Stewardship Through Leadership

Backyard Adventures!
Environmental Education Program

Program Handbook

Presented by the Lowell Parks & Conservation Trust in partnership with Massachusetts Audubon Society – Drumlin Farm Wildlife Sanctuary.

Handbook Contents:

Program Overview and Methodology

The Lowell Parks & Conservation Trust (LP&CT or Trust) is partnered with **Mass Audubon Society - Drumlin Farm Wildlife Sanctuary (MAS)** to offer an after - school program for Lowell youth, called *Stewardship Through Leadership - Stewardship Through Leadership* (STL). LP&CT Project Specialist, Brian Cutler and MAS Teacher - Naturalist, Sally Farrow team up to share their joys and knowledge of the outdoor world. STL serves various sites in the city of Lowell, including, but not limited to Girls Incorporated of Greater Lowell; Citizen Schools, Robinson Middle School campus; and UMass Lowell's after school program at the Bartlett Community Partnership School. STL is an environmental education program, which connects Lowell youth to the various natural resources the city has to offer; in their own backyard.

The program is designed with a goal of exposing urban youth in the city of Lowell, Massachusetts to the outdoor classroom where they will build upon their in - school curricula, become engaged in environmental stewardship in their community, and build self - esteem through team and leadership opportunities.

Through this program we embrace what knowledge students are gaining through their in - school studies and apply this to our field studies through experiential learning in environmental education. STL is geared to maintain a direct relationship to Massachusetts curriculum frameworks, as it is important to support specific areas of academia where our students are in need. The LP&CT offers a valuable sense of place in the city of Lowell with its extensive experience in urban land conservation (protection of natural resources) and strong community networks, while MAS's Building Conservation Communities (BCC) program brings to Lowell its extensive knowledge and skills through their teacher - naturalists, educational program materials, and wildlife programs (wildlife presentations via what are known as ARK's).

Lesson plans are designed to correspond to subjects within Massachusetts curriculum frameworks of Science and Technology/Engineering. Within the Science and Technology/Engineering subject the following areas are focused on in order of greatest concentration: Life Sciences (Biology), Earth and Science, and Technology and Engineering. Mathematics often inherently becomes a valuable component of the program during program components where data analysis occurs. The STL program places great emphasis on stewardship through team and leadership initiatives, which provide students with the skills, knowledge, and experience they need to be successful when taking action to protect the natural environment to improve their community, and succeed in the professional world; to become stewards of their community.

The Unique Geology and Topography of Lowell

The geology of Lowell and the greater Merrimack Valley offers a unique look into the area's natural history. Although Lowell is an urban center, home to well over 100,000 inhabitants, the city exhibits a wide range of geological features and important natural resources. Two major rivers, the Merrimack (meaning swift - water place) and Concord (also known as the Musketicook, meaning "Dead - water"), run through Lowell with their confluence located in the downtown area. The Merrimack once continued past Lowell to Boston, but with the retreat of glaciers during the turn of the ice age they deposited debris, which filled in much of the Merrimack Valley, thus diverting the river east from Lowell to Newburyport. The glacial retreat also left behind several drumlins in the area including Fort Hill and Christian Hill (the site of STL programming at the Robinson Middle School.). Both rivers have been utilized extensively throughout the course of history; by Native Americans, early colonial farmers and fishermen, travelers and transport companies, textile mills, hydroelectric power facilities, and during cultural and recreational events.

Visitors to Lowell will find that the major theme of the city is the championed industrial revolution in New England, as exhibited by the Lowell National Historical Park. Throughout the city there are dozens of parks and open spaces, various wetlands, recreation trails, and an extensive list of urban wildlife. The LP&CT alone has protected over 30 acres of open space in Lowell and owns the historic Spalding House (the LP&CT's future environmental history and education center). Lowell also shares 252 acres of the Lowell - Dracut - Tyngsboro State Forest (1,140 acres) in the northwest corner of the city. The LP&CT, working cooperatively with the City of Lowell, has begun construction of the Concord River Greenway Park (CRG), a multi - use recreation trail stretching several miles through the green heart of Lowell. The CRG will complete missing links in several trail networks, such as the Bay Circuit Trail, the Bruce Freeman Rail Trail, the Merrimack River Walk, and the Lowell Canal Walk. With its improved access to the river and historic signage, the CRG will also serve as an outdoor classroom for the STL program and various LP&CT events. With all the various open spaces Lowell has to offer, and the cooperation between the LP&CT and MAS, Lowell has all the right resources in place to facilitate much needed environmental education programming, being Stewardship Through Leadership.

Need for Environmental Education Programming

The results of MCAS Tests of 2007 at the Robinson and Bartlett schools, where STL is implemented, reveal that more than seventy - five percent of students need improvement or are warning/failing in the areas of science and technology. STL programming supports Science and Technology by cultivating an "all senses used" approach to understanding how the earth functions as one organism and the ways in which we can protect it through stewardship.

- Middle school - age participants enter a series of lessons that convey a basic understanding of the interrelationships found in the natural environment, through hands - on exposure and opportunities to implement coached action projects.
- At the high school age level our aim shifts to a more developed action - based approach, which accomplishes community improvements through the use of technology for data collection and analysis, self - guided physical projects, and community outreach initiatives.
- All STL students have access to the outdoor classroom, professional naturalists in the field, scientific and technology - based field equipment, and ARK's.

Exposing our youth, *Lowell's future leaders*, to the outdoor world is the basis of STL, supported by interactive lessons from geology to ecology, and provision of the tools they need to create positive change in their community and benefit the entire world.

Model Curriculum

Based on a ten - week program and a final presentation.

On site and off site activities/habitats/field study locations: Wildlife Programs (aka MAS - ARK) with MAS wildlife, Monarch butterfly study; tree planting project; four "Basic Bioblitzes"; Wet Lab/Dry Lab; visits to vernal pool, meadow, urban forest, pond, school yard.

BLOCK ONE - Creating a Sense of Place

- Week 1
    - **Lesson Objectives:** Create a Sense of Place and discuss possible action projects for this semester.
    - **Learning Objectives:** Students learn about local wildlife, including the animals which they have been assigned to learn about and monarch butterflies. Games help develop group dynamics and provide a focus for the semester. Students also tour the school yard and learn about local ecology, with documentation by means of a "Basic Bioblitz."
    - **Activities:** Get to Know You Games (Hampered Habitats, see Games section for description) in the school yard; overview of ecology of the school yard; Monarch butterfly study; Basic Bioblitz of school yard and adjacent playing fields.
    - Additional descriptions in Field Studies and Action Projects and Wildlife sections.

- Week 2
    - **Lesson Objective:** Upgrade the local "urban forest" habitat.
    - **Learning Objectives:** Students learn how the use of teamwork helps to accomplish action projects. They will learn what it takes to plant a tree, why trees are beneficial in local and global terms; how trees can benefit their community.
    - **Activities:** Tree planting action project, plant two trees; discuss the benefits of trees and more specifically how these trees will benefit each of our assigned name tag animals; drop wishing stones into hole with tree (a wish for the trees we planted).
    - Additional descriptions in Field Studies and Action Projects section.

- Week 3
    - **Lesson Objective:** Students take a closer look at habitats, including freshwater wetlands, and the organisms within.
    - **Learning Objectives:** Students learn to differentiate between several local habitats, such as forests, meadows, rivers, lakes, and vernal pools. They learn about the adaptations a turtle uses to survive in various habitats. Lastly, students learn methods of identification of macro invertebrates and other organisms.
    - **Activities:** Discussion on habitats, adaptations; Wildlife Program with spotted turtle and wood turtle (see Wildlife section for description); practice Basic Bioblitz during wet lab with water samples from Ice Pond and Poultry Pond, Drumlin Farm, Lincoln, Mass.
    - Additional descriptions in Field Studies and Action Projects section.

BLOCK TWO - Becoming a Teacher Naturalist

- Week 4
    - **Lesson Objectives:** Conduct a review of the material covered during the first three weeks of the semester. Study a migratory bird.
    - **Learning Objectives:** Students reinforce their knowledge base through creative open discussions within the group, as they review the program. Students learn about the adaptations of migratory birds.
    - **Activities:** Nature Jeopardy Game serves as a review of all of the terms, lessons, etc that we have covered thus far; Wildlife Programs with mice and a Broad - winged hawk.
    - Additional descriptions in Games and Wildlife sections.

- Week 5
    - **Lesson Objectives:** Students create a focus for their end - of - semester presentation and identify the practical skills they have developed thus far. The will also learn about terrestrial organisms.
    - **Learning Objectives:** Students learn about what it means to be a teacher naturalist and identify what skills they have acquired. They also learn about fungus, bacteria and invertebrates that inhabit the forest floor.
    - **Activities:** Discuss thoughts on end - of - semester presentation and identify practical skills of teacher - naturalists as exhibited during STL programming; teacher - naturalists present on their educational backgrounds and career paths; dry lab; Wildlife Programs with Madagascar hissing cockroaches and African pixie frog.
    - Additional descriptions in Wildlife section.

BLOCK THREE - Applying Skills and Knowledge in the Field

- Week 6
  - **Lesson Objective:** Perform a coached Bioblitz in the field.
  - **Learning Objective:** Students learn about various organisms, which make up the local ecosystem.
  - **Activities:** Run - around game, H2O Tag; Bioblitz of the school yard and adjacent playing fields; stewardship monitoring of trees that STL apprentices planted last year and this year.
  - Additional descriptions in Games and Field Studies and Action Projects sections.

- Week 7
  - **Lesson Objective:** Perform another coached Bioblitz in the field.
  - **Learning Objective:** The students become scientists and Teacher - naturalist, actively engaged in the observation of local sensitive ecosystem and collecting valuable data. Data will be valuable to the official certification of the West Meadow Vernal Pool and other future studies.
  - **Activities:** Field trip briefing while waiting for bus; Bioblitz of forest and wetland habitats at LP&CT property, known as West Meadow
  - Additional descriptions in Field Studies and Action Projects section.

- Week 8
  - **Lesson Objective:** Solidify plans for end - of - semester presentation.
  - **Learning Objectives:** Students review all of their work from throughout the semester and determine their final approach to their end - of - semester presentation.
  - **Activities:** Semester review of lesson materials, including consolidation of Bioblitz forms, wildlife and habitat sketches, semester descriptions, and photos. Create end - of - semester presentation.
  - Additional descriptions in Field Studies and Action Projects section.

BLOCK FOUR Putting it all together

- Week 9
  - **Lesson Objective:** Create end - of - semester presentation.
  - **Learning Objectives:** Students work towards conveying to the community through visuals, public speaking, etc. all of the teacher - naturalist (environmental education) skills and knowledge they have developed throughout the semester.
  - **Activities:** Students delegate components of creative works presentation, enter Bioblitz information into computer database, create booklets of individual Bioblitzes. Create end - of - semester presentation.
  - Additional descriptions in Field Studies and Action Projects section.

- Week 10
  - **Lesson Objective:** Final end - of - semester presentation preparation
  - **Learning Objectives:** Students continue to work towards conveying back to the community through visuals, public speaking, etc. Make final preparations to presentation.
  - **Activities:** Dress rehearsal of creative works; interpretive scenes; review Bioblitz database; presentation board; public speaking; review general Q&A for presentation visitors. Create end - of - semester presentation.
  - Additional descriptions in Field Studies and Action Projects section.

- End - of - Semester Presentation
  - **Game time!**
  - Demonstrate to peers, friends, family, and local community members all of the skills and knowledge the students developed throughout the semester.

Field Studies and Action Projects Programs

Basic Bioblitz

A ”Basic Bioblitz” is a field form to be completed by the students during field studies, which documents organisms in a given area, according to their current location and habitat, activities, appearances, populations, and conditions, etc. A Bioblitz enables average citizens to play a role in science with the opportunity to enter valuable information into public databases, thus providing data, which can be accessed for current and future institutional studies, such as the effects of acid rain, climate change, pollution, and habitat loss.

This approach to engaging the public in scientific documentation is known as Citizen Science. It is not a new idea, but rather modeled after approaches taken by people, such as cold war U.S. Navy pilots documenting the landscape appearance of mountainous terrain or early colonial farmers observing weather patterns and wildlife populations. Their meticulous notes and documentation provided the essential data needed to conduct such studies, as noted above. A Basic Bioblitz is our way of engaging our youth in this Citizen Science process.

Shown below is a Basic Bioblitz completed by STL students that is part of an effort to create an ecological inventory in support of the certification of a vernal pool on the LP&CT - owned West Meadow property.

Students conducting a field study of their school yard, utilizing the Basic Bioblitz field form.

Basic Bioblitz

Name of Scientist(s): Citizen Schools, Stewardship Through Leadership Apprentices
Date/Time: 11/12/08, 4:44pm
Location of Field Study (example - 12 Oak St., Lowell, MA, behind school):
181 West Meadow Road, Lowell, MA 01854
Type of habitat (examples - meadow, forest, river, vernal pool):
Vernal Pool and mixed forest

What is it? (examples- bird, tree, mushroom, insect, mammal)	**Where is it?** (examples- in tree, on the ground, swimming, flying)	Notes. (Example- How many? Carrying something? Color? Size?
1. Scud aka amphipod	Inside of vernal pool, swimming	Ten legs, like brushed, looks like a shrimp.
2. Phantom midge larva	Inside of vernal pool, floating and swimming	Thin, grayish and clear

Tree Plantings

Tree plantings serve as excellent action projects to carry out with youth of all ages, six and up. The LP&CT often plants trees through its Urban Forestry program and pairs up well with STL when trees and services are needed in this environmental education program. Utility services (digging of holes, etc.) and delivery of trees is done by the City of Lowell Parks and Recreation Department, as partnered with the LP&CT through our ongoing Urban Forestry programming.

In addition to regular STL programming logistical details, the following must be coordinated for a tree planting:

- Determine tree planting location(s) with LP&CT Urban Forestry director and Parks and Rec.
- Tag appropriate shade or ornamental tree(s) at nursery.
- Set up planting schedule accordingly.
- Gather all necessary tools for planting(s).
- Parks & Rec. delivers tree(s), soil, and mulch and digs hole(s).
- Directly involve Urban Forestry director in all planning and implementation.
- Proper plant tree. Understand how to- Convey to youth how to- Involve youth.

Students planting a shade tree in a park adjacent to their school.

Land Stewardship

Land stewardship consists of our youth caring for, maintaining, and monitoring the local landscape. It is really no different than the actions of volunteer land stewards in the LP&CT's Land Protection adult program. Such volunteers visit LP&CT - owned properties, observe their conditions, their uses by the local community members, and they assist the LP&CT in the coordination of action projects designed to protect each property. On the LP&CT's web site is a "Land Steward Monitoring Form," which the volunteer is encouraged to fill out that documents the given property's current conditions.

Our youth carry out virtually the same process occurring right in their own school yard or in a nearby park. Land stewardship activities carried out by youth include the following:

- Monitoring of local open spaces; assessing recent land usage, access points, marked boundaries, trail/property conditions, abutter activity, encroachment issues, littering/vandalism, interesting plants/animals, invasive plants/animals.
- Tree plantings.
- Flower plantings and garden bed weeding/watering.
- Proper mulching techniques.
- Litter collection.
- Boundary/trail signage.
- Basic Bioblitz, creation of an ecological inventory.
- Creation of property/land management plans.

Stewardship projects can include planting flowers in urban parks.

Freshwater Ecology

Freshwater ecology lessons are an integral part of any environmental education program. They are highly engaging and educational. Just about every aspect of this program is hands - on for our youth and the bottom line is that they gain opportunities to learn, while out in the field.

Materials needed for group of 12 students, divided into four groups: 4 large 4' - dip nets, 4 to 8 macro invertebrate identification charts, 4 (Golden Guide) Pond Life books, 4 collection nets, 4 backwash cups, 4 white dish pans, 8 two - way viewers, 8 bug boxes, 12 plastic spoons, 8 pipettes, 4 small dip nets, multiple Basic Bioblitzes or other field forms mounted on cardboard slates, water monitoring/testing kit (minimum basic tests including water temperature, turbidity, pH, and dissolved oxygen).

Additional field instruments and materials may include phosphate/nitrate/bacteria monitoring/test kits, plankton collection net, magnifying glasses, Magiscope (recommended as a field microscope), and white ice - cube trays (used for containing separated specimens).

Objectives: Students will gain exposure to a wide range of freshwater ecosystems/habitats: lakes, ponds, rivers, brooks, streams, and vernal pools. They will learn about characteristics unique to each habitat they study and the habitats' relationships and influences in connection to other habitats and wildlife. They will gain a basic understanding of various cycles including water, oxygen, and life cycles. Students will also have opportunities to collect real and valuable data, upon identifying organisms that may contribute to current and future studies, in addition to their own.

Activity time: 45 minutes minimum.

How to run program: Select a safe location, free from fast flowing or deep water, with ample access to the littoral zone where leaf litter or detritus can be gently scooped up with large dip net.

Divide the class into four groups of three students. Distribute an even amount of program materials within the groups and have them find their own small clearing where they will make their observations.

Bring the entire group to one of the clearings and use this set up of materials to demonstrate the guidelines of this activity. Add about one - gallon of the clearest water possible to the dish pan from the body of water, from which the samples will be pulled. They will also fill a backwash cup at this time.

Dip the large net into the water and gently drag along the bottom collecting “leaves” and gently empty them into the dish pan, pouring the backwash water through the backside of the net to clear out any straggling critters. Macro invertebrates and perhaps tadpoles or crayfish will become visible. This is a good point to inform the group that because the critters were pulled out of the water, they breathe in the water, so we need to ensure that all critters remain underwater whenever possible.

Making observations: At this point, the sample is ready to go. The two - way viewers can have a little water added to them. Spoons, small nets, and pipettes can be used to remove the little critters from the sample and transfer them to the viewers. Student will likely require extended guidance when it comes to their opportunities to carry out the same process you demonstrated. Feel free to be the only one to use the large net for the initial collection if you suspect and safety concern for either the students or the organisms.

Once each group is set up with their samples and materials they are free to observe, describe, and identify organisms. They will use the field guides, books, field forms, and your guidance as a teacher - naturalist to carry out a successful study. Freshwater ecology lessons are loaded with teachable moments, so go with the flow of the overall group and take these opportunities to take advantage of the smaller group ratios.

The water monitoring/testing kits should be used in accordance to guidelines accompanying each kit. Feel free to conduct the physical portion of the tests, while interpreting them to the group as a whole. Always try out your test kits prior to using them in a lesson with youth, so you understand process in addition to any and all associated safety concerns.

This program can be debriefed as a whole group by having the students present their findings to the rest of the group. This may involve the show and tell of completed Basic Bioblitz field forms and descriptive drawings.

Proper clean-up of materials: Clean - up of these activities should be considered before each lesson. Water monitoring/test kits should be disposed of according to guidelines described in each kit. Since organisms, including fungi, bacteria, macro invertebrates are coming into contact with your program materials they can be spread from one ecosystem to another. Rinse all materials if you plan to use them in multiple locations. This is especially crucial to the health of ecosystems, such as vernal pools.

Notes-

- This lesson does not necessarily require all of the materials listed above in order to conduct a successful lesson and you can be creative with much of it, by using reused materials or making and using comparable items: sieves, strainers, yogurt cups, aluminum baking pans, broom sticks, one - gallon plastic water jugs, and duct tape. However, the materials listed here will make for a very sufficiently supplied program.
- It usually only takes one or two dips with the large net to collect a sufficient amount of detritus needed for this program.
- It is not imperative to identify each organism, but rather allow students this rare opportunity for exposure to the outdoors where they can develop observational skills free of pressure. Let them explore.

Above - left: *A student is dipping her net to gently collect detritus.*
Above - right: *students are using their small dip nets, spoons, and pipettes to transfer their specimens into bug boxes. The boy in the blue shirt is holding a macro invertebrate chart which will help his group describe and perhaps identify organisms. The girl in the red shirt is holding a Basic Bioblitz field form, which she is using to collect data and make sketches of their findings.*

A student takes a look at the underside of an invertebrate using his two - way viewer.

Wet Labs and Dry Labs

Wet Labs and Dry Labs generally occur during situations when our youth cannot make it out into the field to conduct a study of local habitats due to lack of transportation, access, or inclement weather. In other words, the field is imported into a classroom setting, thus allowing youth an opportunity to experience a virtual site visit.

During a Wet Lab (Freshwater Ecology lesson), students will engage in macro invertebrate studies and Wildlife Programs with perhaps a Spotted turtle or a Mallard duck. The teacher - naturalist has set up this program with the appropriate resources before the lesson. Water samples will be collected from a local freshwater ecosystem, such as detritus from a vernal pool. The samples are brought to the indoor space for observation. This indoor setting is not quite as exciting as being outdoors in the field of course, however it is still very engaging for all youth. An indoor program provides the students with normal structure of a school classroom. This version of a freshwater ecology program is adapted, simply by placing all of the equipment and samples on a tarp on the floor and performing the rest of the program no differently than it would be done in the field. Most often found in freshwater samples are macro invertebrates and the occasional tadpole. (To learn more about freshwater materials, sample collection processes and observation see the Freshwater Ecology program.)

Students conducting a Wet Lab in their classroom.

A Dry Lab (forest floor ecology) is essentially no different than a Wet Lab, aside from pulling water samples. Prior to a Dry Lab the teacher - naturalist will collect duff (leaf litter) from the floor of a local forest and bring it to an indoor classroom. Like a Wet Lab, performing a Dry Lab provides exposure to nature that may not otherwise occur and can be just as exciting as a site visit itself. Again, a tarp is placed on the classroom floor, while all of the observation - type equipment and field guides/charts and duff are placed on the tarp. Most often found in duff samples are fungi, bacterium, and invertebrates. Although, not all of these organisms can be seen without high powered equipment, much of them can be seen with the equipment our students have access to and it provides excellent insight into soils and an understanding of the trophic levels. Collection is easy. All it takes is a bucket, which the teacher - naturalist fills with duff, and of course replaces it to the same location in the forest from where it came.

This student is using a lumi - loupe to gain a magnified view of a centipede he found in duff collected from a mixed forest.

Games Programs

Hampered Habitats

Materials needed for 10 - 50 players: Playing field, 20'x40' (for smaller groups); four cones, backpacks, or water bottles, etc. set up in corners of rectangle (like a small football field with imaginary sidelines and two end zones).

Objectives: Students will learn about wildlife of New England. They will become familiar with various habitats where wildlife can be found and the amazing adaptations that wildlife depend on for their survival. This game inspires many "teachable moments" when the group leader can stop the group to depict and discuss the realities of living in the wild.

Playing time: 20+ minutes.

How to play: This is essentially a modified version of freeze tag. After you set up what is similar to a small football field, have the entire group line up on one of the goal lines, toes on the line and facing the center of the field. Select 2 - 4 players who will be "predators" roaming between habitats (end zones), while the rest of the group will be "prey" of their choice. Have all the prey simultaneously shout out what kind of animal they are on the count of three, 1 - 2 - 3! Once they have established their animal, explain that the prey, when called by the "speaker," must migrate from one habitat to the other habitat without being tagged by the predators.

The speaker will call out for prey (according to adaptations and behaviors, habitat types, etc) to run from their habitat, across the field to the other habitat-

> *"If your animal has claws!" And the prey all attempt to make it to the other habitat.*
>
> *With the remaining prey in the first habitat only, "If your animal lives in the forest!" And the remaining prey all attempt to make it to the other habitat.*
>
> *With any remaining prey in the first habitat only, "If your animal can fly!" And the remaining prey all attempt to make it to the other habitat.*

Prey are to remain in the habitat they made it to until the speaker has called all the prey out of the first habitat.

When a predator tags a prey animal, the prey must stand two - feet together where they were tagged. The prey are now stationary "cell phone towers" and are able to move their arms to tag passing prey, who if tagged will also become towers.

Notes-

- The **speaker** can be either the **group leader** or one of the **predators**.
- **Predators** can also be noted as being hunters, snow storms, cars, etc, and cell towers can also be noted as smoke stacks, or windmills, etc. Be creative and accurate, while thinking of challenging obstacles that local wildlife (**prey**) encounter.
- In this game, nobody becomes "out." They only change roles and get to learn, while having fun.
- The first round of the game can often be confusing, though following rounds produce great fun and provide many opportunities for teachable moments.
- If this is a game played with an unfamiliar group, you can use name tags with assigned animals (ie. Brian: Grey squirrel). Not only will you quickly gain respect, by knowing Brian's name, but Brian can also become more familiar with his animal throughout the game and beyond.

Nature Jeopardy

Materials needed for 4 - 18 players: Chalkboard and chalk, or dry erase board and markers.

Objective: Students will review concepts and lessons covered throughout duration of program.

Playing time: 15+ minutes.

How to play: A grid is drawn on the board listing multiple categories and ascending point values, as displayed below. The game is played similarly to the Jeopardy TV show.

Adaptations	Habitats	Invertebrates	Fish
100	100	100	100
200	200	200	200
300	300	300	300
400	400	400	400

The group is divided up into two or three teams depending on group size. Each group selects a category and point value when it is their turn. The higher the point value, the more difficult the question should be. To avoid confusion, especially for those youngsters who are not at all familiar with the TV version, answers do not need to be posed as questions (ie. "What is a butterfly?") If the group gets the answer correct, they gain according points. If they do not get the question right, they do gain points, nor do they lose points.

When time is up and the game must come to an end, Double Jeopardy must occur. Each team can bet any value of their total points, which will be added to their total points. Points are not subtracted for incorrect answers.

There are no set questions for this game. Questions can be created on the fly or planned. They should of course coordinate with all concepts and lessons covered throughout the duration of your program.

Example questions-

- Adaptations for 100 points-
  - Q: What adaptation allows a bird to fly?
  - A: Wings.
- Habitats for 200 points-
  - Q: Name two habitats found in Lowell, Massachusetts.

    - A: River and forest.
- Invertebrates for 300 points-
    - Q: What are three facts associated with invertebrates?
    - A: No backbone, insects are invertebrates, some invertebrates help to decompose organic material.
- Fish for 400 points-
    - Q: Name a freshwater habitat in Lowell where fish cannot be found.
    - A: A vernal pool.

Notes-

- Allow for loose answers to questions, so long as the groups seem to exhibit general concepts and understandings associated with questions and answers.
- The benefit of this game is that students always seem to find it as an entertaining way to review and continue to learn. They learn a lot from their peers in this case and they often surprise themselves be finding out how much they have learned and experience. You will be impressed by their knowledge, too.
- A benefit for the teacher - naturalist is that this game can serve as a valuable plan or back up plan for at least part of a class during events when outdoor activities are hampered by rain, other materials become suddenly and unexpectedly unavailable, and you can plan it on the fly.

H2O Tag

Materials needs for 10 - 20 players: Open playing field, approximately 30'x30' or larger.

Objectives: This game will convey that open water is not simply H2O, but that in order for animals who breathe underwater to survive, additional oxygen (O2 gas) must be dissolved within. This game is also an excellent one to play that will run off the energy of a group at the beginning of a lesson that has been sitting in classrooms all day. It is also an excellent game to play at the end of a lesson that will reward a group that has been patient and well behaved during slow moving and very focused environmental education lessons.

Playing time: Up to 20 minutes.

How to play: Have everyone link elbows with a partner (in pairs, and a three - person - link if there is an odd amount of players) and spread out around the playing field. Divide up one pair, call one "oxygen" and the other "water." The rest of the group is "standing water." Oxygen and water play a game of tag. Oxygen chases water, "trying to dissolve" and if they do tag water, the roles are reversed. If water would like a rest and become safe they must link elbows with someone in a standing water pair. The person opposite the person with whom water has linked, now becomes water. This is a little confusing to grasp, so don't be afraid to push this demonstration.

Brian is "water" and he is being chased by oxygen. Brian sees a pair of "standing water," Jane and Sally. He is seeking a rest from the chase so he links elbows with Jane and now Sally becomes "water." Oxygen continues the game of tag, but is now after a new water (Sally).

Notes-

- Play to your heart's delight and even add a second pair of oxygen and water, those engaged in the tagging chase.
- This game is a good way to discuss the flows and processes of water, oxygen gas, carbon dioxide, and so on.

Wildlife Programs

Wildlife Programs (known to MAS as ARK's)

Wildlife programs engage youth in ways that regular props simply cannot. Having a live animal on display brings to life, up close and personal, exposure to animals that people otherwise only hear or read about, see pictures of in books, or if lucky enough see from a distance in the wild. Some animals we don't realize we see, because of their abilities to camouflage. Some animals we only hear from a distance. Because so many animals are nocturnal and they are not often seen during our daytime hikes and the ones that we would see during the day are otherwise hiding, because they have detected us long before we detect them. If we can hear ourselves, they can hear us from a distance. By having live animals in the classroom we have a controlled ability to observe them with ease, as they are unable to flee. Program animals, such as the animals that are cared for by MAS staff and brought to classrooms in Massachusetts are animals that are unable to survive in the wild. MAS - Wildlife Care is not a shelter, but rather a place where injured, ill, or imprinted animals can go after recovering at a licensed animal hospital or veterinary clinic.

Wildlife programs are best when there is a build - up to a climactic moment when the animal in unveiled. We discuss the difference between wild and domestic animals, things that all animals need to survive (food, water, air, reproduction, shelter, protection, space, etc.), habitats, and so on. This is also a good time to pass around tactile objects, perhaps feathers, bones, antlers, or turtle shells, that offer and opportunity to uses senses that go beyond the visuals of simply looking at the animals. For safety purposes, most program animals cannot be touched by students. Once the animal is taken from its carrier and placed in a safe viewing location, by a properly trained teacher naturalist, students will observe the animal's appearance and behavior. Again this is a prime situation where every observation seems to present a teachable moment or rather an ongoing conversation stimulated by the behaviors exhibited by the animals.

The animals immediately strike the students as fantastic, like the great horned owl or snapping turtle. However, we can take a look at mice and the initial reaction may be of fear or the thought that this is an animal that we associate with common knowledge. With a closer, controlled look that these programs offer we observe thigmotaxis, where the mice contour the walls of their enclosure and tree stumps, because they are prey animals seeking shelter from humans who they see as predatory animals. The mice will also grip their young by the scruff and carry them to the safety of shelter if they are place in open areas of the enclosure. Students raise excellent questions, which the teacher - naturalist can often help the group find an answer to by facilitating conversation and provoking creative thoughts and discussions.

Students get a close look at a Painted turtle.

Here they witness the beauty of an American kestrel (falcon) and discuss its remarkable adaptations that make it an efficient and fierce predator.

Above: *A rabbit presents its curious nature with its busy nose, up close and personal with the students.* ***Below:*** *These boys are passing around the empty shell of a painted turtle, providing a chance to understand what a turtle shell feels like.*

Entomology

Entomology, being the study of invertebrates - insects and their kin is a lesson that can be carried out almost anywhere, indoors or outdoors, rural or urban. Without invertebrates most food chains would be severely severed and there would be no soil to grow our food.

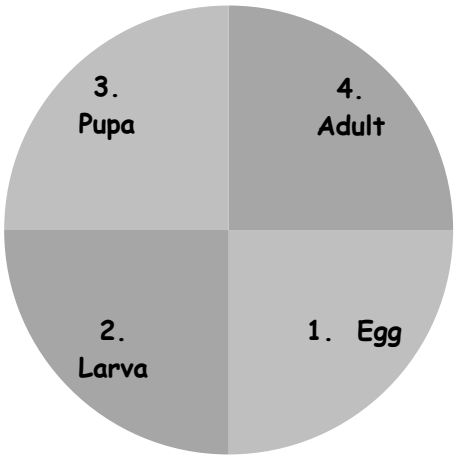
During a hike in the forest it is easy to pull back the leaf litter and look in the duff or roll a log over to find out what is living beneath. We of course should exhibit the idea of replacing logs and leaves the way we found them, as to not destroy the habitats of the critters we are learning from and appreciating. Use bug boxes and other magnification equipment when handling invertebrates, not only to get a closer look at their incredible features and adaptations, but to protect the individual and the invertebrate alike. Students should understand basic concepts, such as the fact that invertebrates have no backbone, the general body parts of insects, the benefits of insects to humans, and so on. Invertebrates are all around, in the sky, up in trees, in and under logs, in the ground, underwater, and you may even find one in the ocean. (See Freshwater Ecology programs, as well as, Dry and Wet Labs as they are equally as effective methods of conveying the subject of entomology.)

Taking a closer look a beetle found under a log in the forest.

When it comes to studying entomology, it is amazing to explore metamorphosis through the life of a Monarch butterfly. Monarchs not only experience complete metamorphosis, but they migrate great distances, and they exhibit remarkable adaptations.

Metamorphosis worksheet

Metamorphosis



Here is an example of metamorphosis:

- **Monarch butterflies** migrate between Canada, the United States, and Mexico
- They lay their **eggs** on **milkweed** plants along the way.
- Caterpillars (**larvae**) hatch from their eggs and eat the milkweed.
- Soon each larva will make a **chrysalis** and become a **pupa**.
- Inside the pupa the caterpillar completes its **metamorphosis** (change) and becomes an **adult Monarch butterfly**.

In so many places from meadows, to road sides and city parks you will find Common milkweed, which is a plant that few animals can consume, because of its toxic nature. Monarchs are able to feed from milkweed flowers and they will lay one egg per milkweed plant, to ensure that each of their young will gain an immediate food source upon hatching. The larvae eat the milkweed and gain an orange coloration to their wings, which signals that they are now toxic to their potential, would - be predators.

Metamorphosis is not the only cycle that Monarchs experience. They will migrate south for the winter all the way to Mexico. On the way back come warmer weather they will make a portion of the journey, lay eggs (on milkweed of course), and their offspring will

continue yet another portion of the journey back north. This cycle is repeated until the seasons begin to grow colder once again and the adults will travel to Mexico to repeat the cycle.

If you are specially trained and have the right equipment, Monarch tagging is an excellent activity to carry out with your youth. You will likely be able to find milkweed someone where around the school yard. If you can find milkweed you may be lucky enough to see a Monarch butterfly or perhaps its eggs, larvae or pupae. Both a pupa and an adult monarch can be carefully placed in a cage for a short period of time. The adults can be tagged with a specific circular sticker, used for Monarch tagging only. One can take notes on the butterflies, such as location found and the sex of the specimen, and including the code on the tag. The butterflies are released and the information is sent to a central location in Washington D.C. where scientists are conducting studies on their migration patterns and populations.

Collecting worms in the garden.

Collaborator Contact Information

- **Lowell Parks & Conservation Trust (LP&CT or Trust)**

Executive Director: Jane Calvin
Project Specialist and Teacher - Naturalist: Brian Cutler
Address: 11 Kearney Square, 4th Floor, Lowell, MA 01852
Mailing Address: PO Box 7162, Lowell, MA 01852
Phone: (978)937 - 0030
Fax: (978)454 - 7637
Web Site: www.lowelllandtrust.org

LP&CT Mission: To improve the quality of life for the people of Lowell through the creation, conservation, and preservation of parks, open spaces, and special places.

- **Massachusetts Audubon Society - Drumlin Farm Wildlife Sanctuary (MAS)**

Education Manager: Kris Scopinich
Address: 208 South Great Road, Lincoln, MA 01773
Phone: (781)259 - 2200
Web Site: www.massaudubon.org

MAS Mission: Protecting the nature of Massachusetts.

Partners - Past and Present

- **Girls Incorporated of Greater Lowell - Operation SMART**
- **Citizen Schools, as Presented by Community Teamwork Inc.**
  - Henry J. Robinson Middle School campus
  - Dr. An Wang Middle School campus
- **UMass Lowell Graduate Program**
  - Bartlett Community Partnership School campus
- **Spindle City Corps and Lowell National Historical Park**
- **Groundwork Lawrence - Green Team**
- **United Teen Equality Center**
- **Light of Cambodia Children**

Our Funders

- **Massachusetts Cultural Council**

Appendix

- **Printed on 100% recycled paper.**

- **Basic Bioblitz (field observation form)**

Basic Bioblitz

Name of Scientist(s):
Date/Time:
Location of Field Study (example -

Type of habitat (examples - meadow, forest, river, vernal pool):

What is it? (examples- bird, tree, mushroom, insect, mammal)	**Where is it?** (examples- in tree, on the ground, swimming, flying)	Notes. (Example- How many? Carrying something? Color? Size?
1.		
2.		

- **Basic Bioblitz (field observation form, second version)**

Basic Bioblitz

Scientist (your name): **Today's date and time range of study:**

General location of study: **Current air/water temperature:**

Type of organism (any living thing)? - Sure? Think so? OR Unsure?	Visible population count?	Specific location and type of habitat?	Current activity AND/OR appearance?	Additional notes.
1.				
2.				
3.				

- **Citizen Science Contribution Form (upgraded version of Basic Bioblitz)**