer shallow water • Extreme heat from climate change due to human activity
Dissolved Oxygen? (D.O.)	• Excess nutrients cause algae blooms which decrease D.O. from fertilizers, farm runoff • If submerged aquatic vegetation (SAV) dies, D.O. decreases • Destruction of forest buffers causes loss of shade, increasing the temperature of the water and decreasing D.O. • Construction, logging, etc. results in excess organic matter to decompose in water which reduces D.O.
Food?	• Pollution from runoff (gas, oil, antifreeze etc.) is toxic to plants and animals
Wet Environment?	• Loss of shade makes water evaporate more quickly
What are positive human impacts?	• Built bog area • Planted trees and native plants for buffer zone • Partial shade allows for the Dissolved Oxygen to be higher in the water because as the water gets hot, the less oxygen can be supported.

Supplement H

Inclement Weather Lesson

**NOTE- This lesson will be similar to the outdoor version, only performed in a different location and with modifications. If Arlington Echo staff clears the groups to go back outdoors, all activities will resume as scheduled.*

Please read the original Hopping through Time lesson prior to reading the inclement weather lesson.

This lesson will be done outside as much as possible. If it is just raining, students will follow the same original lesson plan, just moving the picnic table/discussion parts inside to the bee room. All other outdoor elements may stay the same.

If there is thunder, lightning, or any other inclement weather activity besides the rain, students will move into the bee room to perform the lesson.

1) Ask the students of their prior knowledge about frogs and the frog life cycles.
2) Have students play the Human Impact (Pollution) game and discuss pollution. **(See Supplement I)**.
3) Have the students play the Metamorphosis game (Life Cycle Game, "Rock, Paper, Scissors"). **(See Supplement J).**
4) Following the game, students will have a chance to carry out the water quality tests as written in the original lesson from a sample of water that has been extracted from the bog prior to the lesson beginning. Refill the bog water for every new group that is working indoors.
5) Once the water quality tests are performed, students will answer the remaining questions on the journal page.
6) Students should regroup in a central location, discuss the remaining findings on their journal page, and talk about how humans could negatively or positively impact the bog area **(Supplement G).**
7) Following the lesson, allow the students to play games in their journals if there is still time left, if not, have students move to their next lesson and set up for the next group (see schedule).

Supplement I – Game Instructions

Pollution

Human Impact Game

Instructions:

- Explain that everyone will be wandering around the designated area and as they pass another participant they are to politely shake hands.
- Hand out cards to the students with stages of the life cycle that they will represent. They are not to tell anyone what card they have.
- One or more students will be a source of pollution to the habitat. When they shake hands with another participant, they have the option to secretively double squeeze their hand.
- If a student receives a double squeeze, they are to walk around for a few seconds and then "die" (sit down on the ground). They are not to say anything to any of the other participants.
- After a few minutes, the game stops. The "living" participants are to guess which student(s) are pollution.
- Have the pollution students state what kind of pollution they were.
- Discuss how pollution could affect frogs, including how it can possibly lead to species endangerment or extinction.

Supplement J – Game instructions

Metamorphosis

Frog Life Cycle Game

First review the life cycle of a frog with students.

Egg- Tadpole-- Frog

Instructions:

- Students will float around the room as if they are frog eggs caught in a current. They are to move around randomly until the instructor calls Ribbit.
- When the Ribbit is said, they will play "Rock, Paper, Scissors" with the person closest to them. Partners will stand back to back and on the signal they will turn around and show their symbol.
    - Rock beats scissors
    - Paper beats rock
    - Scissors beat paper
- Whoever wins moves to the next level of the frog's life cycle. For example; if you are an egg you become a tadpole. The student that does not win stays at the same level. If it is a tie, both participants stay at the same level.
- As students move up in the life cycle they are to move around the room in the same manner that the animal would move at this stage. Eggs float, tadpoles swim, and frogs hop. Once a student is a frog, they continue to hop around and play the game as frogs.
- The game ends when everyone (or majority) is a frog.