



Watershed Watch

an Citizen Science Investigation of the Radcliffe Creek Watershed

Student Field Notebook *and* Radcliffe Creek Field Guide

student name

school name





About Watershed Watch

In 2018, the Sultana Education Foundation (SEF), Kent County Public Schools, Kent School and Radcliffe Creek School established a long-term study, monitoring and restoration program known as *Watershed Watch* focusing on Radcliffe Creek, a tributary of the Chester River and Chesapeake Bay.

Students and teachers participating in the program will conduct year-long examinations of the Radcliffe Creek watershed in Kent County, in order to learn 1) how watersheds function, 2) how human activity impacts water quality downstream, and 3) how communities and individuals can implement specific practices to improve water quality and environmental health locally and throughout the Chesapeake region.

Implemented on a county-wide scale, the goal of *Watershed Watch* is to measurably improve understanding of watershed-related issues in Kent County, and encourage students to participate in action projects that lead to improved water quality in Radcliffe Creek and the Chester River.



Content &
Program Partners



Welcome to Watershed Watch

Welcome to the *Watershed Watch* program. Throughout the school year you will be working with your teachers and staff from Sultana Education Foundation (SEF) to complete a scientific investigation of the Radcliffe Creek watershed.

The sections found in this field notebook correspond to different activities you will participate in over the course of the program. Use the pages provided to record data, make observations, and answer questions. There are also pages provided at the end of each module for a personal reflection. Questions to consider when writing a personal reflection include:

- What did you do today?
- What was the focus of the day's activities?
- What was your favorite part of the activity?
- What did you learn about Radcliffe Creek and its watershed?

We look forward to seeing you soon!

Sincerely,

Chris Cerino

A handwritten signature in black ink, appearing to read "Chris Cerino".

Vice President

Sultana Education Foundation

Beth Lenker

A handwritten signature in black ink, appearing to read "Beth A. Lenker".

Science Director

Sultana Education Foundation

Student Field Notebook Development Team

Principal Author - Beth Lenker, *Sultana Education Foundation*

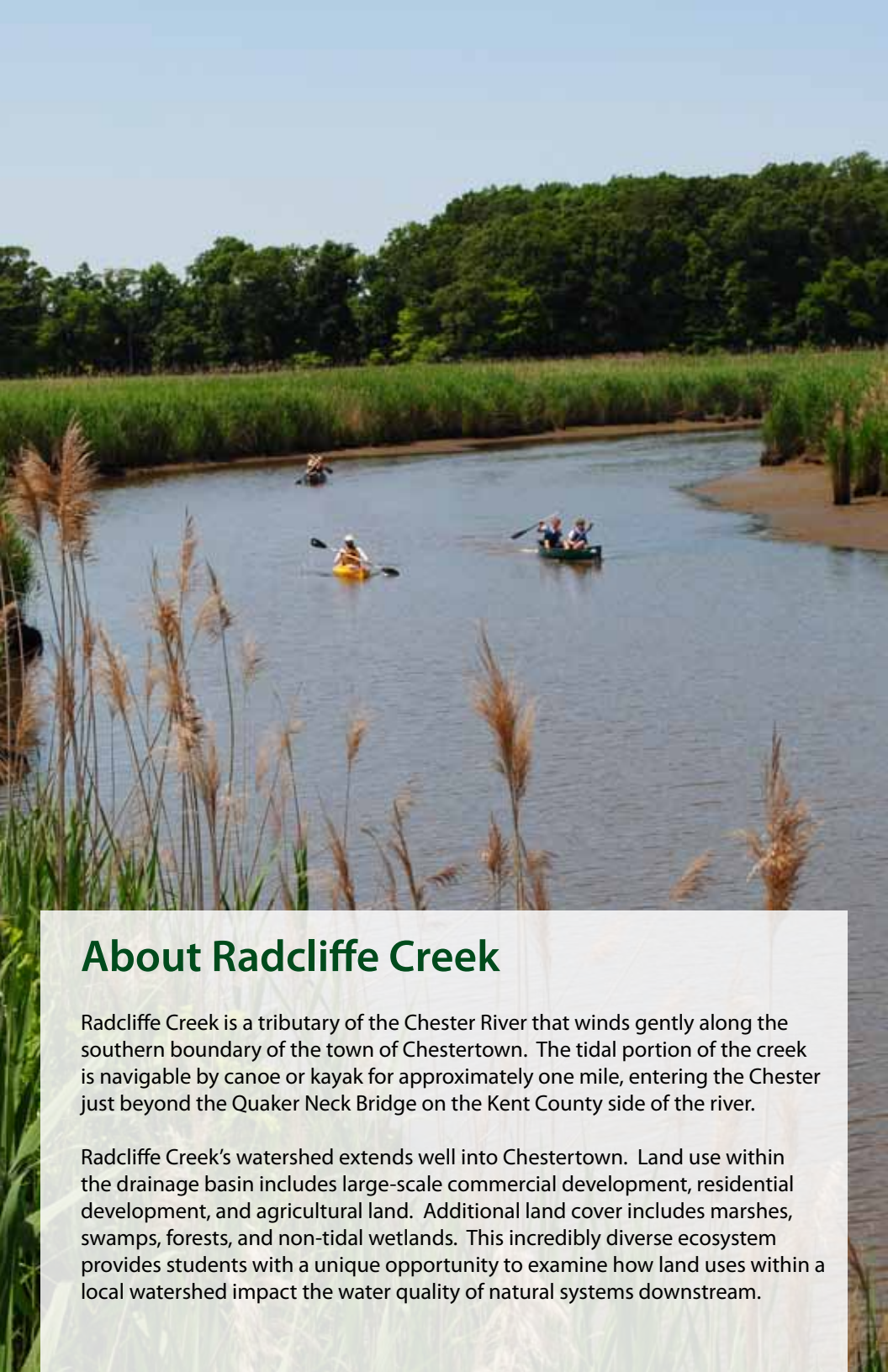
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About Radcliffe Creek

Radcliffe Creek is a tributary of the Chester River that winds gently along the southern boundary of the town of Chestertown. The tidal portion of the creek is navigable by canoe or kayak for approximately one mile, entering the Chester just beyond the Quaker Neck Bridge on the Kent County side of the river.

Radcliffe Creek’s watershed extends well into Chestertown. Land use within the drainage basin includes large-scale commercial development, residential development, and agricultural land. Additional land cover includes marshes, swamps, forests, and non-tidal wetlands. This incredibly diverse ecosystem provides students with a unique opportunity to examine how land uses within a local watershed impact the water quality of natural systems downstream.

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Students are introduced to the concept of a watershed and use online mapping resources at www.wikiwatershed.org to delineate the watersheds of the Chesapeake Bay, Chester River, and Radcliffe Creek.

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Students participate in a classroom session where they learn how to use test kits to monitor water quality parameters and sample macroinvertebrates as a way to gauge stream health.

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Students visit Gateway Park to conduct water quality tests and sample macroinvertebrates at the headwaters of Radcliffe Creek to assess the health of the stream.

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Students analyze Radcliffe Creek water quality data, use their findings to assign a grade to the stream’s health, and compare their assessment to grades assigned to the creek by local scientists.

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Module 1: Watershed Mapping

Location: At Your School

A. Watershed Models

Activity: Working with your classmates, use the Chesapeake Bay watershed tarp and ping pong balls to model how water moves throughout the watershed. Record your observations:

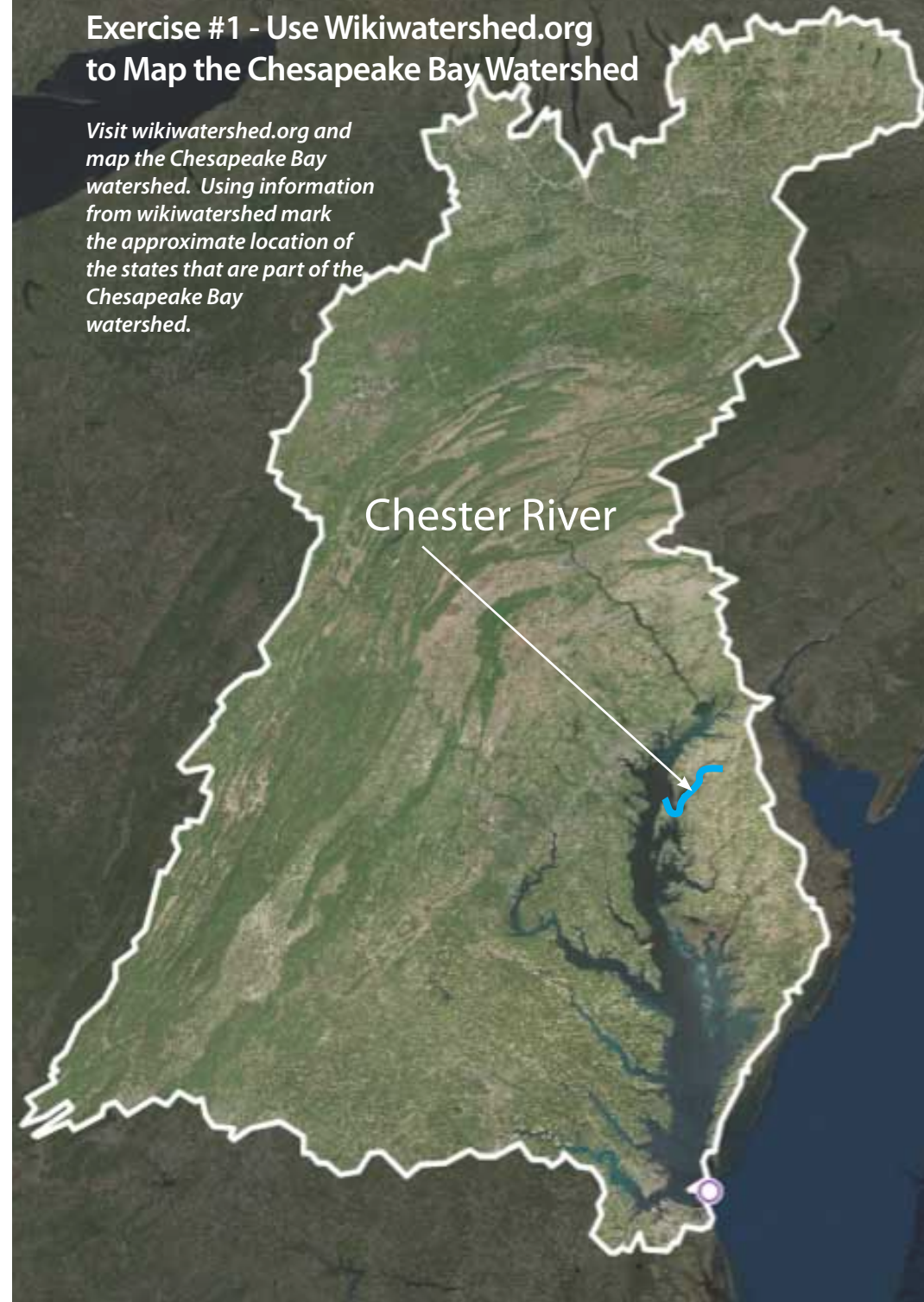
Activity: Repeat the activity using the Radcliffe Creek watershed tarp. Record your observations:

Question: Based on your models, how would you define a watershed?

Chesapeake Bay Watershed

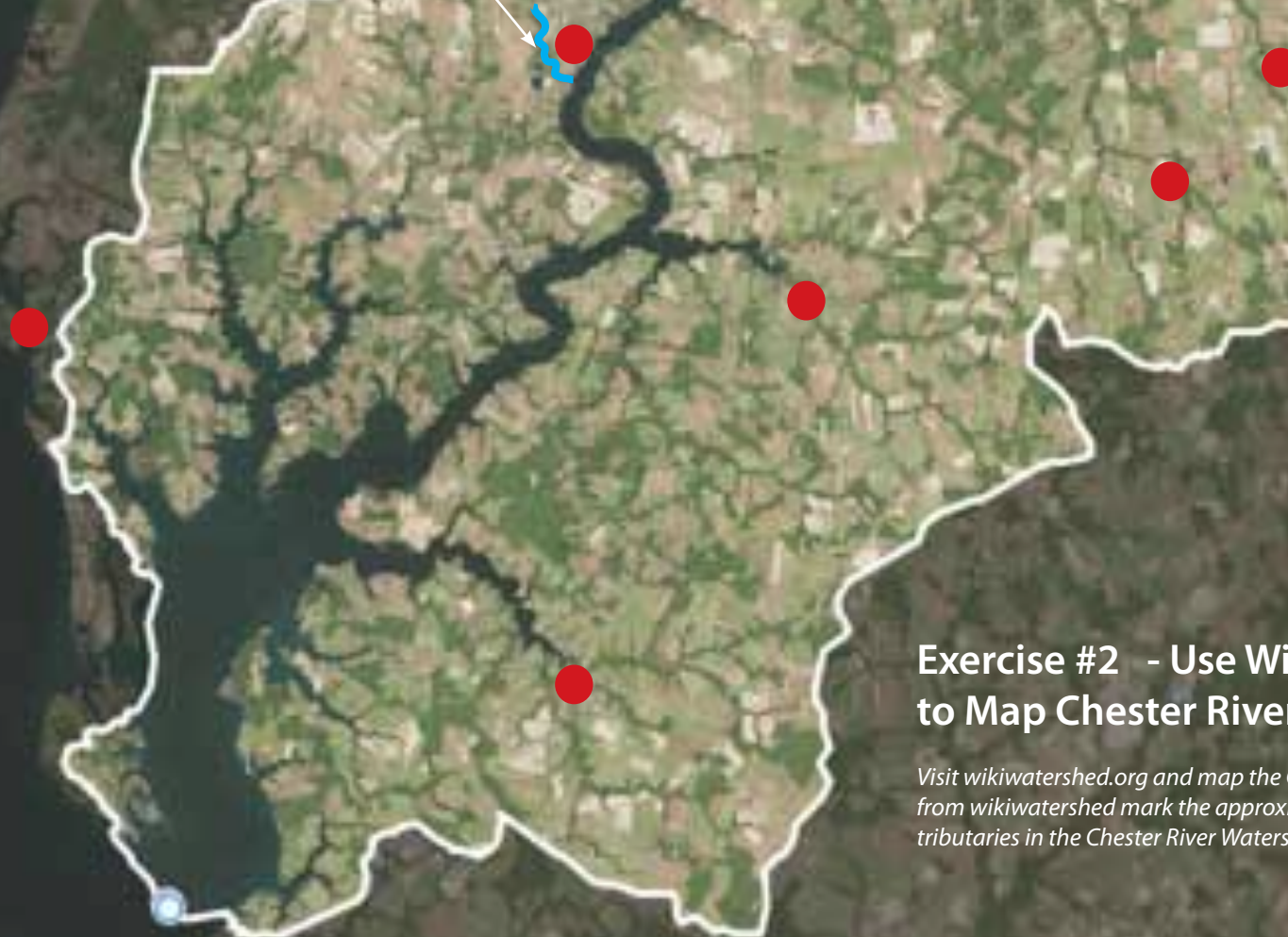
Exercise #1 - Use Wikiwatershed.org to Map the Chesapeake Bay Watershed

Visit wikiwatershed.org and map the Chesapeake Bay watershed. Using information from [wikiwatershed](http://wikiwatershed.org) mark the approximate location of the states that are part of the Chesapeake Bay watershed.



Chester River Watershed

Radcliffe Creek



Exercise #2 - Use Wikiwatershed.org to Map Chester River Watershed

Visit wikiwatershed.org and map the Chester River watershed. Using information from wikiwatershed.org mark the approximate location of major towns and tributaries in the Chester River Watershed on the map above.

Radcliffe Creek Watershed

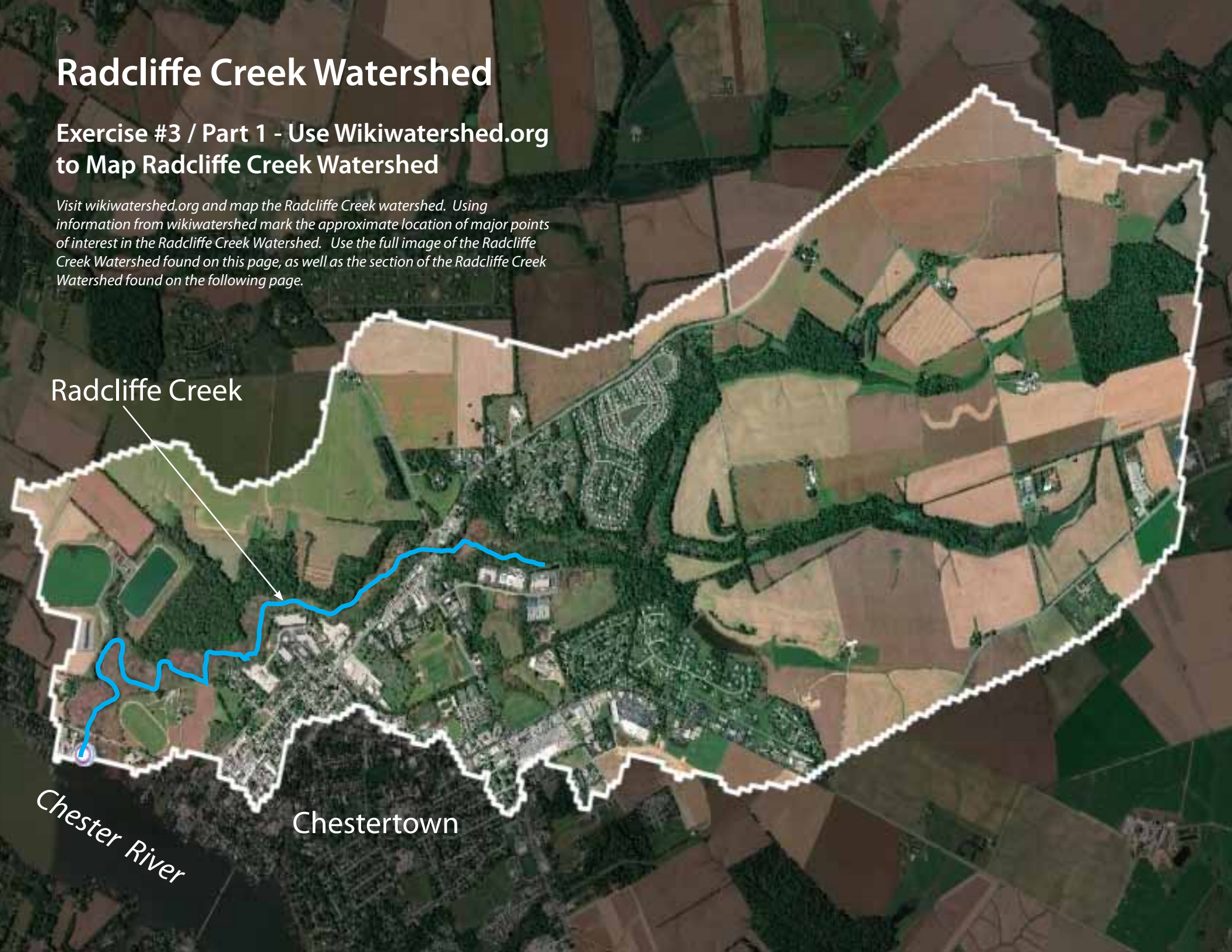
Exercise #3 / Part 1 - Use Wikiwatershed.org to Map Radcliffe Creek Watershed

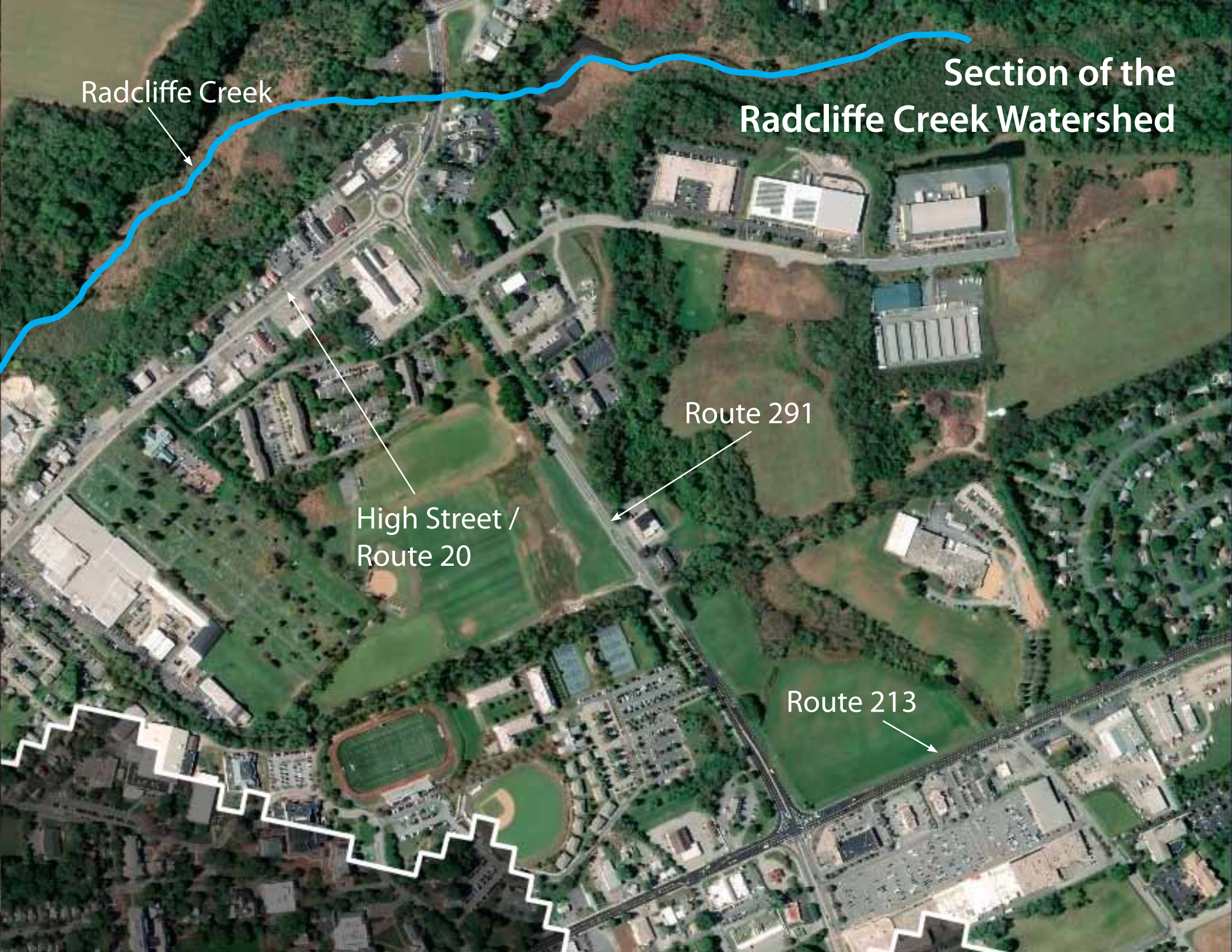
Visit wikiwatershed.org and map the Radcliffe Creek watershed. Using information from wikiwatershed mark the approximate location of major points of interest in the Radcliffe Creek Watershed. Use the full image of the Radcliffe Creek Watershed found on this page, as well as the section of the Radcliffe Creek Watershed found on the following page.

Radcliffe Creek

Chestertown

Chester River





Radcliffe Creek

Section of the
Radcliffe Creek Watershed

Route 291

High Street /
Route 20

Route 213

B. The Health of Radcliffe Creek

Question: What are some of the land uses found in the Radcliffe Creek watershed?

Question: How does the land use within the watershed affect the health and quality of Radcliffe Creek? Give at least two examples.

Question: Why does this matter? Why should we care about the health of Radcliffe Creek?

Make a Prediction: Based on the land use patterns that you can identify within the Radcliffe Creek watershed, make a prediction about the water quality you will find on your field trip to the headwaters of the stream. Do you think the water will be clear and clean? Cloudy and polluted? Somewhere in between? Be sure to explain your hypothesis.

C. Module 1 Reflection

Module 2: Intro to Field Sampling

Location: At Your School

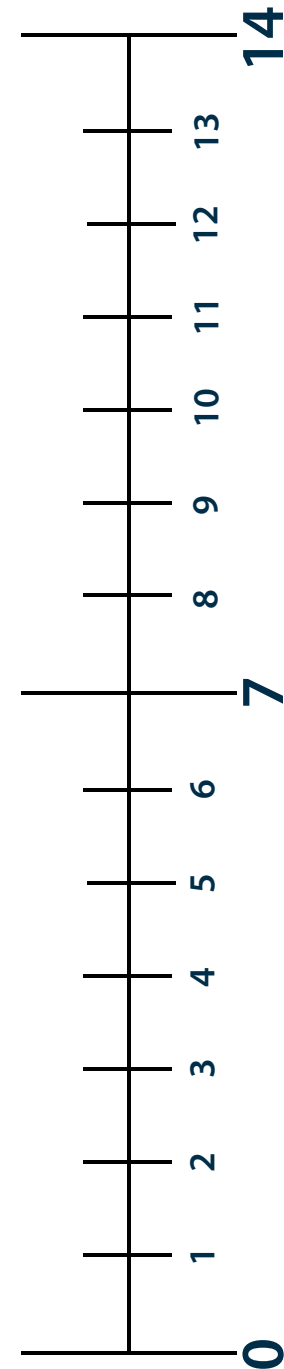
A. Warm-up Questions

Question: What could scientists look at to get an idea of the water quality of Radcliffe Creek? Why?

Question: The indicators we will use during Watershed Watch to explore the health of Radcliffe Creek include:

pH Scale

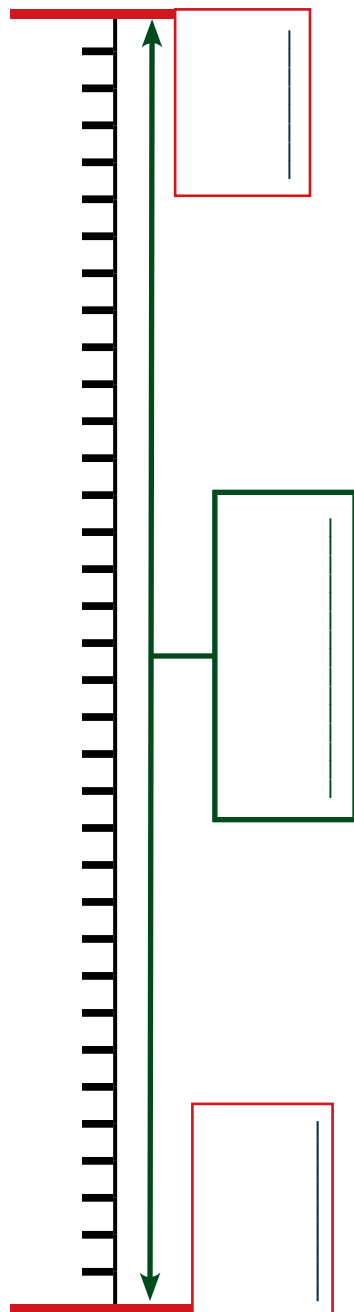
(label this scale according to instructions from your teacher)



Salinity Scale

(label this scale according to instructions from your teacher)

PPT = Parts Per Thousand



Water Chemistry Data Sheet

Sample

Date: _____ Time: _____

GPS Coordinates: _____

Weather: _____

Air Temp. (°F): _____ Air Temp (°C): _____

Water Temp. (°F): _____ Water Temp (°C): _____

Salinity: _____ pH: _____

Dissolved O₂: _____ Nitrogen: _____

Phosphorus: _____

Additional Notes:

Common Macroinvertebrates

Sensitive Species



Gilled snails



Mayfly



Water pennies

Semi-Sensitive Species



Clams



Freshwater mussels



Crayfish

Tolerant Species



Leeches



Orb snails



Black fly larva

Definition - Define macroinvertebrate

Macroinvertebrate Survey Data Sheet - Simulation

Sensitive	Semi-Sensitive	Tolerant
Caddisflies (except net spinners) Mayflies Stoneflies Watersnipe flies Riffle beetles Water pennies Gilled snails Total: () x 3 =	Dobsonflies Fishflies Craneflies Damselflies Dragonflies Crayfish Clams Mussels Total: () x 2 =	Aquatic worms Black flies Midge flies Leeches Lunged snails Orb snails Total: () x 1 =

Macroinvertebrate Survey Scoring Simulation

During your visits to Radcliffe Creek you will collect information about macroinvertebrates that live in around the Creek. You will record this data (see page 17), and then use a form like this to “score” your results.

Date: _____ Time: _____

Use the tally sheet on the opposite page to record the number of each type of macroinvertebrate you find. Based on your findings, analyze the health of Radcliffe Creek's headwaters and record your data below.

Stream score based on macroinvertebrate data

_____ Excellent (> 22)

_____ Good (17-22)

_____ Fair (11-16)

_____ Poor (< 11)

Prediction: Make a prediction about which macroinvertebrates you will find in Radcliffe Creek. Be sure to support your prediction.

Module 2 Reflection

[illegible]

Module 3: Radcliffe Creek Headwaters

Location: Gateway Park, Chestertown

Aquatic Life Data Sheet

Date: _____ Time: _____

Organism #1

Common Name: _____

Classification: _____

Quantity: _____

Description/Notes: _____

Organism #2

Common Name: _____

Classification: _____

Quantity: _____

Description/Notes: _____

Organism #3

Common Name: _____

Classification: _____

Quantity: _____

Description/Notes: _____

Organism #4

Common Name: _____

Classification: _____

Quantity: _____

Description/Notes: _____

Organism #5

Common Name: _____

Classification: _____

Quantity: _____

Description/Notes: _____

Organism #6

Common Name: _____

Classification: _____

Quantity: _____

Description/Notes: _____

Organism #7

Common Name: _____

Classification: _____

Quantity: _____

Description/Notes: _____

Additional Notes (or drawings):

Macroinvertebrate Survey Scoring

Location: Radcliffe Creek Headwaters

Date: _____ Time: _____

Use the tally sheet on the opposite page to record the number of each type of macroinvertebrate you find. Based on your findings, analyze the health of Radcliffe Creek’s headwaters and record your data below.

Stream score based on macroinvertebrate data

_____ Excellent (> 22)

_____ Good (17-22)

_____ Fair (11-16)

_____ Poor (< 11)

Additional Notes (or drawings):

Macroinvertebrate Survey Data - Radcliffe Creek Headwaters

Sensitive	Semi-Sensitive	Tolerant
_____ Caddisflies (except net spinners)	_____ Dobsonflies	_____ Aquatic worms
_____ Mayflies	_____ Fishflies	_____ Black flies
_____ Stoneflies	_____ Craneflies	_____ Midge flies
_____ Watersnipe flies	_____ Damselflies	_____ Leeches
_____ Riffle beetles	_____ Dragonflies	_____ Lunged snails
_____ Water pennies	_____ Crayfish	_____ Orb snails
_____ Gilled snails	_____ Clams	
	_____ Mussels	
Total: (_____) x 3 = _____	Total: (_____) x 2 = _____	Total: (_____) x 1 = _____

Water Chemistry Data Sheet

Location: Radcliffe Creek Headwaters

Date: _____ Time: _____

GPS Coordinates: _____

Weather: _____

Air Temp. (°F): _____ Air Temp (°C): _____

Water Temp. (°F): _____ Water Temp (°C): _____

Salinity: _____ pH: _____

Dissolved O₂: _____ Nitrogen: _____

Phosphorus: _____

Additional Notes:

Storm Drain Survey

Location: Radcliffe Creek Headwaters

Walk around and survey the area along Radcliffe Creek by Gateway Park, the crossing of Route 20, behind the Royal Farms, and along the end of the Chestertown Rail Trail. Use the blank map on the following page to color the observed land uses around Radcliffe Creek. Be sure to use the colors indicated in the key. Mark the locations of storm drains and/or pipes.

Color Key for Land Use



Dark green **trees, forest**



Light green **grass, mowed lawn**



Brown **fields, agriculture**



Red **buildings, houses**



Black **roads, streets**



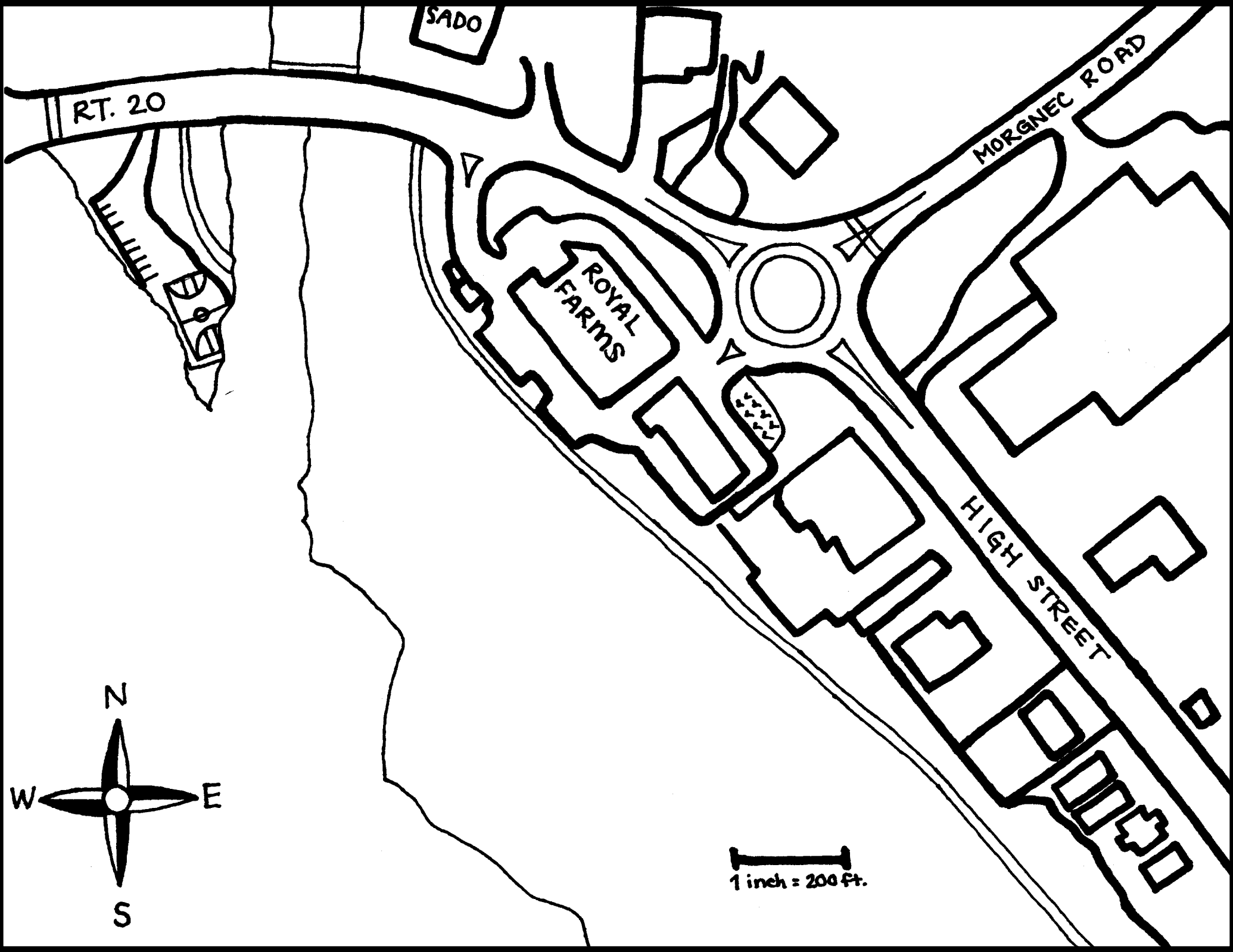
Grey **paved surfaces, parking lots**



Light blue **fresh water (ponds, lakes, streams)**



Dark blue **brackish water (rivers, bay)**



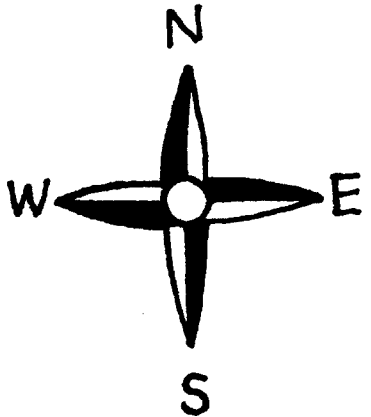
SADO

RT. 20

ROYAL FARMS

MORGNEC ROAD

HIGH STREET



1 inch = 200 ft.

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Module 4: Radcliffe Creek - Past & Present

Location: Holt Education Center

A. Land Use

Question: How has the land around Radcliffe Creek and the Chester River been used in the past?

Question: How has the land changed? Use evidence from the maps in your answer.

B. Plants and Animals

Activity: Identify three organisms and explain the role they play in the Radcliffe Creek Ecosystem.

Organism #1: _____

Describe this organism's role in the ecosystem:

Organism #2: _____

Describe this organism's role in the ecosystem:

Organism #3: _____

Describe this organism's role in the ecosystem:

Question: How does water quality affect the health of the organisms you described on the previous page?

Question: What are the internal features that make some macroinvertebrates sensitive to pollution?

Dissection: Draw and label the parts of the organism you dissected during this module.

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Module 5: Ecosystem Experts

Location: At Your School

Becoming an Ecosystem Expert will prepare you to be an expert on one of the many organisms we will see while paddling Radcliffe Creek.

A. Organism Selection

Start by choosing one organism from the following list:

Birds

Great blue heron
Bald eagle
Barn swallow
Osprey
Red-winged blackbird
Wood ducks
Mallards

Invertebrates

Grass shrimp
Macroinvertebrates
Crab
Brackish water clams
Mammals
Muskrat
White-tailed deer

Plants

Phragmites
Cattails
Wild rice
Smooth cordgrass
Arrow arum (Tuckahoe)
Pickerelweed
Big cordgrass
Duckweed

Fish

Mummichog
Banded killifish
White perch
Striped killifish

Reptiles

Red-bellied turtle
Brown water snake
Eastern painted turtle
Stinkpot musk turtle
Black rat snake

B. Organism Report

Organism's Common Name: _____

Organism's Scientific Name: _____

Question: What role does your organism play in the ecosystem?
Can it have positive or negative impacts?

Question: What role does your organism play in the food web?

Question: What evidence does your organism leave that it has been in the area?

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This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Location: Wilmer Park

Species Check List:

- ☐ Bald eagle
- ☐ Banded killifish
- ☐ Barn swallow
- ☐ Black rat snake
- ☐ Brown water snake
- ☐ Eastern painted turtle
- ☐ Grass shrimp
- ☐ Great blue heron
- ☐ Mallard duck
- ☐ Mummichog
- ☐ Muskrat
- ☐ Osprey
- ☐ Red-bellied turtle
- ☐ Red-winged blackbird
- ☐ Snapping turtle
- ☐ Stinkpot musk turtle
- ☐ Striped killifish
- ☐ White perch
- ☐ White-tailed deer
- ☐ Wood duck

- _____ Arrow arum (Tuckahoe)
- _____ Big cord grass
- _____ Cattails
- _____ Phragmites
- _____ Pickerelweed
- _____ Smooth cord grass
- _____ Wild rice

[illegible]

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Location: Lower Radcliffe Creek

Use the tally sheet on the opposite page to record the number of each type of macroinvertebrate you find. Based on your findings, analyze the health of Radcliffe Creek's headwaters and record your data below.

_____ Excellent (> 22)

_____ Good (17-22)

_____ Fair (11-16)

_____ Poor (< 11)

Additional Notes (or drawings):

[illegible]

Macroinvertebrate Survey Data - Lower Radcliffe Creek

Sensitive	Semi-Sensitive	Tolerant
_____ Caddisflies <i>(except net spinners)</i>	_____ Dobsonflies	_____ Aquatic worms
_____ Mayflies	_____ Fishflies	_____ Black flies
_____ Stoneflies	_____ Craneflies	_____ Midge flies
_____ Watersnipe flies	_____ Damselflies	_____ Leeches
_____ Riffle beetles	_____ Dragonflies	_____ Lunged snails
_____ Water pennies	_____ Crayfish	_____ Orb snails
_____ Gilled snails	_____ Clams	
	_____ Mussels	
Total:	Total:	Total:
(_____) x 3 = _____	(_____) x 2 = _____	(_____) x 1 = _____

Location: Lower Radcliffe Creek

Additional Notes:

Sultana Education Foundation

Watershed Watch Field Notebook

Module 7: What Does it all Mean?

Location: At Your School

A. Compare & Contrast

Question: How did your water quality test results from the headwaters of Radcliffe Creek compare to the results from the lower creek? Do the differences make sense? Why or why not?

B . Plotting Your Data

Your teacher will ask you to graph water quality data collected on Radcliffe Creek using the graph pages at the end of this section. You will need to complete this graphing exercise before moving on to the next Section.

C. Interpreting the Data

Use the graphs you completed in part B of this module to answer the following questions.

Question: Do the salinity levels of Radcliffe Creek change over time? How would changes in salinity affect the organisms living in the creek?

Question: What do you notice about your pH graph? Is there anything surprising? Why or why not?

Question: How did the dissolved O₂ level of Radcliffe Creek change over time? What might account for any differences you see?

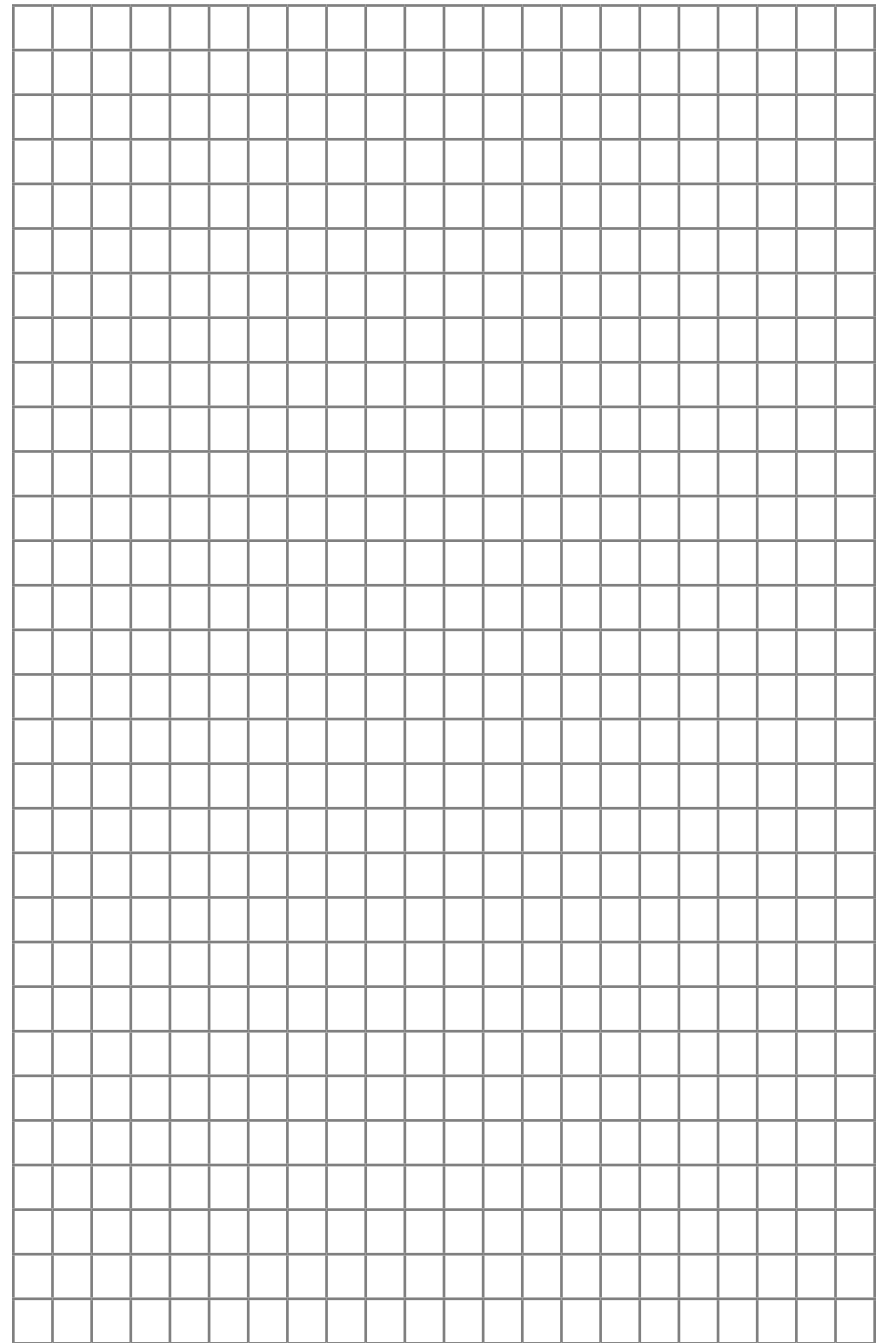
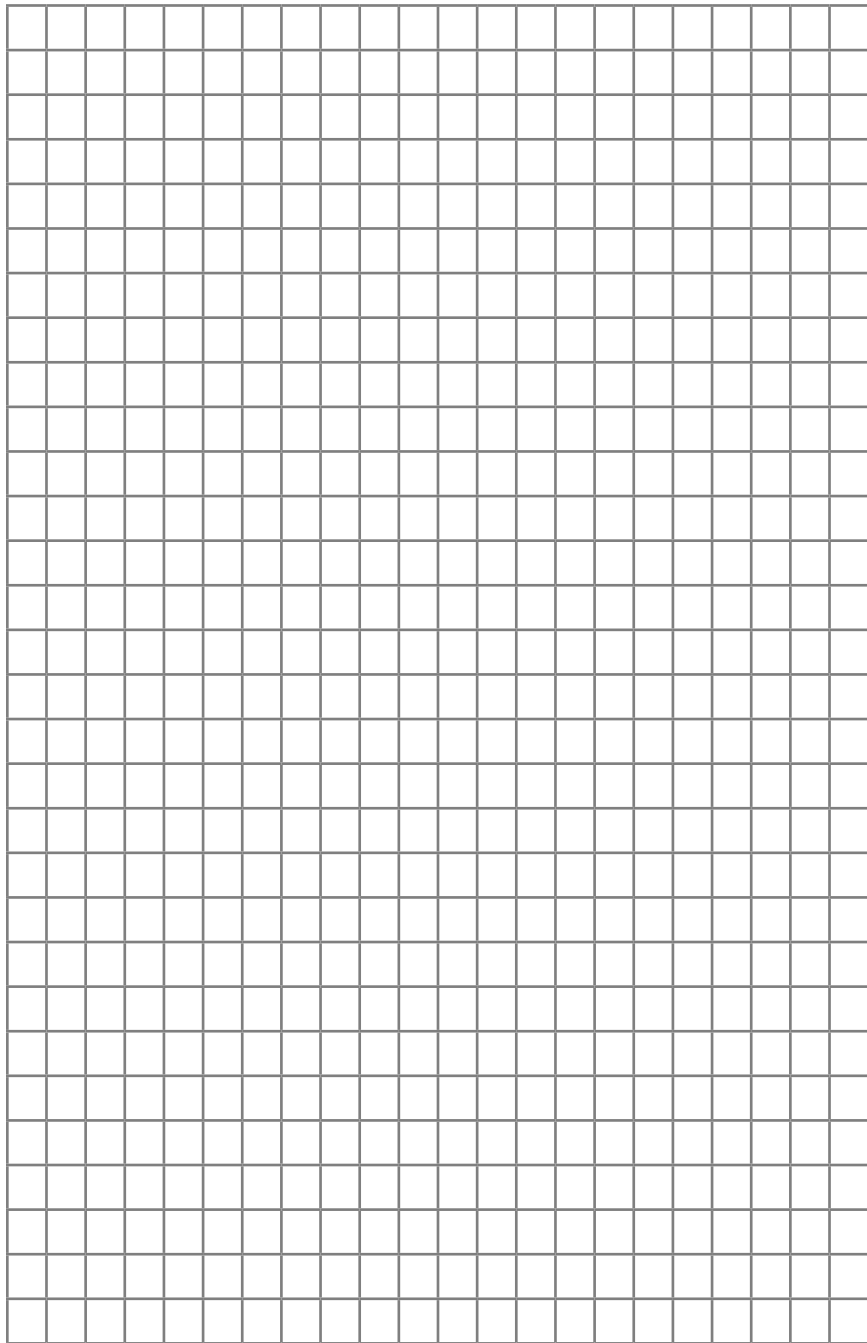
Question: Describe your nutrient level graphs (nitrogen & phosphorus). How might nutrient levels impact the Radcliffe Creek ecosystem?

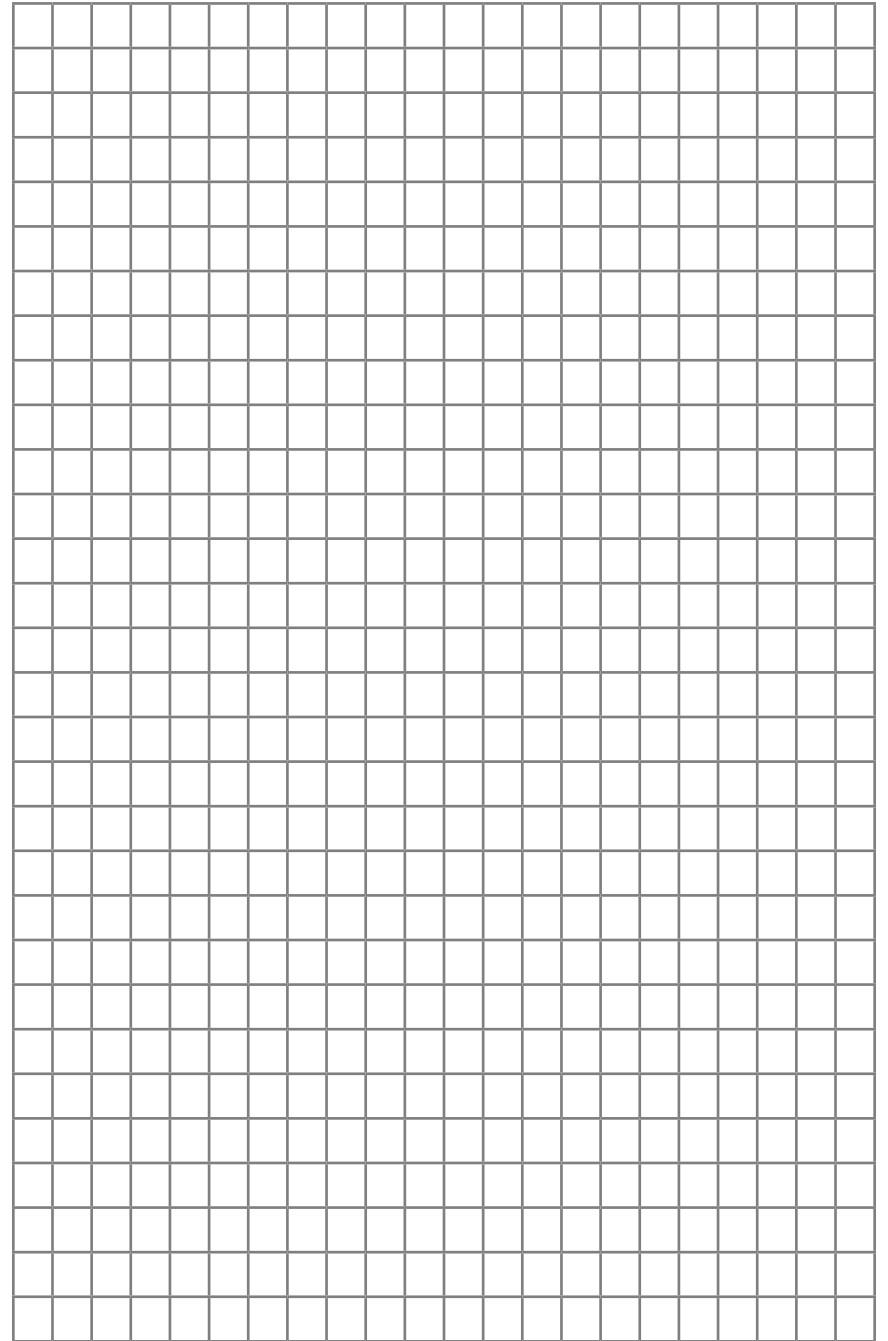
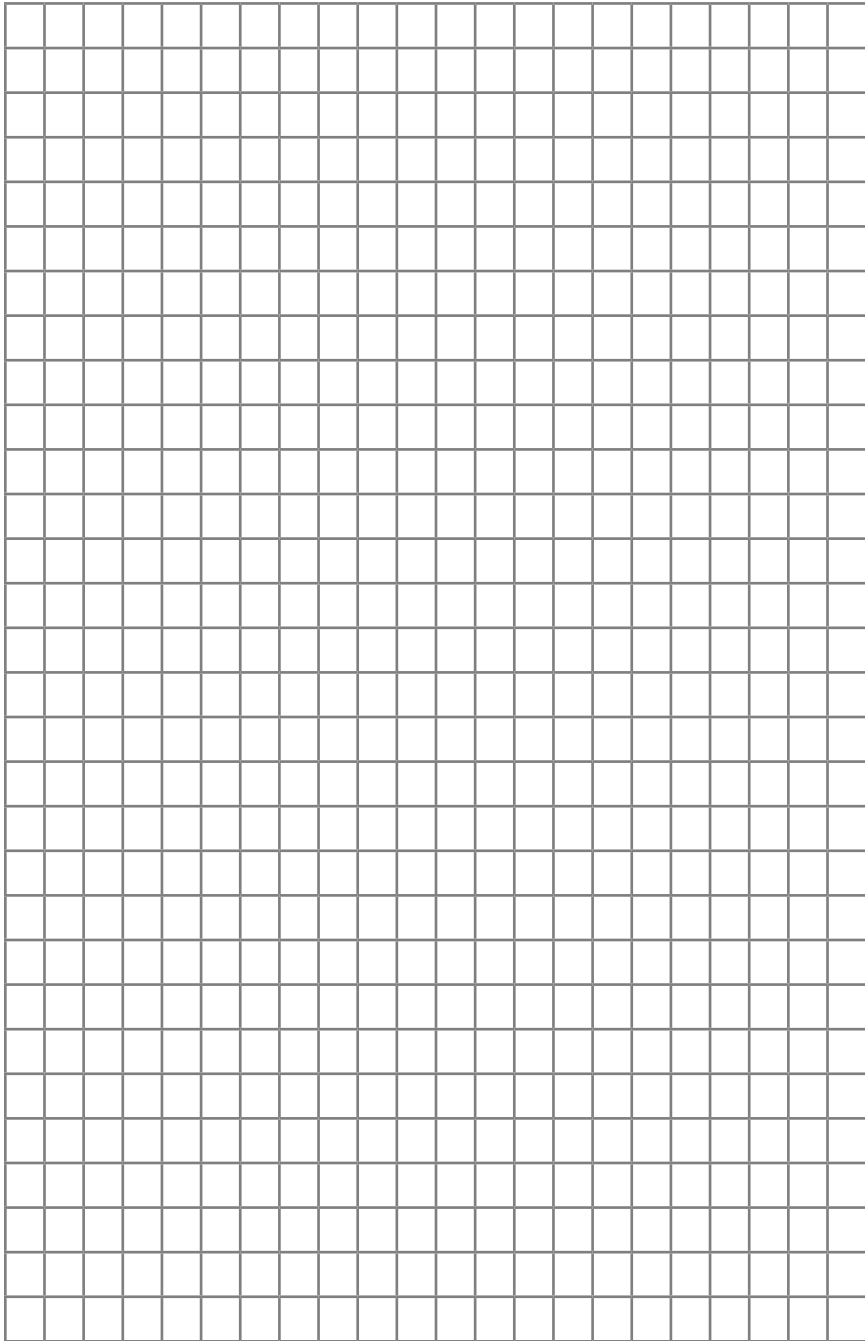
Question: What grade would you give Radcliffe Creek? Use evidence from our investigation to support your answer.

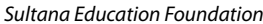
Question: How does your grade for Radcliffe Creek compare to the grade that was given to the creek by local riverkeepers? What might account for any differences you see?

Question: How do our results affect the overall health of the Chesapeake Bay?

Question: What are some things you could do to help improve the health of the Radcliffe Creek watershed?







Watershed Watch Field Notebook

Module 8: Take Action!

Location: At Your School

A . Envisioning an Action Project

Your teacher will ask you to create an “action project” to benefit the water quality of Radcliffe Creek. This could involve hands-on projects to improve habitat in the watershed, or community action projects to increase public awareness. The rest of this module will help you define the specifics of your project.

B . Describing Your Action Project

Briefly describe your action project idea.

Explain how your project will positively impact the Radcliffe Creek watershed.

List the steps you will take to complete your project.

What supplies are needed to complete your project?

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C. Module 8 Reflection

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Module 9: Presenting Your Work

Location: Holt Education Center

A . Envisioning a Presentation

Your teacher will ask you to create a presentation that communicates the findings of your research on Radcliffe Creek.

B . Describing Your Presentation

How can you communicate your investigation, results, and action projects to the local community?

Outline your presentation or display here:

C. Module 9 Reflection *(to be completed following your presentation)*

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



Radcliffe Creek Field Guide

A Guide to Some of the Plants and Animals of the Radcliffe Creek Watershed

Reptiles



Stinkpot Turtle



Eastern Painted Turtle



Black Rat Snake



Skink



Common Snapping Turtle



American Bullfrog



Terrapin Turtle (rare)



Common Water Snake

Fish



Yellow Perch



Bullhead Catfish



White Perch



Mummichog



Striped Killifish (female)



Banded Killifish



Pumpkinseed Sunfish



Atlantic Silverside

Birds & Waterfowl



Mallard Duck



Wood Duck



Red Winged Blackbird



Blue Heron



Bald Eagle



Osprey



Barn Swallow



Green Heron

Mammals



White-Tail Deer



Red Fox



Muskrat



Nutria



Raccoon



Groundhog



Possum



Gray Squirrel

Crustaceans & Mollusks



Atlantic Blue Crab



Barnacle



Freshwater Mussel



Grass Shrimp



Mud Crab



Scud



Crayfish



Freshwater Clam

Submerged Aquatic Vegetation



HYDRILLA: *Hydrilla is an invasive grass that arrived in the United States in the 1950s through the aquarium trade. It grows in dense mats, and its leaves grow in whorls which usually contain five leaves. In Radcliffe Creek, hydrilla is thickest along the edges and in the upper section of the stream.*



WILD CELERY: *Wild celery is a native grass that grows in fresh to low salinity brackish water. The leaves are long and ribbon-like, with a lime green stripe down the center. Celery is an important food source for waterfowl during their winter migration to the Chesapeake region.*



EURASIAN WATERMILFOIL: *Eurasian watermilfoil is an invasive grass that thrives in low salinity creeks where water quality is degraded. The leaves are feather-like and grow in whorls of four or five. While not a great food source for waterfowl, milfoil does provide excellent cover for fish and crabs.*



COONTAIL: *Coontail is a native plant that can either be rooted to the bottom or free floating. Its leaves are stiff and hold their shape when removed from the water. Coontail is an important food source for ducks and geese and provides shade and spawning habitat for smaller fish.*



NAIADS: *There are four different species of naiads in the Chesapeake region. All varieties have slender branching stems that have short leaves less than 4 cm long. They are native to the area and serve as an important food source for many species of ducks.*

Wetland Plants



PHRAGMITES: *Phragmites* is an invasive reed that can grow to 12 feet tall. It is typically found along the shoreline in dense colonies. Because it grows in such thick stands, it crowds out native plants that have much more food value to local animals. Red-winged blackbirds value *phragmites* habitat for nesting sites.



ARROW ARUM: Arrow arum, also known as tuckahoe, is an annual emergent plant that thrives along the shorelines of Radcliffe Creek. The plant's root system contains a large, potato-like tuber that was a valuable food source to local Indian tribes. Its leaves take the shape of an arrowhead, and it often grows alongside pickerelweed.



PICKERWEED: Pickerelweed is a native plant whose leaves look similar to those of arrow arum, with the main difference being that the leaf bottoms have rounded (rather than pointy) lobes. In the summer, the plant can be identified by its long purple flowers, which provide food and habitat for butterflies.



CATTAILS: Cattails grow in thick stands on the upper reaches of Radcliffe Creek. The plant once served as a valuable food source for both Indians and early colonists. The roots are edible and rich in starches, the young shoots can be eaten raw and taste like cucumbers, and the long leaves could be woven into mats.



WILD RICE: Wild rice is an annual grass that thrives in the middle and upper reaches of Radcliffe Creek. The seed heads reach peak ripeness in July - August and provide a rich source of food for dozens of species of birds. This native grass used to be harvested by Native Americans, who added the grains to salads.

Wetland Plants *continued*



BIG CORDGRASS: Big cordgrass (*Spartina cynosuroides*) is a native grass that thrives along the shorelines of brackish water marshes such as those found in Radcliffe Creek. It can grow to a height of eight feet and the seed heads provide valuable food to many species of birds.



SMOOTH CORDGRASS: Smooth cordgrass (*Spartina alterniflora*) is a native wetland grass that is found on the lower stretches of Radcliffe Creek. The peak growth occurs from July through September, with rich seed heads providing food for birds.



MARSH HIBISCUS: The marsh hibiscus is a native flower that can be white or pink. The flowers contain five petals and measure up to five inches across. Peak blooms occur from July through August. The root systems of this plant were once used to provide the flavoring for marshmallows.



SEASHORE MALLOW: Seashore mallow is a native, pink flower that blooms along the brackish water shorelines of Radcliffe Creek from July through September. The flowers often appear in large stands, attracting many species of insects and butterflies.



JEWELWEED: Jewelweed is common on the upper, fresh water stretches of Radcliffe Creek. The flowers are bright orange, and the leaves can be used to treat a variety of skin rashes such as poison ivy.



Sultana

EDUCATION FOUNDATION



Sultana

EDUCATION FOUNDATION

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410-778-5954 (f)

sultanaeducation.org

About the Sultana Education Foundation

Founded in 1997, the Sultana Education Foundation is a private nonprofit dedicated to providing unique, hands-on educational opportunities that promote stewardship of the Chesapeake Bay's historic, cultural, and environmental legacies. The Foundation is a two-time recipient of the National Maritime Historical Foundation's Walter Cronkite Award for Excellence in Maritime Education.