Jeannine Phelan
21st Century Naturalists
Integrated Science Curriculum & RI Ecosystems
Grades 7-12

General Science, Biology, Earth Science
Skills used by the students: observation, data collection, documentation, analysis, laboratory procedures, presentation.
Duration: 7 months to include September through November, and March through May
Group size: six students
Setting: Seekonk River Estuary just South of Swan Point and North of Blackstone Park

Objectives: (The students will…)

- choose two semi permanent sites to observe
- construct and place a 3 dimensional quadrat on each selected site
- observe, document, and identify flora and fauna within each quadrat noting numbers and diversity of species
- collect and document data on the atmospheric and hydrospheric conditions within each quadrat weekly
- graph data
- draw portraits of selected specimens of flora and fauna
- keep a portfolio of portraits
- collaborate with peers
- present findings
- learn that the atmosphere, biosphere, hydrosphere, lithosphere, and cryosphere are inter connected
- understand the number and complexity of components operating within the Earth system
- learn careful observation skills
- understand how observations collected in a local area can be linked to adjacent areas, and extrapolated to a larger area such as the globe
- identify their own place on the planet and their ability to interact with, and influence, the natural systems on the Earth

Materials:

three,3-dimensional quadrats made from: 12 to 36, 94cm long, 1 inch pvc tubes
8 to 24, three-way, 90^{o} angle, corner pieces to connect the pvc tubing
tether to secure quadrats into place
journal with either blank pages or graph paper pages
estuary/ salt water test kit
thermometer
anemometer
light meter
GPS
flow meter
field guides: plants, insects, marine invertebrates, benthic macroinvertebrates

Method:
The students will tour the area and determine which two sites they will focus their observations on. Once the specific sites are selected, they will take GPS readings and place their 3 dimensional quadrats.

One day each week, the students will go to each site and collect data within each quadrat: Water samples will be collected to test for salinity, DO, BOD, pH, nitrates, phosphorus, (coliform bacteria test will be monthly). They will assess air temperature, water temperature, soil temperature, soil pH, ambient light, wind speed and direction, stream flow, tide height, plants, animal tracks, insects, invertebrates.
Flora and fauna will be counted, identified, and sketched into their journals.

Once each month the students will graph the data they have collected for that month and place a copy in their journals. They will collaborate on a copy to give to the teacher for future use in presenting and sharing findings from the entire experience.

Background:

An estuary is where salt water and fresh water meet and mix. Rivers bring freshwater downstream while tides bring salt water upstream. They are important because they function as nurseries for fish and shellfish because they are more structurally protected than other areas and contain many nutrients. Estuaries are very productive ecosystems, similar to coral reefs and rainforests. Estuaries are migratory pathways for both fish and fowl between freshwater and open ocean. Estuaries may concentrate or retain nutrients, phytoplankton, and other materials which are good for feeding juvenile organisms. However, such concentrations can lead to nitrification which is harmful to the ecosystem. Nitrification can lead to eutrophication (an over abundance of nutrients). Eutrophic systems are often low in dissolved oxygen which is harmful or fatal to many organisms. (NRPA p.3.)

The teacher will need to be familiar with the procedures specified in the estuary/ salt water test kit, with the use of field guides to identify species, general knowledge of indicator species and how the number and diversity of species indicates the health of an ecosystem. Water quality can be determined by either chemical tests or by assessing the organisms living there. The teacher may also wish to collaborate with an Art teacher to coordinate simultaneous lessons in drawing nature and the creation of a nature journal.

Classroom lessons may include the physical features of the watershed, maps of the watershed, and identifying possible point and non-point sources of pollution. The area we are studying tends to be cluttered with debris that washes ashore. A variation for additional activities may include coastal cleanup days and garbage archaeology. (For example, one student found a small, cobalt blue bottle with the words “bromo seltzer” on it. This led the student to conduct additional research to determine the age and nature of his find.) Extensions may be individualized to suit the needs and interests of the students. The teacher may also collaborate with an English teacher in using the students’ experiences in poetry and reflective writing pieces.

The quadrat and 3-d quadrat are tools used to actively explore the environment by closely examining a well defined space. Data collected using one meter quadrats or one-cubic meter quadrats define an inclusive, open, natural laboratory. Data collection and analysis helps student scientists understand the dynamic, multi-faceted, and complex Earth system along with many of its interconnected physical and chemical components. 3-d quadrats include cross sections of the atmospheric, subsurface, chemical, biological, and physical cycling. The one-cubic meter frames are constructed of sturdy, inexpensive pvc pipe and are able to be placed in any environment. Components measured in each quadrat include aspects of all five spheres of the Earth system: atmosphere, biosphere, hydrosphere, lithosphere, and cryosphere. The frames can be placed on the ground, partly on the ground and in water, or completely submerged. Multiple quadrats can be placed along a transect to observe a series of specific environments and relationships among them.

Assessment

1. Keep a journal in which you narrate your weekly observations, experiences, sketch organisms you encounter, and data you collect.

2. How and why did you choose the area where you placed your quadrat?

3. Choose three parameters and create a graph depicting how each parameter varied over time.

4. Analyze your graphic data: Were you able to collect enough data points to show a trend in each of your chosen parameters? What trends did you observe? Were you able to observe any correlations between parameters (such as light intensity and temperature?) How many different parameters could be interacting inside your 3-d quadrat?

5. Present your results.

National Standards 6-12

- abilities necessary to do scientific inquiry
- understanding the process of scientific inquiry
- interactions of energy and matter
- interdependence of organisms
- matter, energy, and organization in living systems
- energy transfer in the Earth system
- geochemical cycles
- natural resources
- environmental quality
- natural and human-induced hazards
- science and technology in local, national, and global challenges

Benchmarks/ Frameworks/ NSPS/ Environmental Literacy Benchmarks

3 A2 Science and technology are essential to one another for such purposes as sample collection, measurement, data collection and storage, computation, and communication of information.

4 C7 Human activities…have changed the Earth's land, oceans, and atmosphere. Some of these activities have decreased the capacity of the environment to support some forms of life.

S4A Big ideas and unifying concepts

S5B Uses concepts in Science Standards 1-4 to explain observations and phenomena.

S5E Identifies problems, proposes, and implements solutions, and evaluates for accuracy.

S6A Uses technology and tools to observe and measure objects and organisms.

S6B Acquires information from multiple sources.

M4A Collects, organizes, and displays data in appropriate formats.

EL M5 Describe the cyclic changes in the natural world and compare common characteristics.

M10 Describe an environmental change and give consequences of that change.

M11 Describe the possible effects on the survival of organisms and species brought on by changes in environmental conditions.

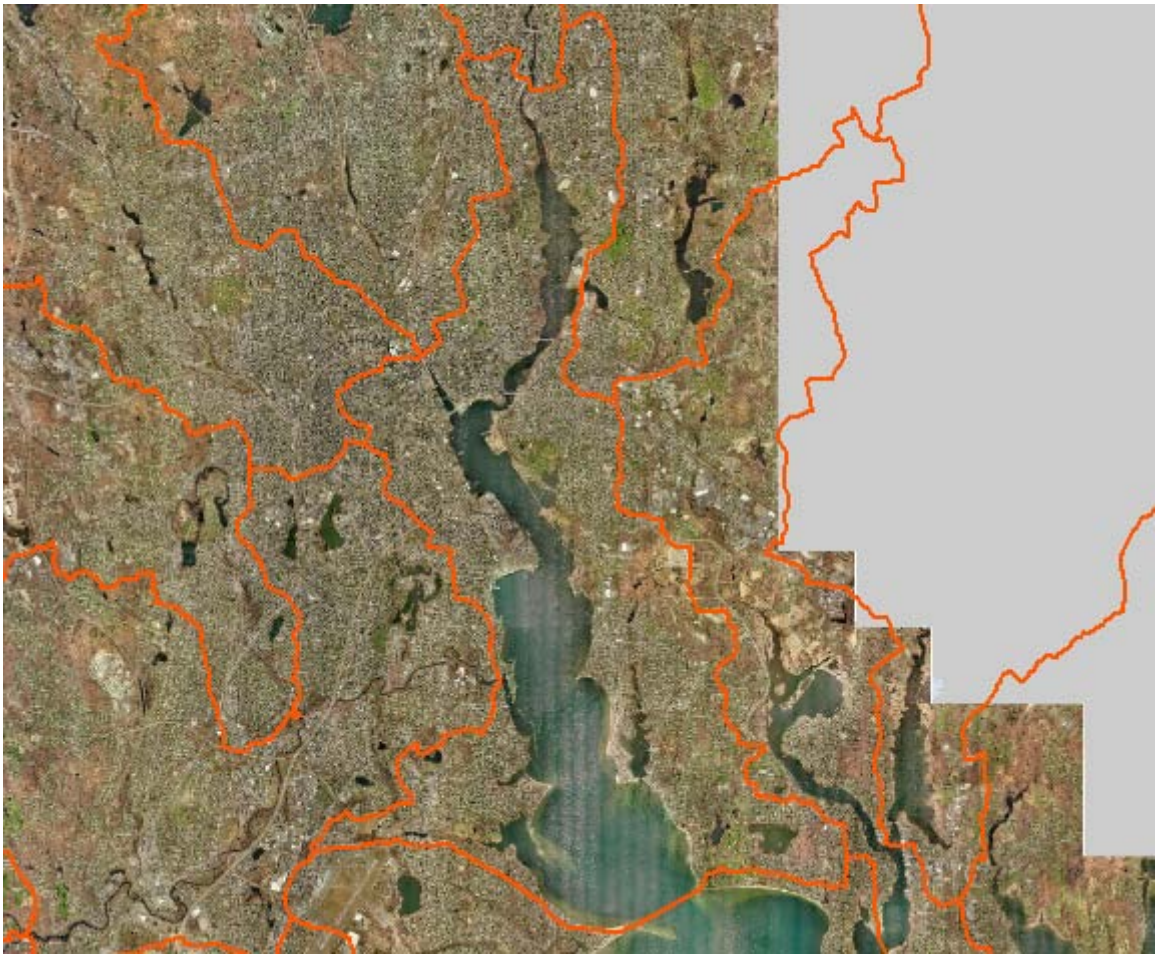
M14 Use appropriate keys to identify organisms.

M16 Choose and use appropriate technologies to gather and record observations regarding a complex system and use the observations to make predictions about the effects of changes made to system components.

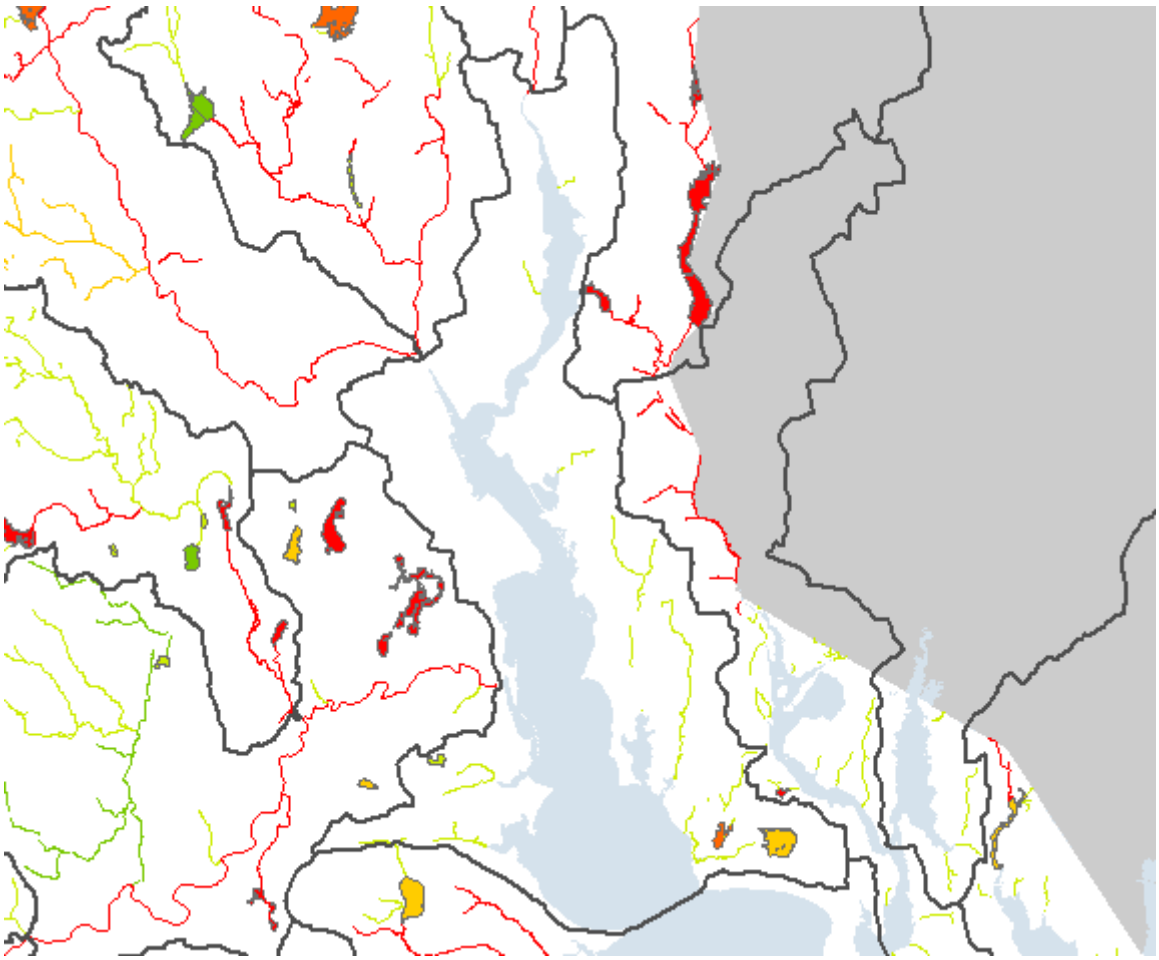
M18 Identify patterns of change in the natural and technical worlds as trends, cycles, or chaos.

M20 Explain the ways in which humans impact the environment.

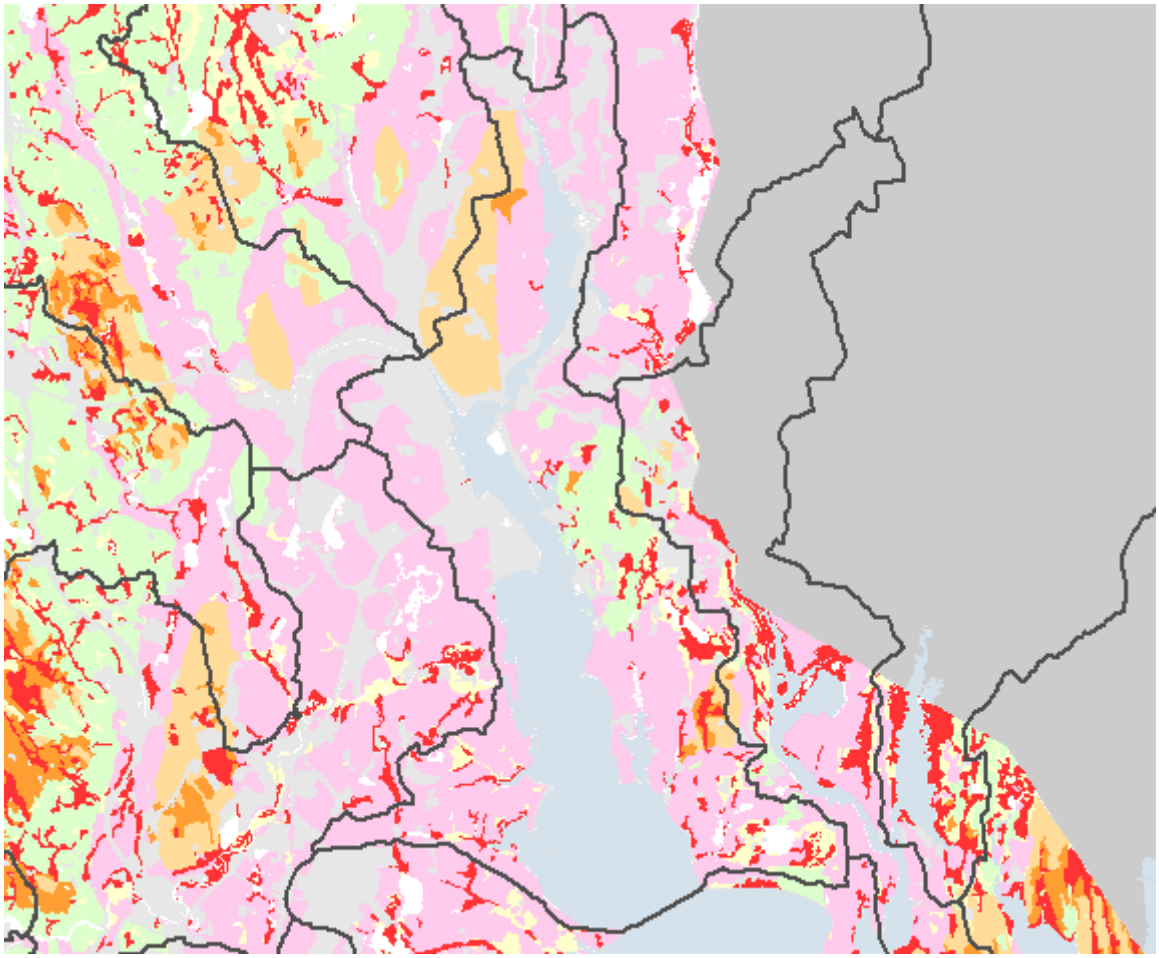
M23 Identify a community environmental problem and propose a solution for that problem using information collected to support the proposal.



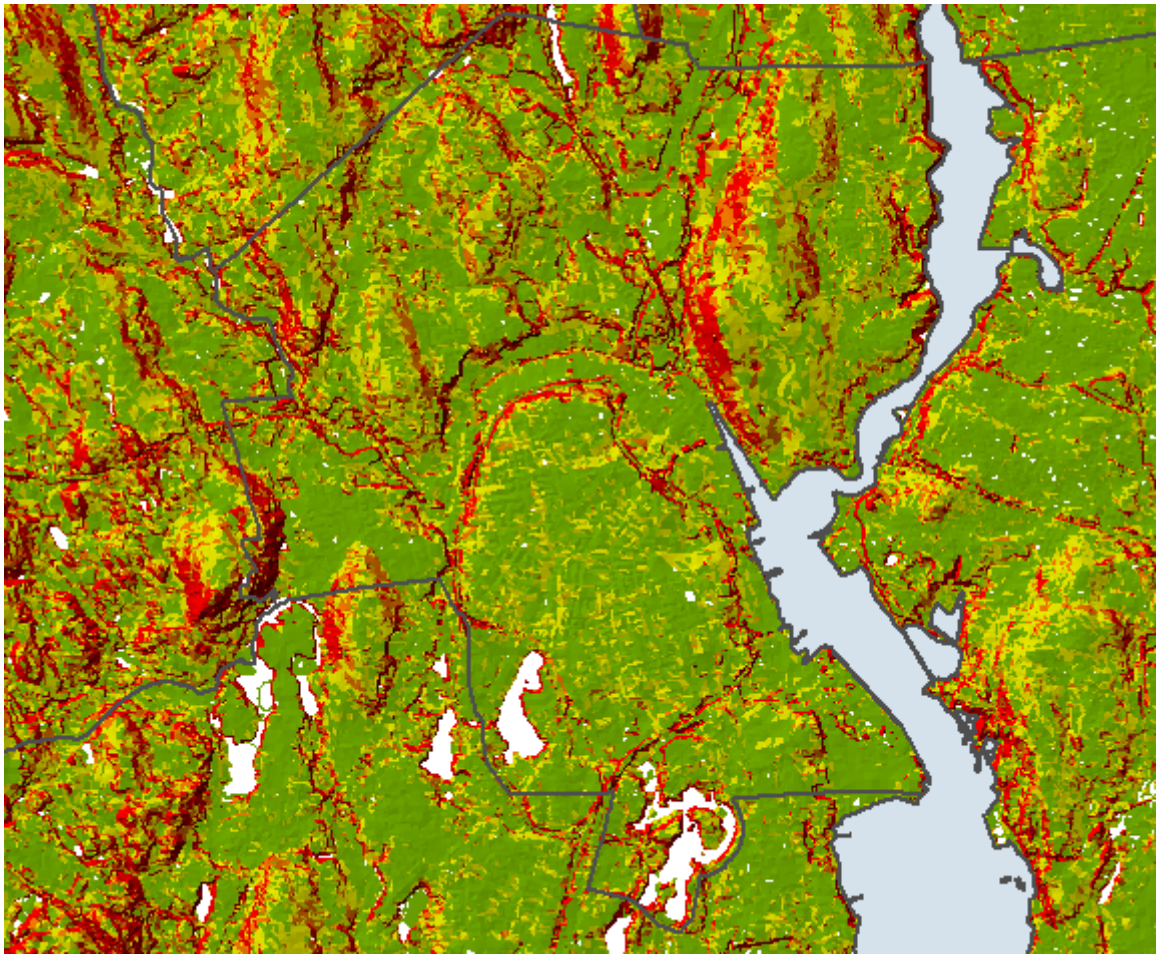
Seekonk watershed



Seekonk water quality



Seekonk hydro and water table



Providence/ Seekonk slope

Sources

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