Graduate Partners in Science Education
Fall Module III
Ecology

Goals: The Ecology Module is the last of the fall series of experimental units, and also deals with the most abstract content: how the physical features of natural habitats determine who lives in them and how those residents are distributed. As with the Microbiology module, this experiment seeks to highlight to students that important patterns in nature often require careful observation and scientific thinking, not to mention the use of technology (pH and temperature meters), before they become obvious. This module also should teach students that organisms have a "comfort zone", or a set of environmental conditions in which they do best, and outside of which they do poorly or are absent altogether. One additional goal should be to discuss with students how these concepts translate to larger scales, such as regional, continental or global. The Rio Salado Project is also one of our field sites for the spring Participatory Phase, so mentors should encourage student exploration and consideration of the site for future work.

Age Level: 7^{th}-8^{th} Grade

Approximate Time: Three sessions, beginning with one 50 minute class period, and followed by two 2½ hour sessions, one on site at the Rio Salado Habitat Restoration Project and the second at the school.

Background: Ecology is the study of the relationship(s) between organisms and their environment, including other organisms. That sounds really broad, and indeed it is. Ecologists work on this subject at the four corners of the earth and everywhere in between. The study of ecology has become more and more important as we have begun to realize the influence our single species, *Homo sapiens*, is having on the environment and other organisms that inhabit it. What we are discovering is not often pretty. Humans are having large and detrimental effects on habitats worldwide, and this is changing the numbers, distributions and interactions of living things, many of which we are just learning about. Knowing more about the effect of humanity on the environment is an essential first step in understanding how to change our own interactions with the world around us in healthier ways. And even in areas where humans have had little impact, ecology can help us to understand the basic processes that govern how living things interact with each other and their surroundings. These insights can in turn help us to understand natural places closer to home. For this module, we explore one such place, the Rio Salado Habitat Restoration Project. The Rio Salado Project is a stretch of the old Salt River bed, once filled with more than a dozen land fills, that is now home to more than 170 species of birds. How did this change come about? By the efforts of the City of Phoenix, Phoenix Flood Control, the Audubon Society, and a number of other entities, a once dry, trashed stretch of the Salt River has been restored to something of what it might have looked like a century or so ago. Native plants have been reintroduced, waterways have been established, and organisms, many gone from downtown Phoenix for many

decades, have begun to trickle back in. The module described below will introduce students to this area and allow them to begin thinking about how organisms (aquatic plants and algae) interact with non-living features of their environment (pH and temperature).

Objectives: Students will be able to:

- identify parts of the scientific method, including research questions, hypotheses, tests, predictions, results and conclusions within the context of an experimental study
- come up with their own hypotheses and predictions
- choose locations within a site that represent the area they are studying and measure temperature and pH.
- develop a method for measuring the concurrent plant community, including algae and aquatic plants.
- present the results of their study to classmates using an oral presentation.

Standards:

National Science Standards (Grades 5-8):

Content Standard A. Science as inquiry.

- Develop abilities necessary to do scientific inquiry
- Develop understandings about scientific inquiry

Content Standard C. Life science.

- Structure and function of living systems
- Regulation and Behavior
- Diversity and adaptations of organisms

Arizona State Science Standards (Grades 5-8):

1SC-E1. Identify a question, formulate a hypothesis, control and manipulate variables, devise experiments, predict outcomes, compare and analyze results, and defend conclusions

PO 2. Conduct an experiment using a scientific method
PO 3. Analyze the results of an experiment
PO 4. Defend conclusions drawn from the analysis

1SC-E3. Organize and present data gathered from their own experiences, using appropriate mathematical analyses and graphical representations

PO 1. Construct a representation of data (e.g., histogram, stem-and-leaf plot, scatter plot, circle graph, flow chart)
PO 2. Interpret patterns in collected data

4SC-E7. Explain and model the interaction and interdependence of living and non-living components within ecosystems, including the adaptation of plants and animals to their environment

Materials:

1 pH meter per group
1 thermometer or temperature meter per group
5 liquids of differing pH (ammonia, orange juice, shampoo, tap water, Coca Cola, etc.)
4 sample containers per group (for algae samples)
1 digital camera per group (optional)
1 GPS unit per group (optional)
1 dissolved oxygen meter (optional)
1 turbidity meter (optional)
1 salinity meter (optional)

Procedure:

Day 1 – pH and Temperature Meter Demo at Phoenix Prep

1. Students need some preliminary training on the meters they will be using the following week at the field site. In order to demo the pH and temperature meters, and associated software on class laptops, students will take measurements on a series of 5 (or 10 if time permits) different samples.
2. Students must at the very least take static measurements of pH and temperature, which display in the bottom left hand corner of the software. These measurements can be written down on one of the data sheets below.
3. Time-permitting, the software associated with the pH and temp probes allows for dynamic measurements to be taken. Just press the play button at the top of the frame and the computer will record pH and temp at regular time increments. To stop taking measurements on one thing and start a new line of measurements, press the store button along the top, and press play again when you are ready to take another set of measurements. This should leave the previous line of measurements in one column (and on the graph) and start a new column and differently colored line for the next set of measurements.
4. When moving between different samples, rinse twice in distilled water to clean both probes.
5. When taking dynamic measurements, it may be a good idea to look at the mean value of measurements, as well as their range. This can be accomplished by highlighting a particular set of measurements and pressing the Stats button.

Day 8 – Field Trip to the Rio Salado Project

1. Student/mentor groups will work together in pairs within the park. There are four locations/comparisons available, one for each set of 2 mentors and 10-12 students:
    A. Swift moving versus non-moving water – this comparison is between the reservoir next to the parking lot (non-moving) and its outlet and associated stream. Students can make predictions about water temperature, pH and if a meter is available, dissolved oxygen. Plant communities are also quite different in each, and collection of algae should be relatively easy. Animal communities also differ. Mentor/student groups can work together or split up and look separately at the two areas.
    B. North bank versus south bank of the Demonstration Riparian area - obvious comparisons here are daylight exposure, which may effect temperature and plant communities. Students can also make predictions about pH. More emphasis can be placed on terrestrial plant community differences here, suiting this comparison to digital photography for quantification in the classroom later. Student could also do plant transects along the banks.
    C. Main channel – there is no obvious single comparison here, but there are a range of channel depths, characteristics, plant communities etc. ranging from stagnant and swampy to swift moving and rocky. This area takes a little more creativity to isolate specific questions and hypotheses, etc. but there is plenty here to look at and work with. Dissolved oxygen, salinity and light level are all optional measurements that could be interesting, but are dependent on equipment availability.
    D. Storm water runoff underneath west footbridge just west of the Central Avenue bridge – as with C, comparisons are less obvious, but there are a range of areas to investigate here. The runoff feeds a particularly rich community of algae, which students could explore and compare to any other body of water in the park. This area is fed from city storm water runoff, so the source of water could be an interesting point of discussion to guide hypotheses, etc. As with other areas, dissolved oxygen, salinity, light level, etc. would be valuable additions to just looking at pH and temperature.
2. Mentor student groups will be assigned one of the four areas above (see map below for locations) prior to entering the bus. Mentors should work with students to assign student roles and a plan of attack. (20 minutes, 2:00 pm)
3. We will be met by one or two rangers at the Rio Salado Project. They will give a brief presentation about the park for the students, including some discussion of how to start a career in park management. (15 minutes, 2:15 pm)

4. After the ranger presentation, groups should move to their field sites and work to brainstorm hypotheses, predictions, etc. Use of the scientific method flowchart below is encouraged but not necessary. (20 minutes, 2:35 pm)
5. At the bare minimum, students should measure pH, temperature and GPS location at a number of locations at their sites. If available, dissolve oxygen, salinity and light level can be measured as well. The locations for these measurements should be thought through carefully, with justifications to be used when presenting the data to classmates the following week. At least one digital camera per location will be available, and can be used either to take pictures for presentations the following week or as a tool for quantification of plant and algal communities. All groups will also be provided with sample containers for taking water and/or algal samples for evaluation in the lab the following week. We do have digital microscopes at our disposal, which could be used to quantify algae density, species richness, etc. the following week. Assignment of specific roles for students is highly recommended. (1 hour, 3:35 pm)
6. One of the major goals for this module is to introduce students to this field site. If time remains, or even during data collection, students should be encouraged to explore, to get their hands dirty, and to keep an eye out for things they might want to come back to look at more closely.
7. At 3:35 pm, students should make their way back to the buses in the parking lot, which will need to leave promptly at 3:45. Additional discussion of results and a formation of a plan for the following week are encouraged during the bus ride back to the school.
8. Mentors, please write down the number of the laptop that students worked with if any data was saved on it. Also, downloading of images on to the laptops can be accomplished during the bus ride back to the school.

Day 15 – Data Analysis and Presentations at Phoenix Prep

1. The goal of this 2½ hour session is to move from analysis of data collected the previous week to a PowerPoint presentation in front of the class. How data are analyzed and graphed is going to be determined by the nature of data collection and characteristics of the field site. Students will have access to laptops, the internet, and the photos they took the following week. Graphing of data can occur using Excel, or an internet-based graphing site used in Phoenix Prep classes which students are familiar with. You have 1½ hours to work with students on their presentations. If data analysis moves swiftly, students can be encouraged to spend more time on background information, or expanding the discussion to larger spatial scales (how does this relate to other aquatic systems in the area?). This portion of the module is intentionally free form to allow students to be creative about how they present their findings. One presentation per pair of mentor/student groups is sufficient. Presentations should be roughly 10-15 minutes in length. (1½ hours, 3:00 pm)
2. Students will present for 10-15 minutes each, if possible in the Media Center. (45 minutes, 3:45 pm).

3. Student presentations will be followed by a survey to be completed by the students regarding their experiences during the fall. (15 minutes, 4:00 pm).

Group Members:_____ Mentor:_____

Question

Proposed Explanation (Hypothesis)

Experiment

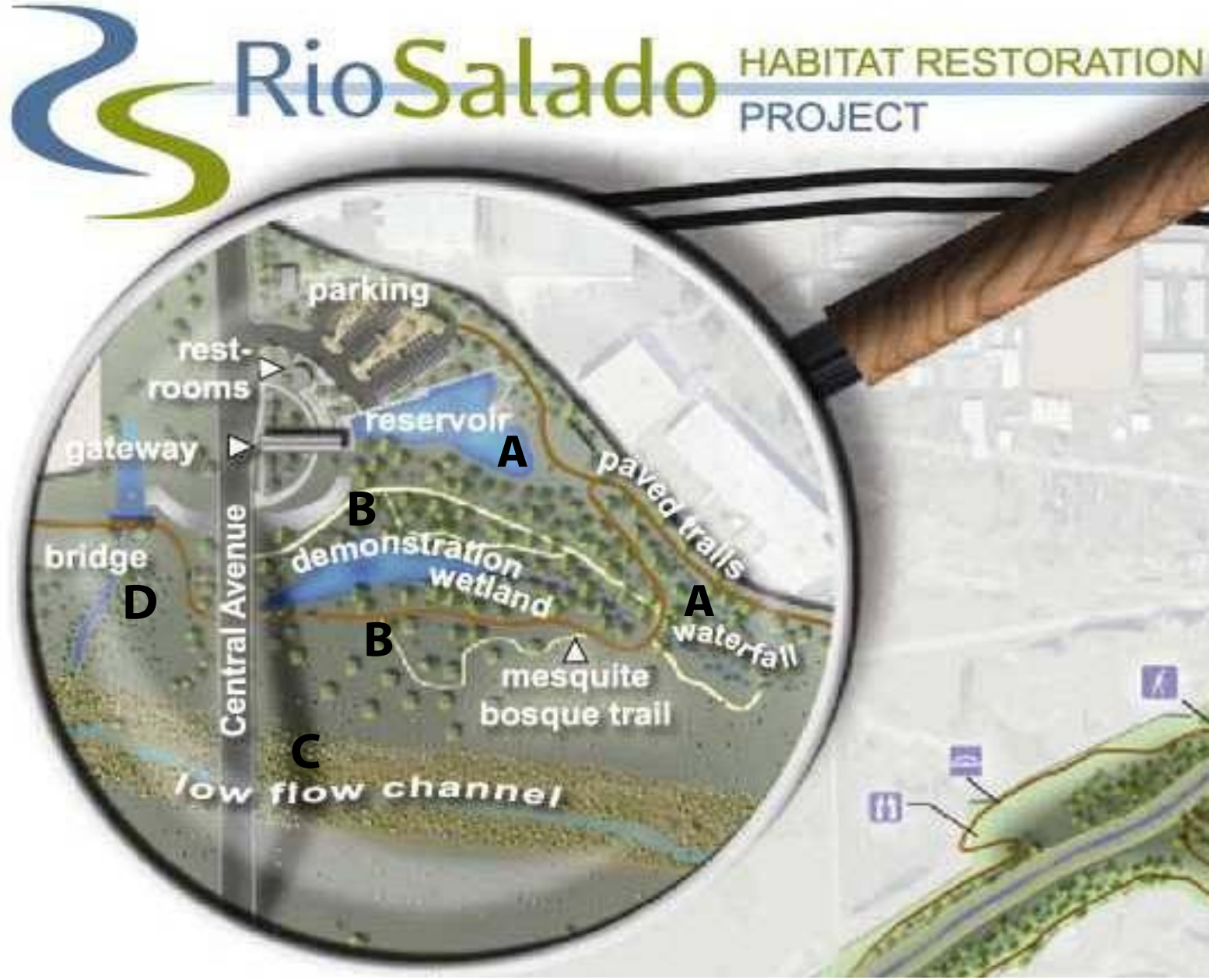
Predicted Result **Actual Result**

Conclusion

Ecology Module Data Chart

Group Members: Mentor:

Location:	Measurement:								
	pH	Temperature	GPS	Photographed?	Water/Algae Sample?	Salinity	Light Level	Dissolved Oxygen	Other


RioSalado
HABITAT RESTORATION
PROJECT
parking
rest-
rooms
reservoir
gateway
A
paved trails
B
demonstration
wetland
bridge
D
Central Avenue
A
waterfall
B
mesquite
bosque trail
C
low flow channel