Chesapeake
CLASSROOMS

TEACHER'S GUIDE

CHESAPEAKE BAY FOUNDATION

Saving a National Treasure

CHESAPEAKE BAY FOUNDATION

Saving a National Treasure

CHESAPEAKE CLASSROOMS

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Chesapeake
CLASSROOMS

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The Chesapeake Bay Foundation

The Chesapeake Bay Foundation is an independent conservation organization working to restore the Chesapeake Bay and surrounding watershed through education, advocacy, restoration, and litigation.

CBF Education: Learning for Life

Arthur Sherwood, CBF's first president, was adamant about the power of getting kids "out on the water messing around in boats." Young people would save the Bay if they loved it, he argued, and they would love it if they experienced it.

That simple idea has remained at the core of CBF's award-winning Education programs. As we celebrate our 50th anniversary, more than 1.5 million people have learned with us to date. I was one of them, and I can tell you these experiences are far more than field trips.

There is pure joy, but also deep value, in learning outside. Students gain the tools for creative thinking and problem solving, discover how they fit into an intricate natural and social system, and explore how they can change it for the better. This is critical for our ability to restore the Chesapeake Bay watershed and solve other complex, generational challenges like climate change.

CBF continues to work with an incredible cast of educators, administrators, and partners across the watershed to ensure every student has these opportunities. From supporting teachers to designing curriculum and helping schools overcome barriers to outdoor learning, we are creating a brighter future for our watershed, our communities, and our planet.

—Tom Ackerman,
Vice President for Environmental Education and the Henry L. and Grace Doherty Chair, Chesapeake Bay Foundation

Teacher Professional Learning

Chesapeake Classrooms professional development programs help connect teachers with the tools, resources, and support needed to bring outdoor learning and hands-on investigations to their students. We also work with whole school systems and partner networks to create the institutional frameworks and community connections that help ensure every student gets these opportunities.

These programs are supported by CBF's Teacher Environmental Literacy Leaders (TELL) network, an established community of teacher leaders in environmental literacy and watershed education. The TELL network participates in professional learning experiences focused on content, pedagogical strategies, and leadership skills to support environmental literacy. The participants serve as resource providers, instructional and curricular specialists, and mentors on Chesapeake Classrooms courses. This connection strengthens the role and reach of environmental literacy across the watershed and provides support to teachers as they design and implement Meaningful Watershed Educational Experiences (MWEEs).

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For more information on the Chesapeake Classrooms professional learning program, visit **cbf.org/ccsummer**.

FIELD INVESTIGATION JOURNAL

CBF STAFF

Course Title: _____

Dates: _____

Course Leader(s): _____

Course Leader(s) e-mail: _____

Driving Question: _____

Investigative Questions: _____

1. _____

2. _____

3. _____

4. _____

5. _____

Driving Question: _____

Investigative Question(s): _____

Local issues: _____

Weather: _____

Notes: _____

Journal Entry: _____

Today supported:

MWEE Essential Elements			
☐ Issue Definition	☐ Outdoor Field Experience	☐ Synthesis and Conclusions	☐ Environmental Action Projects

MWEE Supporting Practices			
☐ Teacher Facilitation	☐ Learning Integration	☐ Local Context	☐ Sustained Experience

How did the day support MWEE Essential Elements and Supporting Practices? _____

Questions for tomorrow: _____

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How did the day support MWEE Essential Elements and Supporting Practices? _____

Questions for tomorrow: _____

Water Quality Testing Data

CBF-LED WATER QUALITY INVESTIGATION

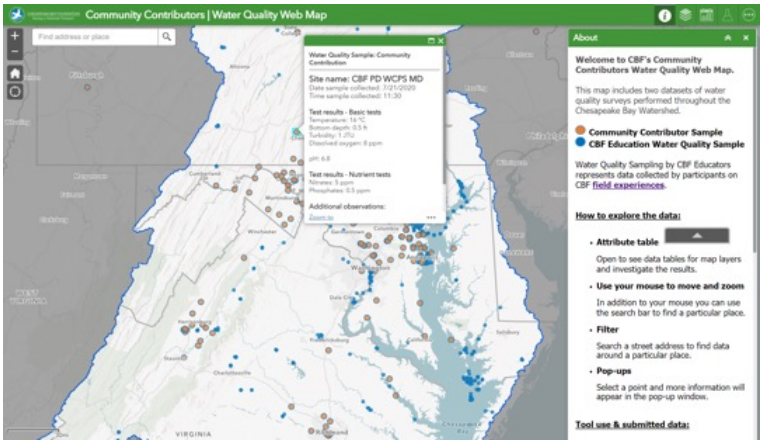
ABIOTIC FACTORS	SITE 1	SITE 2	SITE 3	SITE 4	SITE 5
Location					
Date					
Time					
Tide					
Weather					
Dissolved O_2 0PPM 3 5 12PPM POOR FAIR GOOD					
Temperature					
Turbidity 0 cm 50 100 150 200 cm+ POOR FAIR GOOD EXCELLENT					
Nitrates 0 PPM 1.0 1.5 PPM+ GOOD FAIR POOR					
Phosphates 0.0 PPM 0.1 0.15 PPM+ GOOD FAIR POOR					
pH 0 2 4 6 8 10 12 14					
Salinity 0 PPT 34 PPT FRESH BRACKISH SALT					

Independent Water-Quality Investigation

Making observations of local rivers and streams is one of the best ways to gauge watershed health. The local land cover impacts quality of your local waterways, which all adds up to the overall health of the Bay. You have been provided with a water quality testing kit so that you can collect quantitative data about your local waterway, and the procedures over the next few pages will help you make observations of aquatic and terrestrial plants and animals, land cover, and human activities to also collect qualitative data and get an idea of the bigger picture.

Add your data and observations to our Community Contributors GIS database! Once you've collected data in the table on page 23, share it here: arcg.is/yX9fP

You can interact with this map and see and download data from throughout the watershed by going here: cbforg.maps.arcgis.com/apps/webappviewer/index.html?id=74a718eff1f747caa93662baa0a3b15e



BACKGROUND

Dissolved Oxygen

Dissolved oxygen is closely tied to the survival of plant and animal life in all bodies of water in the watershed. It is affected by natural processes and by human activities. The amount of oxygen in any water body varies naturally, both seasonally and over time. This occurs due to a balance between oxygen input from the atmosphere and certain biological and chemical processes, some of which produce oxygen while others consume it (photosynthesis and respiration, respectively).

Stratification in the water column, which occurs when less dense freshwater from an estuary mixes with heavier seawater, is one natural cause of hypoxia—lack of dissolved oxygen. Limited vertical mixing between the water layers restricts the supply of oxygen from surface waters to more salty bottom waters. Hypoxia occurs most often, however, as a consequence of human-induced factors, especially nutrient pollution (also known as eutrophication). The causes of nutrient pollution, specifically of nitrogen and phosphorus nutrients, include polluted runoff from agricultural, urban, and suburban areas; fossil-fuel burning; and wastewater treatment effluent.

Turbidity

Turbidity is the cloudiness or clarity of water. Visibility depends on the amount of suspended and colored materials in the water—material that comes from either sediment washed into a water body or biological activity in the water body (algae or plankton).

Students should think about what can affect how clear water is (things like sediment in polluted runoff, phytoplankton, and algae blooms are important considerations) and why this is important (light penetrating to submerged vegetation, visibility for predators, congestion for filter-feeders, sedimentation for bottom-dwellers).

Temperature

Generally, the temperature of the water varies with the seasons and with exposure to heat energy from the sun. Seasonal changes in temperature will influence the migration, hibernation, dormancy, and reproduction behaviors of aquatic organisms. Deforestation and development around small tributaries to the Bay can increase the temperature of streams due to removal of shade from trees and surface runoff from hot roadways, parking lots, and rooftops. Warmer water cannot hold as much dissolved oxygen as colder water, and some species will suffer from this related impact on temperature as well, especially larger, active, freshwater species like trout.

In the deep water of larger tributaries and the open Bay, stratification occurs when surface waters are warmed by the sun and do not mix with deep, cooler water at the bottom. This is one factor that helps contribute to the Bay's dead zones. However, the "fall turnover" is a phenomenon that can be observed by measuring the temperature at the surface and at the bottom of the water. Once air temperatures cool, the surface water also cools, and will sink to the bottom, forcing the (possibly oxygen-depleted) water from the bottom back to the surface where it will be replenished with oxygen by exposure to the air. The fall turnover occurs every year and is what allows for changes in the size of the summer dead zone.

pH

The pH of water determines the solubility (amount of a substance that can be dissolved in the water) and biological availability (amount that can be utilized by aquatic life) of chemical elements such as nutrients (phosphorus, nitrogen, and carbon) and heavy metals (lead, copper, cadmium, etc.). For example, in addition to affecting how much and what form of phosphorus is most abundant in the water, pH also determines whether aquatic life can use it. In the case of heavy metals, the degree to which they are soluble determines their toxicity. Metals tend to be more toxic at lower pH because they are more soluble (like methyl-mercury in some acidic rivers of the Chesapeake Bay).

Nutrients—Nitrate and Phosphate

Levels of nutrients, nitrogen and phosphorus, in waterways are important measurements of water quality, and levels of these nutrients are evaluated in natural waters by measuring concentrations of nitrate and phosphate, both of which are nutrients necessary for life and found in small amounts in all aquatic environments. In elevated concentrations, these nutrients can become a form of pollution by causing excess algae growth and decomposition which leads to depleted oxygen levels and eventually dead zones with no oxygen. This is a process known as eutrophication. Both nitrate and phosphate are limiting factors in algae growth, with phosphate being the more limiting factor in freshwater systems and nitrate being the most limiting factor in brackish and marine systems—both nutrients need to be elevated in order to cause eutrophication.

Phosphates enter waterways via discharge and runoff of sewage, manure, and fertilizer, commercial detergents and industrial effluents, and by flowing through areas with phosphorus-rich bedrock.

Nitrates are present in lawn and crop fertilizers, human and animal waste, and organic material like dead leaves and detritus. Runoff from the land containing these things as well as atmospheric deposition of nitrogen from burning fossil fuels will lead to high concentrations of nitrate in natural waters.

Salinity

The salt content (salinity) of a water body is one of the main factors determining what organisms will be found there. The density of water is impacted by the salinity level, and is another factor that leads to stratification in the Bay. Denser salt water enters the Bay from the Atlantic Ocean, and less-dense freshwater flows over top. While some mixing does occur, salinity levels will increase with depth in deeper, open waters.

Salinity is also important because it affects dissolved oxygen solubility. Generally, the higher the salinity level, the lower the dissolved oxygen concentration. Oxygen is about 20 percent less soluble in seawater than in freshwater at the same temperature. That means, on average, seawater has a lower dissolved oxygen concentration than freshwater.

INSTRUCTIONS

Before you go outside:

1. Set up your test kit:

a. Inventory all of the contents with the jar. It should include:

- One Indicator Card
- One mini pencil
- One small glass test tube and black plastic screw-on lid
- One large plastic test tube and translucent plastic press-on lid
- Two adhesive thermometer strips (may appear to be just black—they turn colors when exposed to temperatures within their range of measurement)
- One Secchi sticker
- 20 blister packs of dissolved oxygen TesTabs (enough to perform 10 tests)
- 5 blister packs of pH TesTabs (enough to perform 10 tests). To order replacement TesTabs and parts for your kits, scroll to the bottom of this webpage: monitorwater.org/order-kits/advanced-kits-replacement-parts

b. Locate the Secchi sticker and the thermometer strips

c. Place the Secchi sticker, off center, in the bottom of the jar

d. Place the two thermometer strips on the outside of the jar, close to the bottom

These test kits are made and sold by LaMotte, a company in the Chesapeake Bay watershed that sells lots of water testing supplies for education. EarthEcho is the organization that created this test kit for schools around the world to monitor their local waters with simple, non-toxic procedures. Visit their website for extension materials and for translations of the testing instructions in several languages: monitorwater.org

2. Plan your water-testing outing:

a. Find a location ahead of time. You can use this map to find the closest stream to you: cbforg.maps.arcgis.com/apps/webappviewer/index.html?id=7ee4d6bb407e4ecdac73d8797fb50b34

Keep in mind that especially in highly developed areas, streams can be fully contained in pipes underground!

b. If you are planning to test a stream that you have never visited before, you may want to take some time to scout it out first: make sure that there is safe, public access.

c. Refer to the "Packing List & Outdoor preparedness" checklist in your Google Classroom and be sure to fill out the "Virtual Programs Participant Form" before you head out.

d. Bring someone with you—family and friends make great field lab assistants! If you'll be going out alone, be sure to let someone know where you're going and when you plan to be back.

e. Watch this instructional video to see how the tests are done before you try it yourself: youtu.be/UyZ7o2id9wE

3. Gather your materials:

- EarthEcho/LaMotte water quality test kit
- Refractometer (not included on all courses)
- A hand towel may also be useful
- Sunscreen, hat, water, snacks
- This Teacher's Guide—record your results in the data table on page 23

Once you have performed all of your tests, keep the pH and DO chemicals in the test tube until you get home. There, you can mix these together, dilute them 10:1 with water, and safely pour them down your drain. You may also refer to the safety instructions included with the kit.

To gather your data:

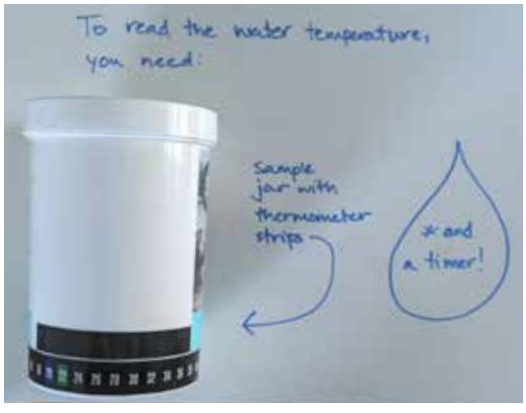
1. Record the temperature:

Range: Temperature varies seasonally and with available shade and/or surrounding land cover. More impervious surface and fewer trees result in higher temperatures, especially in shallow water.

a. With the sample jar partially filled and the lid on, (to prevent it from sinking if you drop it!) submerge the thermometer strips on the jar about 10 centimeters below the surface of the water in the stream/river/bay

b. Keep the thermometer strips submerged for one minute

c. After one minute, remove the jar from the water and immediately read the thermometer strip by looking for the number with the green background.



2. Collect a water sample:

a. Empty the contents of the test kit jar—the hand towel is a good place to lay out these items.

b. Gather a sample of water. Either from the edge of the water, or if the stream is shallow and safe, by standing in the stream, submerge the jar fully in the water. If there is a current, aim the opening of the jar into the current (upstream) and allow the water to flow into the jar for about 30 seconds. If you are standing in the stream, be sure to stand downstream from the point at which you are collecting the water sample.

c. Cap the jar while it is still fully submerged in the water

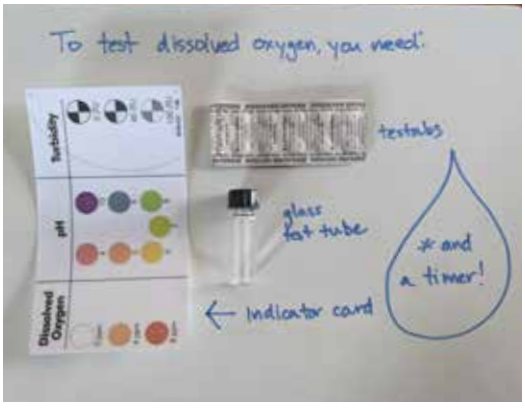
3. Test for dissolved oxygen (DO):

Range: Zero to 12 milligrams per liter (mg/L) with 8 to 9 mg/L being very good quality water, 4 mg/L or below is considered a stressed environment and an impaired water. Three or below is stressful to most aquatic organisms. Two and below is considered hypoxic and a dead zone. And 0.2 mg/L indicates anoxic waters.

a. Locate the small, glass sample vial and the Dissolved Oxygen TesTabs (you will need two TesTabs)

b. Fully submerge the glass vial in your sample water

c. Place the two Dissolved Oxygen TesTabs in the glass vial and screw the lid on the vial—some water will spill out, which is good. This means that there are no air bubbles in the vial, which could skew your results with a higher concentration of DO than is actually present.



d. Fully dissolve the tablets in the water by inverting the vial several times. This may take up to four minutes!

e. Find a spot to rest the sample and set a timer for five minutes. You may find you're able to use this time to perform the turbidity and/or temperature procedures.

f. When your five minutes are up, compare the color of your sample to the shades of red for the DO concentrations on the Indicator Card. The shade of your sample may be somewhere between the colors on the Indicator Card—use your judgment to determine the best approximate concentration of DO in your sample!

4. Test the pH:

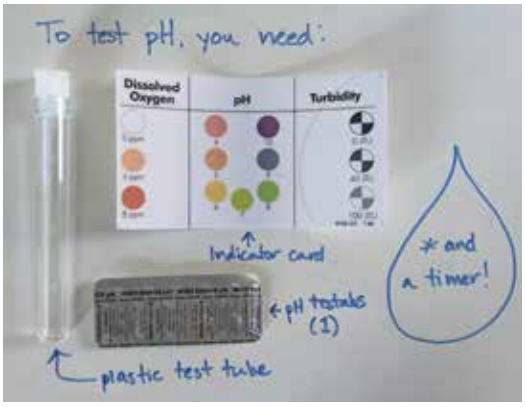
Range: pH can range from 0 to 14, with 7 being neutral. Results less than 7 are acidic while a pH greater than 7 are basic. Normal rainfall has a pH of about 5.6—slightly acidic due to carbon dioxide gas from the atmosphere reacting with rainwater to form carbonic acid. The healthy range of pH for most organisms is 6.5-8.2.

a. Locate the large plastic test tube and the Wide Range pH TesTabs (you will need one TesTab)

b. Fill the test tube to the 10 mL line with the water sample

c. Add one pH TesTab, cap the tube, and invert the test tube several times until the tablet dissolves, though you may still be able to see small bits of the tablet. This is okay.

d. Compare your sample to the shades and pH levels on the Indicator Card

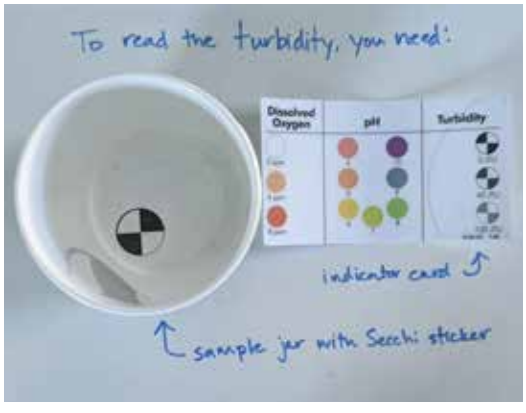


5. Determine the turbidity:

Range: Turbidity can be measured using several different methods that gather data using various units of measurement. The method you are using reads turbidity in Jackson Turbidity Units, or JTUs. An ideal turbidity reading is 10 JTU or less.

a. After you have collected the water sample, pour out some of the sample so that the jar is filled just to the "FILL LINE" on the sticker of your jar.

b. Locate the Indicator Card and, with your sample in the shade (you may need to shade your sample with your body), compare the clarity of the Secchi sticker to the turbidity levels on the card. Your sample will likely be somewhere between the levels on the card—use your judgment to make the call on the turbidity level. This is a somewhat subjective test.



6. Test the salinity:

Range: Water in the Chesapeake Bay is brackish, a mixture of both fresh and saltwater. In the Bay proper it ranges from one ppt (parts per thousand) to 34 ppt. Salinity varies by season and location in the Chesapeake Bay and its tributaries.

a. Obtain your refractometer and pipette. You can first check to make sure that your refractometer is calibrated:
   - Rinse your pipette a few times with distilled or tap water
   - Place a small amount of distilled or tap water on the prism and look through the eyepiece.
   - The salinity level should be at 0‰. If it is not, use the small screwdriver included with your refractometer to turn the screw on top until the line falls at 0‰.

b. Flip the plastic cover back from the glass prism on the end opposite the eyepiece

c. With the prism facing up, place a small amount of sample water from the pipette onto the surface of the prism.

d. Look through the eyepiece and see where the line between the white lower portion and blue upper portion of what you see crosses the scale.

e. Read the number on the right side of the scale—this will be your salinity level in parts per thousand (‰)

7. Observe for excess nutrients:

Range: Nitrate concentrations of less than 1 mg/L and phosphate concentrations of less than 0.1 mg/L are considered healthy. These tests can be pricey and often involve the use of toxic chemicals, which is why you will make observations of physical traits of the water and land to make a hypothesis about the presence of excess nutrients instead of performing a chemical test. You can also check out the Chesapeake Monitoring Cooperative's interactive database of water quality measurements from around the Chesapeake Bay watershed to get an idea of long-term trends of nutrient levels in your area: **cmc.vims.edu**

For the following questions, use your judgment to score whether you suspect it is unlikely, possible, or likely that excess nutrients are in the water. Choose one answer from each question, then add up the points for each answer. Feel free to adjust points if your observations of the land and water fall in between what is described below.

Look at the land surrounding the water. Which of the following most closely characterizes this land?

- ☐ Trees, shrubs, and grasses/forest: 0 points
- ☐ Long grass/meadow, some shrubs: 0 points
- ☐ Mowed grass/residential lawns: 4 points
- ☐ Mix of impervious surface (pavement, rooftops, sidewalks) and trees, shrubs, and/or grass: 6 points
- ☐ Mostly or all impervious surface: 6 points
- ☐ Agriculture/farmland (crops or livestock): 6 points

Does the water appear to have excess algae?

- ☐ No green water, no algae clinging to structures in the water: 0 points
- ☐ Water is a greenish color: 4 points
- ☐ Algae is growing on rocks, pilings, at the surface of the water or on other structures in the water: 4 points

Are organisms present in and around the water?

- ☐ Fish, insects, or other animals living in the water: 0 points
- ☐ Dead fish washed up on the banks: 6 points

Score: (You will need to enter this assessment in the "Qualitative Water Quality Observations" in the Community Contributors survey.)

0–4 Unlikely that excess nutrients are present.

5–10 Possible that excess nutrients are present.

11–16 Likely that excess nutrients are present.

Water Quality Testing Data

INDEPENDENT WATER QUALITY INVESTIGATION			
ABIOTIC FACTORS	**IDEAL RANGE**	**SITE 1 RESULT**	**SITE 2 RESULT**
Dissolved Oxygen	>5 mg/L	mg/L	mg/L
Turbidity	<10 JTU	JTU	JTU
Temperature	Varies seasonally, however most smaller streams should be shaded	Degrees Celsius	Degrees Celsius
pH	6.5–8.2		
Nutrients	Unlikely that there are excess nutrients in the water		
Salinity	Varies by location. Nontidal streams and rivers should have a salinity of 0 ppt.	ppt	ppt

Collecting data and making observations drives more student led investigations!

Visit cbf.org/join-us/education-program/learn-outside-learn-at-home.html to find additional videos, and worksheets connected to Chesapeake Bay watershed curriculum. Related investigations include:

What makes a healthy stream?

What lives in our freshwater stream?

Backyard Report Card

Species Identification List

SPECIES	LOCATION	QUANTITY	NOTES

Species Identification List

SPECIES	LOCATION	QUANTITY	NOTES

CBF's Schoolyard Report Card

How is your schoolyard doing? How is it impacting the health of the Chesapeake Bay? Follow this Report Card and find out! We will examine how your school uses resources like water and energy and how you can make your schoolyard a better habitat! Grab a clipboard and a writing utensil and start by standing outside your school.

OUTSIDE THE BUILDING: WATER AND EROSION

1. **First, take a look around your schoolyard. How you would describe the grounds? Take a minute to draw a map or write a few sentences about what you see.**

2. **Is your schoolyard mostly paved with concrete? Is there a lot of grass? Are there any trees? Choose from the options listed below. Make your best guess!**
   a. Entirely made of concrete, pavement, blacktop, and sidewalks (0 points)
   b. Mostly grass, concrete, and sidewalks (3 points)
   c. A combination of grass, and gravel, with shrubs, and trees and sidewalks (6 points)
   d. Totally forested with lots of natural landscaping, like mulch (10 points)

3. **After looking at the ground, let's look up at the school roof and find the gutters along the sides of your building. Where do the gutters empty out rainwater? Your school roof drains rainwater into mostly:**
   a. Well-vegetated trees and shrubs or un-mowed grass (10 points)
   b. A rainwater collection system, like a rain garden or rain barrel (10 points)
   c. Mowed grass (3 points)
   d. Bare soil or an impervious surface, like a sidewalk or parking lot (0 points)
   e. Directly underground into a storm drain (0 points)

4. **Next, scan your schoolyard. Look for patches of bare soil and signs of erosion such as areas where rainwater has carved-out ditches or washed-out vegetation. (You might find evidence of erosion next to where the gutters drain!) Your schoolyard has:**
   a. Very little erosion and few patches of bare soil (10 points)
   b. Several patches of bare soil or areas where soil is eroding (5 points)
   c. Mostly bare, exposed soil or impervious surfaces (0 points)

5. **Does your school have any run-off control systems? Check the list below and add up your points!**
   - ☐ Rain Garden (2 points)
   - ☐ Rain Barrel (2 points)
   - ☐ Meadow (2 points)
   - ☐ Wetland (2 points)
   - ☐ No-Mow Zones (2 points)
   - ☐ Forested buffer zone, or a line of trees (2 points)

6. **Take a guess, approximately how much of the water runoff from your school is managed by these types of systems?**
   a. More than half, we have many of the runoff control systems listed above around our schoolyard! (10 points)
   b. Less than half, we have a few of the runoff control systems listed above and still have visible erosion around the schoolyard (5 points)
   c. None, water runoffs our schoolyard directly into impervious surfaces (0 points)

7. **Do you know your school's grounds keeper? Find out! Ask your teacher or your principal! When you find out who they are and where to find them, ask them about how they manage your school grounds. Do they use fertilizer is used on the grounds? If so, how do they apply it? What do they need to consider before adding fertilizer?**
   a. Grass clippings are left as a natural fertilizer (10 points)
   b. Lawn fertilizer is used after doing soil tests (8 points)
   c. Lawn fertilizer is used according to the package instructions (6 points)
   d. Lawn fertilizer is applied at random (3 points)

How many total points did your schoolyard get for this section?	

After exploring your schoolyard, what are additional observations you made? What did you notice about how water runs off your schoolyard?

_____

_____

_____

Can you think of ways to improve how water is absorbed around your schoolyard? Brainstorm three solutions.

1. _____

2. _____

3. _____

OUTSIDE THE BUILDING: SCHOOLYARD HABITAT

Now that we have a sense of what covers the ground of your school yard and how water moves across it, let's take a closer look at how your schoolyard might be a habitat!

1. **Describe the vegetation on your schoolyard:**
    a. Trees and bushes cover a significant part of the schoolyard (10 points)
    b. Trees and bushes dot the landscape of the schoolyard (6 points)
    c. There are few or no trees and bushes on the schoolyard (0 points)

2. **How much of your schoolyard is a mowed grassy area? Make your best guess!**
    a. Less than 50% (10 points)
    b. Between 50% and 80% (6 points)
    c. Over 80% (4 points)

3. **Find the lowest lying area of your schoolyard. What is the vegetation like in this area?**
    a. Well vegetated with trees, shrubs, and grasses (10 points)
    b. Tall un-mowed grass (8 points)
    c. Mowed grass (5 points)
    d. Bare soil, gravel, or pavement (0 points)

4. By counting the different types of leaves, bark, and berries, how many different types of plants are living on your schoolyard?

a. 15 or more (15 points)

b. 10–15 (10 points)

c. 5–10 (5 points)

d. Less than 5 (2 points)

5. Below are examples of habitats. Which of the following can be found on your schoolyard? (4 points each)

- ☐ Woodlands with many types of plants and trees
- ☐ Tall grassy meadows
- ☐ Thick brush and brambles or a brush pile
- ☐ Dead standing trees or rotting logs on the ground
- ☐ Streams with forested buffers
- ☐ Student-planted gardens

6. Can you see any animals on your schoolyard? Write down all the species you see and tally them! Mammals, birds, and insects all count!

a. 0-3 species (3 points)

b. 3-6 species (5 points)

c. 6-10 species (10 points)

d. 10 or more species (15 points!)

How many total points did your schoolyard get for this section?	

After exploring your school's habitat, what are additional observations you made?

_____

_____

To bring more LIFE to your schoolyard, you could:

- Plant native shrubs and flowers that attract wildlife
- Identify what local animals may need and restore their habitat
- Ask your teacher how to get involved
- Plant trees!

OUTSIDE THE BUILDING: RESOURCE CONSUMPTION

Before we head inside your school, we will make our way to the parking lot or bus drop off area, towards the entrance.

1. **Count the total number of vehicles in the parking lot.**
   a. Under 50 vehicles (10 points)
   b. 50-75 vehicles (5 points)
   c. 76 and up (0 points)

2. **Are there bicycle racks at your school and do people use them?**
   a. Yes, there are racks with bikes (10 points)
   b. Yes, there are racks with no bikes (5 points)
   c. No, there are no racks (0 points)

3. **Is there any reward or encouragement for teachers or students who walk to school, ride their bikes, carpool or take public transit?**
   a. Yes (10 points)
   b. No (0 points)

4. **Do your school buses idle while they wait for students? If you don't know the answer, ask the front office staff or your teacher.**
   a. Yes, buses idle (0 points)
   b. No, buses do not idle (10 points)

5. **Can you easily find storm drains around your school parking lot? Is there a sign telling you where the water drains?**
   a. Yes (5 points)
   b. No (0 points)

How many total points did your schoolyard get for this section?	

After exploring how your school uses resources, what are additional observations you made?

_____

_____

_____

INSIDE THE BUILDING: RESOURCE CONSUMPTION

Next, we will move inside your school and take a look at how your school uses water. Find the closest bathroom to begin the next part of the report card.

1. How many gallons of water does each toilet use per flush?

To answer this question, visit a typical student bathroom at your school. Most toilets have the water usage or gallons per flush (gpf) on the inside of the tank or near the back of the toilet bowl behind the seat. If you cannot find your toilet's water use stamp, then determining its age is your key to its water use. Federal plumbing standards passed in 1992 required that toilets use no more than 1.6 GPF, so if your toilet was installed before 1992, then it likely uses 3.5-7 GPF.

a. 1.28 GPF (5 points)
b. 1.6 GPF (4 points)
c. 1.7-3.4 GPF (3 points)
d. 3.5 GPF (2 points)
e. Greater than 3.5 GPF (0 points)

2. Do the sinks have faucets that automatically shut off?

a. Yes, 75% or more of the faucets automatically shut off (5 points)
b. About half of the faucets automatically shut off (3 points)
c. None or few of the faucets automatically shut off (0 points)

3. Do you observe any leaky faucets, leaky pipes, or leaky/running toilets?

a. No observable leaks or drips (5 points)
b. Yes, some (25%-75%) of the faucets and/or pipes are leaking and I can hear a few of the toilets running well after their last flush. (3 points)
c. Yes, most (75% or more) of the faucets and/or pipes are leaking and I can hear the toilets running well after their last flush. (0 points)

4. Visit two bathrooms. Are there signs in the bathrooms reminding you to turn off the water or explaining where the water goes once it goes down the drain?

a. Both bathrooms have signs (5 points)
b. One bathroom has signs (3 points)
c. Neither bathroom has signs (0 points)

5. Does your school have working water fountains or water bottle refill stations?

a. Yes, working water fountains and water bottle refill stations (5 points)

b. Yes, working water fountains or water bottle refill stations (3 points)

c. No, our school's water fountains do not work properly (0 points)

How many total points did your schoolyard get for this section?	

COMPARE YOUR SCORES

Now it's time to compare the scores of each category to find out your school and schoolyard's most positive and negative impacts on local waterways and the Bay!

List your scores from:

Outside the Building: Water and Erosion (62 possible points)	
Outside the Building: Schoolyard Habitat (84 possible points)	
Outside the Building: Resource Consumption (45 possible points)	
Inside the Building: Resource Consumption (25 possible points)	

DISCUSSION QUESTIONS

What is your school doing best for the health of the Bay?

_____

_____

_____

_____

_____

_____

Where do you think your school could improve the most?

_____

_____

_____

_____

_____

_____

In what category are you most interested in helping by doing a project?

_____

_____

_____

_____

_____

_____

What is an extra credit assignment you would like to give your school to improve its score?

_____

_____

_____

_____

_____

_____

COMPLETING A SCHOOLYARD SITE SURVEY

As a class or a group, you can use this site survey to complement the schoolyard report card and identify areas where Bay-friendly practices could be implemented.

PROCEDURE:

1. Draw an outline of the school property, school buildings and parking lots. Use the grid on page 36. This is your base map.
2. Break into groups and walk the entire schoolyard.
3. Sketch on your base map all of the important physical, human-related and biological characteristics listed below. Create a legend and designate symbols to mark important characteristics.
4. Share your observations as a class.
5. Create a collective schoolyard site survey.

Physical Characteristics

Topography:

- Identify high and low spots.
- Locate steep slopes.

Prevailing wind:

- Indicate prevailing wind direction.

Sunny and shady areas:

- Distinguish between areas that receive full sun, partial shade and full shade.

Water:

- Designate any areas that are obvious drainage or waterways.
- Indicate direction of water runoff.
- Locate any areas where erosion is occurring.
- Locate spots that seem especially wet or dry.

Human-Related Characteristics

Structures:

- Identify structures where students play or gather such as playground equipment, bike racks, signs, benches, picnic tables and fences.

Fields:

- Identify the athletic fields and areas that are used for informal play either by the school or other members of the community.
- Identify where students gather for fire drills.

Accessibility:

- Identify areas that are accessible during a class period.
- Indicate formal and informal pathways.
- Identify spaces used by the public.

Utility features:

- Locate obvious utility lines above or below ground.
- Locate existing water or irrigation lines and accessible spigots.

Biological Characteristics

Plants:

- Locate and identify trees, shrubs and plants that provide food and cover for wildlife, both on and adjacent to the school grounds.

Wildlife:

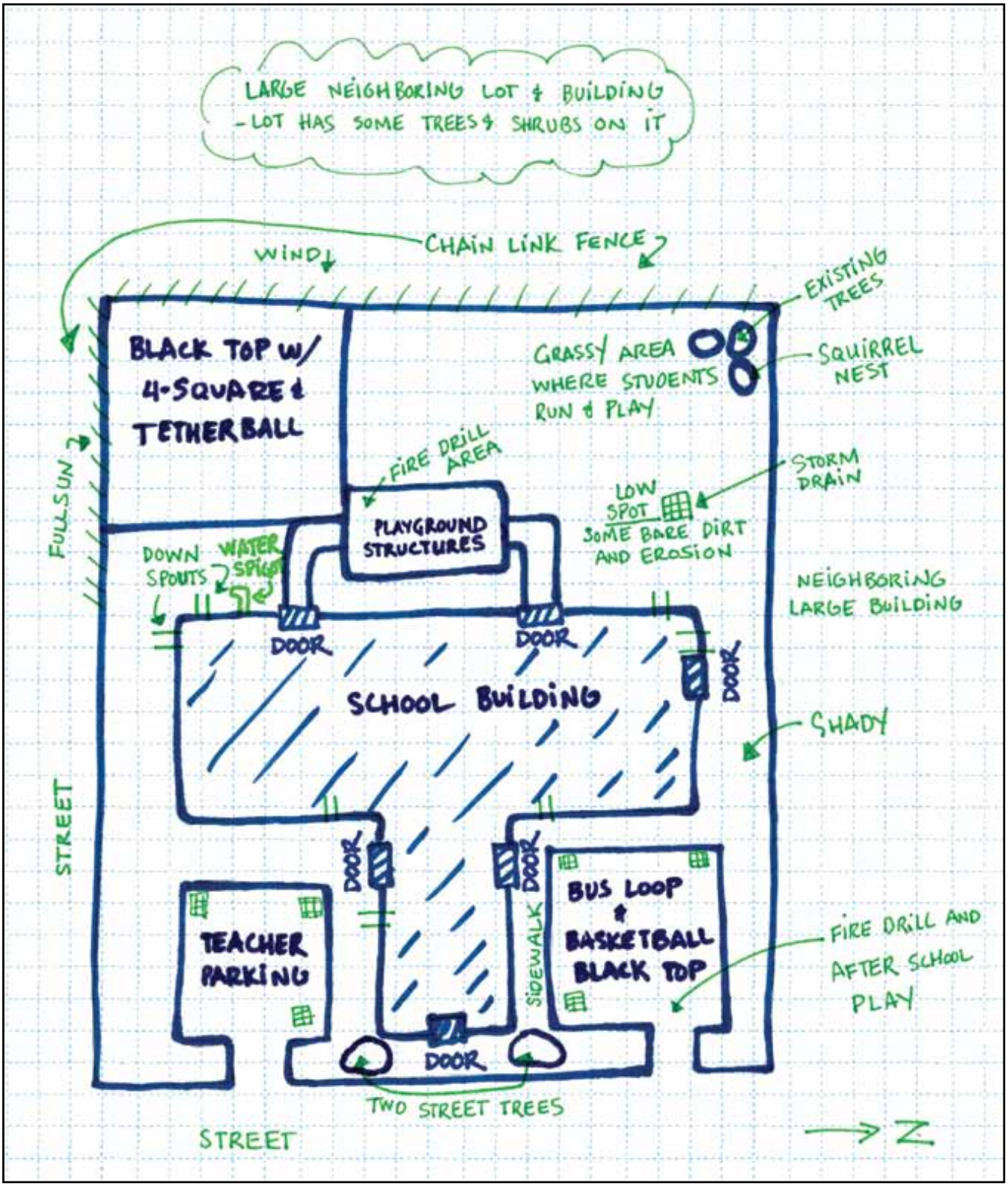
- Locate and identify signs of wildlife on the school grounds.

Groundcover:

- Indicate different groundcovers such as turf grass, bare spots, pavement, woodland groundcovers, native plantings or garden areas.

Source: fws.gov/sites/default/files/documents/FWS-Schoolyard-Habitat-Guide_0.pdf

Example of a Master Plan Assessment: Cityport Elementary School



Nature Journaling

Nature journaling is a way to creatively connect and build a deep, lasting relationship with the natural world. Practice using the prompts included. Find CBF's entire nature journaling blog series at cbf.org/blog/save-the-bay/nature-journaling

Materials Needed: nature journal or paper, pen or pencil, coloring materials, internet access.

I SEE, I WONDER

Assignment

Find a safe spot to observe outside (backyard, porch, by a window). Spend some time studying your environment.

First: Take a few moments to jot down or draw what you observe in this environment. This is purely what is readily apparently based on your senses—what you can see, hear, smell, or feel.

Second: Write down what you are curious about. What do you wonder, what do you wish you knew, and why are things occurring the way they are?

Finally: Write down any connections you can make between the environment you're observing and any past experiences you have had. Do the components of this environment remind you of anything?

Journal Prompt

Write a letter to someone (a friend, a colleague, a family member) who has never seen the place you observed. Use words to describe the setting so they could imagine being there.

NATURE MINDSET

Assignment

Before going outside, create a t-chart in your journal. Take stock of how you are feeling before going outside. List these feelings and thoughts on one side of your chart. Afterwards, find a safe spot to sit outside (backyard, porch, or by a window). Spend a moment resting. Fill the other side of your chart with any new thoughts and feelings that arise while you are enjoying nature. Looking at your lists. Has spending time in nature improved your mood, brought you peace, and/or energized you? Write and draw about the benefits you have experienced. If you found that spending time in nature brought you stress, document those feelings and attempt to trace their source.

Journal Prompt

Create a how-to guide for enjoying nature. How would you prepare physically and mentally to be outside? Where would you go and why? What resources would you bring with you to enhance your outdoor experience.

Additional Resources

John Muir Laws

Harvard Project Zero: Artful Thinking

Harvard: I see, I think, I wonder

Harvard Health Publishing: Sour mood getting you down? Get back to nature

Forbes: Here's How Creativity Actually Improves Your Health

SOUND MAPPING

Assignment

Find a safe spot to observe outside (backyard, porch, or by an open window). Close your eyes and settle into a comfortable position. Relax your breathing for a few moments. Begin to focus on the sounds around you. Note the distance, volume, pitch, and variation of each sound. Acknowledge the sounds that you are contributing to this space as well. Allow yourself to spend at least eight minutes quietly listening before starting your journal entry. Begin by creating a mark on your page that signifies your position, then build a map of the sounds around you. Use writing and drawing to record the distinct variations of each sound.

A nature recording is provided in the additional resources for a comparative listening experience.

Journal Prompt

Can you imagine what a sound map of your favorite natural place would look like? How do certain sounds add value to a place? What would your map look like if you removed all of the natural sounds? Would that place maintain the same value to you?

WITNESS TREE

Assignment

Trees are important for several reasons. Find a safe spot (backyard, porch, by a window) where you are able find one or more trees to observe. If there are no trees in your area, search for tree imagery online. Observe your tree(s) for three to five minutes. Write down all the roles and jobs of the tree(s) you are observing. Crosscheck your list by visiting the Benefits of Trees website.

Journal Prompt

Imagine you are the witness tree in your story. Rewrite the experience from the tree's perspective.

Materials Needed: nature journal or paper, pen or pencil, coloring material

Additional Resources

Sharing Nature: Sound Map

Lower Columbia Estuary Partnership: Sound Mapping Activity

Smithsonian Magazine: These Five "Witness Trees" Were Present at Key Moments in America's History

High Plains Public Radio Prairie Tayles: Witness Trees

National Park Service: Silent Sentinels of Storied Landscapes

Chesapeake Classrooms Project: Designing Meaningful Watershed Educational Experiences (MWEEs)

CBF STAFF

Chesapeake Classroom Project

Construct and communicate a Meaningful Watershed Educational Experience (MWEE) using the Environmental Literacy Model (ELM).

DIRECTIONS

1. Strategize how to use a locally relevant environmental issue as the foundation for achieving learning goals. A few Planning Tools Toolbox resources are included in this guide.
2. Convey plan using the ELM. Include how each MWEE component will be addressed linking key lessons and resources. Cite sources if lessons are not original.
3. Submit completed ELM through Google Classroom ≤ 2 weeks after course completion. A Teacher Environmental Literacy Leader (TELL) mentor will provide feedback using the MWEE Audit Tool.

Understanding The MWEE

Meaningful Watershed Educational Experiences consist of elements and practices that build upon each other to create a comprehensive, student-centered learning experience. Throughout the MWEE, teachers provide structure, support, and encouragement as students use their curiosity and creativity to investigate and take action to address a local environmental issue. MWEEs are appropriate for all grade levels with content and practices growing in complexity and sophistication across the grades—starting with teacher-guided investigations and progressing to student-led inquiry.

Using the MWEE framework helps educators create an engaging program to achieve their learning objectives. Learning objectives should address academic standards, but might also include other objectives, such as teamwork, social-emotional learning, and civic responsibility.

MWEE ESSENTIAL ELEMENTS The four essential elements describe *what students do*. The essential elements are not meant to be linear, and some occur repeatedly throughout the MWEE.

- Issue Definition
- Outdoor Field Experiences
- Synthesis and Conclusions
- Environmental Action Projects

MWEE SUPPORTING PRACTICES The four supporting practices that describe *what teachers do*, along with their partners, to ensure successful implementation with their students.

- Teacher Facilitation
- Learning Integration
- Local Context
- Sustained Experience

The Teaching Resources on Bay Backpack provide information, lesson plans, and classroom resources about the Bay and its watershed.

The Environmental Literacy Model

The **Environmental Literacy Model (ELM)** is a comprehensive planning tool that can help you think through the details of your MWEE. The ELM is designed to help situate the MWEE within the scope and sequence of the curriculum and to ensure that Environmental Action Projects are in direct response to the learning that took place during the earlier phases of the MWEE. ELMs may also be helpful with communicating to school leadership, the local community, and colleagues.

Chesapeake Classrooms uses the Environmental Literacy Model (ELM) to support teachers in the development and curricular integration of Meaningful Watershed Educational Experiences.

The Environmental Literacy Model features three primary components:

- Curriculum Anchor
- Issue Investigation
- Informed Action

The **Curriculum Anchor** defines the learning objectives and the driving question within the local context, the Curriculum Anchor demonstrates the MWEE supporting practices of ***Learning Integration*** and ***Local Context***, and the identification of a driving question for the ***Issue Definition*** essential element. Usually, the Curriculum Anchor is completed by the teacher with no student involvement so the teacher can place the ELM within their curriculum.

Issue Investigation provides the opportunities for students to construct knowledge and understanding through multiple investigations or lessons around a life-relevant issue. By working together throughout the investigation to construct, communicate, and refine explanations about the driving question, the Issue Investigation component of the ELM demonstrates how students engage in the ***Issue Definition***, ***Outdoor Field Experiences***, and ***Synthesis and Conclusions*** essential elements of a MWEE. Issue Investigation may include supporting questions developed by the teacher that covers required curriculum content and lessons; however, be sure to leave space for questions and investigations developed or co-developed by your students.

Informed Action empowers students to adapt and apply the knowledge they have constructed through Issue Investigation. As students develop a claim, identify solutions, design plans, and take informed action, they engage in the essential elements of ***Synthesis and Conclusions*** and ***Environmental Action Projects***. Remember, Students should be actively involved in developing the action project.

By directly supporting the full suite of activities outlined in the ELM, you also fulfill the MWEE supporting practices of ***Teacher Facilitation*** and ***Sustained Learning Experience***.

The Environmental Literacy Model (ELM) was developed by the Chesapeake Bay Foundation through the Maryland Environmental Literacy Partnership and has been updated in partnership with the Chesapeake Bay Program for use with MWEEs. For more information on the ELM, visit cbf.org/mwee.

MWEE Planning

ENVIRONMENTAL LITERACY MODEL (ELM)

Title: _____ **Author:** _____

School/district: _____ **Audience (grade/course):** _____

CURRICULUM ANCHOR

DEFINING THE LEARNING OBJECTIVES AND CURRICULUM CONNECTION

What are the curriculum indicators, performance expectations, and/or student learning objectives?
Are there opportunities to meet academic standards in multiple disciplines or content areas?

DESCRIBING THE LOCAL CONTEXT

What is the local and life-relevant environmental issue, problem, or phenomenon that will serve as the context for learning?

IDENTIFYING THE DRIVING QUESTION

What is the open-ended, life-relevant question that meets academic standards/learning objectives?
Reminder: It should guide inquiry for the investigations and provide opportunities for environmental action.

ISSUE INVESTIGATION

ASKING QUESTIONS AND DEFINING ISSUES

What are supporting questions that students may investigate to further explore the driving question? List the supporting questions that cover your required curriculum content and lessons, but leave at least one Issue Investigation open for those developed or co-developed by your students. Use the space to describe how you will guide them through this student-directed process. After completing your MWEE, add in the student-directed investigations.

Issue Investigation 1 Who is involved in developing this investigation? ☐ *teacher and/or* ☐ *students?*	**Issue Investigation 2** Who is involved in developing this investigation? ☐ *teacher and/or* ☐ *students?*	**Issue Investigation 3** Who is involved in developing this investigation? ☐ *teacher and/or* ☐ *students?*

PLANNING AND CONDUCTING INVESTIGATIONS

How could students plan and conduct indoor and outdoor investigations to actively address the supporting questions? What kinds of data could be collected to draw conclusions and make actionable claims?

Issue Investigation 1 Is this investigation occurring ☐ *indoors and/or* ☐ *outdoor?*	**Issue Investigation 2** Is this investigation occurring ☐ *indoors and/or* ☐ *outdoor?*	**Issue Investigation 3** Is this investigation occurring ☐ *indoors and/or* ☐ *outdoor?*

ISSUE INVESTIGATION (CON'T)

ANALYZING AND INTERPRETING DATA

How could students analyze data (graphic, models, etc.) to reveal patterns and relationships?
What could the process of synthesizing evidence look like?

Issue Investigation 1	Issue Investigation 2	Issue Investigation 3

CONSTRUCTING AND COMMUNICATING A CLAIM

How could you guide your students through the process of developing claims based on their evidence?
How may they communicate these evidence-based claims to internal and/or external audiences?

Issue Investigation 1	Issue Investigation 2	Issue Investigation 3

INFORMED ACTION

IDENTIFYING SOLUTIONS

How could you encourage your students to identify and explore a variety of solutions that could directly address the issue? How could students make decisions about which solution(s) to implement?

DESIGNING A PLAN AND TAKING INFORMED ACTION

What resources or frameworks will students use to create their plan of environmental action? During what time period will they execute their action project?

EVALUATING ACTION

In what ways could students reflect on the action project and determine the extent to which it successfully addresses the issue?

MWEE Self-Assessment Tool

This document is a draft self-assessment tool developed to help teachers think through their MWEE. It was designed by J.Sickler Consulting for the NOAA BWET funded Systemic Solutions for the Susquehanna Projects and it draws from the MWEE Audit Tool, as well as an observational tool (created by JSC and eeEvaluations in 2017); it focuses on all MWEE essential elements and supporting practices, but only on the sub-indicators that were identified as highest priority and toughest bars to clear for teachers. For a more thorough audit download the MWEE Evaluation Tool at baybackpack.com/mwee/what-is-a-mwee.

ESSENTIAL ELEMENTS

Issue Definition

This was tough.	I got started on this.	I did it!	I totally nailed it!
I identified what supporting questions we would be investigating in the MWEE.	Students spent some time thinking about and choosing the issue, problem, or phenomenon from different perspectives including their own.	Students spent time thinking about and discussing the issue from different perspectives AND had a role in identifying potential options for our MWEE.	Students spent time meaningfully thinking about and discussing the issue from different perspectives AND were the drivers behind what we investigated in the MWEE.

Outdoor Field Experiences

This was tough	I got started on this.	I did it!	I totally nailed it!
We did not go outside for any field experiences.	Students went outside for one field experience that related to our driving issue.	Students went outside for multiple field experiences. Sometimes we discussed how the activities we did in the field connected to our MWEE.	Students went outside for multiple field experiences. In all of the field experiences, we discussed how the activities we did in the field connected to our MWEE.

Synthesis & Conclusions

This was tough	I got started on this.	I did it!	I totally nailed it!
While students drew results and conclusions in their work, they presented what they found only to me	Students reported their results and conclusions with one another (within our class).	Students reported their results and conclusions audiences within our broader school community, such as other classes/ grades, teachers, or staff.	Students reported their results and conclusions to audiences outside of our school in some form, such as parents, the school board, community members, local professionals, media, or government representatives.

Environmental Action Projects

This was tough	I got started on this.	I did it!	I totally nailed it!
Students did not participate in an action project.	I chose and designed the action project; students participated to implement the action.	Students had a role in both choosing and implementing our action project, but an adult primarily did the planning.	Students took a strong role in both planning and implementing our action project. Student decisions had meaningful impact on how we did the project.

SUPPORTING PRACTICES

Teacher Facilitation

This was tough	I got started on this.	I did it!	I totally nailed it!
I primarily allowed other teachers, staff, or professionals to take the lead on facilitating all parts of the MWEE.	I actively facilitated student experience in some essential elements of the MWEE, but relied on other teachers, staff, or professionals to take the lead in facilitating at least one element.	I actively facilitated or co-facilitated with a partner all essential elements of the MWEE (issue definition, field experiences, synthesis, and environmental action projects.	I successfully acted as a co-learner with my students, actively supporting students to take increasing ownership and control of the direction for our investigation throughout all elements of the MWEE.

Learning Integration

This was tough	I got started on this.	I did it!	I totally nailed it!
I haven't identified or articulated specific learning objectives for the MWEE.	I know the learning objectives for the MWEE, but I didn't clearly document them.	I have clearly written learning objectives for the MWEE, but they mainly integrate with only one discipline OR they don't directly support academic standards.	I have clearly written learning objectives for the MWEE, and those objectives integrate with multiple academic disciplines and standards.

Local Context

This was tough	I got started on this.	I did it!	I totally nailed it!
The MWEE was centered on a broad, large-scale problem, issue, or phenomenon. While the issue might be relevant locally, we focused on understanding the broad concept.	The MWEE was centered on a broad, large-scale problem, issue, or phenomenon. I made efforts to explain connections to local issues, but the students' work was primarily around understanding the larger concept.	The MWEE's driving question primarily addressed a locally relevant problem or issue. Some students were able to draw direct connections between the issue and their lives, but this was inconsistent.	The MWEE's driving question was consistently focused on a locally relevant problem or issue. And students were able to draw direct connections between the issue and the impact on their lives.

Sustained Experience

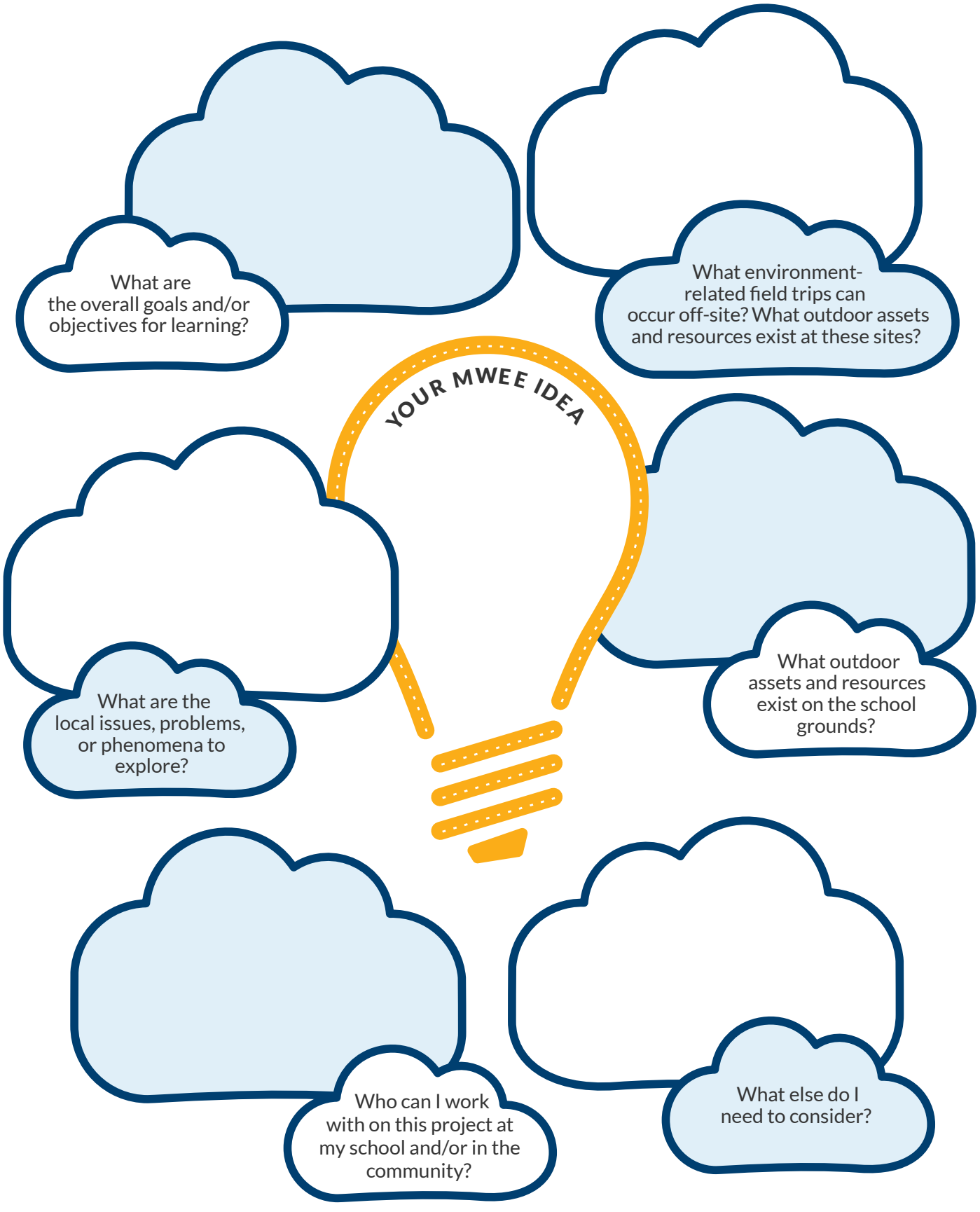
This was tough	I got started on this.	I did it!	I totally nailed it!
The MWEE was completed in one to three days.	The MWEE was completed in the span of a week or two, mainly centered around a field experience and pre/post activities.	The MWEE was completed over the span of a single unit of instruction, maybe taking several weeks or a month.	The MWEE was a sustained project that spanned a series of instructional units and occurred over at least a full semester (or even a full school year).

RESOURCES

Find additional resources at cbf.org/eduresources and baybackpack.com

KENNY FLETCHER

MWEE THINK CLOUD



DEVELOPING DRIVING AND SUPPORTING QUESTIONS

EFFECTIVE DRIVING QUESTIONS

- Allows for the exploration of both natural and social systems.
- Supports learning objectives.
- Open-ended.
- Relevant and related to students' lived experiences.
- Provides the opportunity for students to develop and explore as their knowledge and understanding evolve.
- Examples:
  - How has climate change impacted the ecology and community use of our river?
  - How has our school community supported our local watershed?

SUPPORTING QUESTIONS

Supporting questions help students find information needed to develop potential answers to the driving question. Student generated questions help engage students in the investigation.

DEVELOPING QUESTIONS

Practice developing questions yourself and as an engagement practice with your students. Choose one idea from each column to help brainstorm a few possible questions. Then come up with your own ideas for each column and discuss how you might use this approach with your students to support your MWEE.

Question Stem	Doer	Action	Issue	For Whom
How can... What could... How do\does...	I... our class... our school... our town... our state ... our watershed...	change... design... create... investigate... impact... understand...	ecosystem value for... water quality in... land use for ... wildlife habitat in... pollution in... migration patterns in...	the Bay... our creek/river... our school/ community... our schoolyard...

Find the related student worksheet on p.62 in *An Educator's Guide to the Meaningful Watershed Education Experience (MWEE)*, which can be downloaded at baybackpack.com

ASSESSING A SITE FOR AN OUTDOOR FIELD EXPERIENCE

As a MWEE Essential Element, Outdoor Field Experiences can take place on schoolgrounds or a nearby stream or park. They can also take place at offsite locations like state parks, wildlife refuges, or education centers equipped with experts, gear, and facilities. Regardless of location, Outdoor Field Experiences often require planning with multiple people, from support staff and school administration to transportation and outside facilitators.

While planning any Outdoor Field Experience, you should always consider the following:

- How will field experiences be used to make observations, collect data, or otherwise help answer the driving/ supporting questions?
- How can field experiences be used to explore solutions as part of Environmental Action Projects?

Use the chart to assess sites for an Outdoor Field Experience. For each site, consider the additional questions.

	Possible Site #1: School Grounds	Possible Site #2:	Possible Site #3:
Site location and description			
What do the field experiences contribute to your MWEE (learning objectives, science and engineering practices, etc.)?			
What will the teacher do to facilitate learning?			

What natural features, facilities, and/or programs are available at the site?

Are there costs associated with this site (transportation, program fees, etc.)?

What permissions and/or permits need to be secured?

Does the site provide adequate access for students of all abilities? This may include technology mediation, boardwalks, guide ropes, braille signs, etc.

What resources would you need to make it happen?

Find the full explanation and tool on pp.17-20 in *An Educator's Guide to the Meaningful Watershed Education Experience (MWEE)*, which can be downloaded at baybackpack.com

BRAINSTORMING ENVIRONMENTAL ACTION PROJECTS

This MWEE Essential Element allows students to understand that they personally have the power to bring about change by taking action to address environmental issues at the personal, community, or societal level. Taking action instills confidence in students and can contribute to students becoming environmental stewards in their communities.

Explore the types of Environmental Action Projects listed below. After reviewing the examples, brainstorm additional projects that could fit into each category

RESTORATION OR PROTECTION:	COMMUNITY ENGAGEMENT:
actions that assist in the recovery or preservation of a watershed or related ecosystem that has been degraded, damaged, or destroyed.	actions that inform others about how to address community-level environmental issues.
Plant a tree Remove invasive species Install a rain garden	Present to local organizations Record or broadcast a PSA Mentoring

EVERYDAY CHOICES:	CIVIC ENGAGEMENT:
actions that reduce human impacts on watersheds and related ecosystems and offer ways to live more sustainably.	actions that identify and address issues of public concern. Students acting along or together to protect societal values or make a change or difference in the student's school, neighborhood, or community.
Reuse plastic take-out containers Compost food or yard waste Monitor and save water	Present to school board Attend at a townhall meeting Write to an elected official

Find additional examples in An Educator's Guide to the Meaningful Watershed Education Experience (MWEE), which can be downloaded at baybackpack.com

MOVING FROM CLAIMS TO INFORMED ACTION

Name: _____ **Class:** _____

Claim

Question	Solution #1	Solution #2	Solution #3
What action could be taken to address the environmental issue?			
How would this action help to address the issue?			
What resources would you need to make it happen?			

Glossary

Algae—group of primitive, non-flowering plants that include certain seaweed and microscopic phytoplankton.

Anadromous Fish—fish, such as American shad, that migrate from their primary habitat in the ocean to freshwater to spawn.

Benthic Organisms—plants and animals living in or on the bottom in aquatic environments.

Brackish Water—mixture of fresh and salt water.

Blueprint—The Chesapeake Clean Water Blueprint is the mandatory federal/state effort to restore water quality in the Bay and its rivers and streams. It comprises EPA's science-based pollution limits for nitrogen, phosphorus, and sediment in the Chesapeake Bay watershed and the Bay states and the District of Columbia's plans to achieve limits.

Catadromous Fish—fish, such as the American eel, that migrate from their primary freshwater habitat to the ocean to spawn.

Copepods—minute shrimp-like crustaceans; often they are the most common zooplankton in estuarine waters.

Decomposer—organisms (chiefly bacteria and fungi) that break down dead organic matter.

Detritus—decomposed or partly decomposed plant and animal matter.

Dissolved Oxygen—oxygen released into the water by photosynthesis and air—water interactions; essential for respiration of aquatic animals.

Ebb Tide—falling or lowering tide.

Ecology—the study of interrelationships of living things to one another and to their environment.

Ecosystem—an interactive system of a biological community and its non-living environment.

Erosion—the wearing away of land surfaces by wind or water; erosion occurs naturally but it is often intensified by land-use practices.

Estuary—semi-enclosed, tidal, coastal body of water open to the sea in which fresh and saltwater mix.

Eutrophication—over-enrichment of a body of water due to excessive nutrient loading, often resulting in depletion of dissolved oxygen.

Flood Tide—rising tide.

Food Web—complex interaction of food chains in a biological community.

Habitat—the place where a plant or animal lives.

Intertidal Zone—the area between high and low tide.

Marsh—low, wet, grassland without trees, periodically covered by water.

Nekton— free swimming aquatic organism such as fish.

Nitrogen—an inorganic nutrient essential for plant growth; excess amounts can cause eutrophication.

Non-point Source Pollution—pollutants entering waterways from a general area, such as polluted runoff from farmland or suburban communities.

Nutrients—chemicals (primarily nitrogen and phosphorous) necessary for organisms to live.

Organic Matter—chemical compounds made with carbon, made in live processes by plants and animals

pH—a measure of the acidity or alkalinity of a material, liquid, or solid; estuarine water is, naturally, slightly base.

Phosphorous—nutrient essential for plant growth and reproduction; usually associated with polluted farmland runoff, sewage, and detergents.
Phytoplankton—the plant form of plankton, most are microscopic; they are important as primary producers in an estuarine ecosystem.

Photosynthesis—process by which plants convert sunlight into living tissue using carbon dioxide, water, and nutrients; primary production.

Plankton—organisms living suspended in the water column, often microscopic but sometimes visible to the naked eye.

Plant Zonation—the distribution of plant species into zones in response to some habitat condition such as salinity or moisture.

Point-Source-Pollution—pollution from a definable source, such as an outfall pipe.

Polluted Runoff—Stormwater becomes polluted runoff when rain collects oil, fertilizers, pet waste, pesticides, toxic metals, and other pollutants from pavement and other hardened surfaces as it runs into local waterways.

Pollution—presence of abnormally high concentrations of harmful substances in the environment, often put there by people.

Primary Producers—organisms using the sun's energy and inorganic nutrients to synthesize organic compounds; provides energy to other organisms.

Phytoplankton—the plant form of plankton.

Salinity—the measurement (parts per thousand/ppt) of the amount of dissolved salts in water; 35 ppt for seawater, 0 ppt for freshwater.

Secchi Disk—a white plate-sized disk attached to a rope, that when lowered down into the water measures turbidity or water clarity.

Sediment—particles that accumulate on the bottom of a waterway.

Sewage Treatment Plant—place where sewage is treated to make it safe to be pumped into a river or the Bay.

Tides—periodic movement of a body of water by the gravitational attraction of the moon and sun with the rotation of the earth.

Tributaries—streams and rivers that supply a larger body of water.

Trophic Levels—the levels at which an organism feeds in a food web (producer, primary consumers etc.).

Turbidity—the measurement of water cloudiness; it may be affected by such things as sediment and plankton concentrations.

Underwater Grasses (Bay Grasses)—rooted vegetation that grows beneath the water surface.

Watershed—an area of land that is drained by a specified river or other body of water.

Zooplankton—the animal form of plankton.

Course Contact Information

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Chesapeake Bay Watershed Map