Open Spaces as Learning Places
GREENSPACE UNIT

THE "OPEN SPACES AS LEARNING PLACES" PROGRAM

PROGRAM STRUCTURE

The Open Spaces as Learning Places program teaches environmental science through six curriculum units focused New Haven open spaces. The program takes place over 9 weeks in both the spring and fall semesters. Each year, we teach approximately 27 hours of science education to 200 New Haven 6th grade students. In addition, through teacher training workshops and on-going support, we provide professional guidance to New Haven public school teachers.

In the **Schoolyard Unit** students learn that even the schoolyard is part of the natural world. By studying New Haven's history and creating a wildlife enhancement project in their schoolyard, students recognize the role humans and nature play in shaping the landscape.

The **Greenspace Unit** raises student awareness of open space at the neighborhood level. Children learn about local stewardship efforts of neighborhood residents to restore open space by transforming vacant lots into greenspace sites, landscaping yards, and maintaining curb strips. Students note the effects of natural change on the neighborhood environment and examine the special adaptations that allow flora and fauna to thrive in their neighborhood habitats.

The **Park Unit** takes an ecological approach to open space by focusing on a nearby city park to teach students about natural communities and ecosystems within their local park. Students begin to appreciate the ecological significance of open space. They become aware of the dynamic state of nature as they observe materials cycling through the forest environment and learn about successional change.

The **River Unit** makes regional connections, showing how watersheds join together urban communities and suburban towns to open space areas. Students study stream dynamics to see how water shapes the Earth's surface. After learning that water is a limited resource, students identify sources of pollution that threaten local rivers. After a canoe trip on a nearby river, the children explore adjacent wetland habitats rich with wildlife.

The **Pond Unit** ties together concepts from previous lessons and uses the example of a local pond for the study. The children use physical, chemical and biological measurements to analyze water quality. As they sample pond life, students observe food webs, metamorphosis and adaptations to different pond habitats. The students see successional change and learn how overlapping ecosystems provide valuable edge habitat for wildlife.

The **Cemetery Unit** provides a geological overview of landscape change. Students discover that the Earth's crust, composed of rocks and minerals, moves slightly every day. At a local historic cemetery, students look for change over time on gravestones, noting differences in resistance to weathering among rock types. They also learn that cemeteries serve as wonderful habitat for urban wildlife.

To download any of these teaching materials for free, please visit www.urbanresourcesinitiative.org.

GREENSPACE UNIT: SUMMARY

This unit raises student awareness of open space at the neighborhood level. Children observe the efforts of neighborhood residents to create and improve open space by transforming vacant lots into Greenspace sites, landscaping yards and maintaining curb strips. In addition to human impacts on open space, students note the effects of natural change on the biotic and abiotic components of the neighborhood environment. Students examine the special adaptations that allow flora and fauna to thrive in their neighborhood habitats. Through unit activities, the children understand how an abandoned space can be designed to meet the needs of plants and animals as well as humans.

GREENSPACE UNIT: LEARNING OBJECTIVES

Journal

- Students apply their understanding of animal adaptations to create a drawing of an animal.
- Students use descriptive language to write about an imaginary creature.

Worksheets/Reviews

- Students can identify the different components that comprise a habitat. *Review Sheet 2.1-Greenspace Review*
- Students can distinguish between biotic and abiotic objects. *Review Sheet 2.2-Greenspace Review*
- Students demonstrate an understanding of organisms that inhabit the forest floor by describing their characteristics and adaptations. *Review Sheet 2.2-Greenspace Review*
- Students demonstrate an understanding of the role that seed dispersal plays in plant reproduction. *Review Sheet 2.1-Greenspace Review*
- Students practice observation skills by exploring sounds and objects in the greenspace site. *Worksheet 2.1-Scavenger Hunt (Part I)*
- Students create a drawing that accurately reflects the features in a sampling area. *Worksheet 2.1-Scavenger Hunt (Part III)*
- Students can identify characteristics of wildlife that allow it to survive in its environment (urban and non-urban). *Review Sheet 2.2-Greenspace Review*

Classroom Performance

- Students listen and respond to presentations by looking at the speaker and asking relevant questions.
- Students can identify some of the ways humans improve the environment, e.g., the restoration of a vacant lot, wildlife enhancements, etc.
- Students observe the interconnectedness and interdependence in the ecosystem through observation of the terrarium.

- Students are able to classify the characteristics of seeds.
- Students observe similarities and differences in the natural and built environment surrounding their schools and are able to match photographs to actual places.
- Students understand the ways in which ecological restoration can bring together members of a community and aid in the development of social networks, e.g., community events on Nash Street and crime prevention on Arch Street.
- Students recognize community members and organizations that have influenced the development of New Haven, Connecticut.
- Students work cooperatively in groups, e.g., share materials and help team members to explore the Greenspace.
- Students can observe and describe animal adaptations by viewing animal skulls.
- Students define the dietary terms: herbivore, carnivore, and omnivore, based on the functions that they serve in the ecosystem.
- Students can use the appropriate measurements for distance, height and speed.

GREENSPACE UNIT																	
Science Curriculum Standards and Framework - Grade 6		**Classroom Activities**					**Outdoor Activities**					**Focus Activities**					**Journal**
Content Standards	**Expected Performances**	Vacent Lot to Neighborhood Gem	Indoor Habitat	Amazing Plant Adaptations	Seeds on the Move	Seeds on the Move	Neighborhood snapshots	Learn About the Lot	Stop, Look And Listen	Hula Hoop Transects	Urban Survival Challenge	Amazing Animal	Skull Skills	Critter Cuisine	Animal Olympics	Camoflague	Imaginary Creature
Scientific Inquiry, literacy, and numeracy	**C INQ.1** Identify questions that can be answered through scientific investigation.									X							
	C INQ. 3 Design and conduct appropriate types of scientific investigations to answer different questions		X			X				X	X	X	X			X	
	C INQ. 4 Identify independent and dependent variables, and those variables that are kept constant, when designing an experiment		X							X							
	C INQ. 5 Use appropriate tools and techniques to make observations and gather data					X	X		X	X	X						
	C INQ. 8 Draw conclusions and identify sources of errors									X							
	C INQ. 9 Provide explanations to investigated problems or questions			X		X	X			X	X	X	X			X	X
	C INQ. 10 Communicate about science in different formats, using relevant science vocabulary, supporting evidence and clear logic	X	X	X		X				X	X	X	X				X
6.2 Matter and Energy in Ecosystems	**C 4.** Describe how abiotic factors, such as temperature, water and sunlight, affect the ability of plants to create their own food through photosynthesis	X	X	X													
	C 5. Explain how populations are affected by predator-prey relationships		X									X	X	X			
	C 6. Describe common food webs in different Connecticut ecosystems		X											X		X	

GREENSPACE UNIT																	
English Language Arts Standards and Curriculum Framework - Grade 6		Classroom Activities				Outdoor Activities					Focus Activities					Journal
Content Standards	**Expected Performances**	Vacent Lot to Neighborhood Gem	Indoor Habitat	Amazing Plant Adaptations	Seeds on the Move	Neighborhood snapshots	Learn About the Lot	Stop, Look And Listen	Hula Hoop Transects	Urban Survival Challenge	Amazing Animal	Skull Skills	Critter Cuisine	Animal Olympics	Camoflague	Imaginary Creature
1.1 Students use appropriate stategies before, during, and after reading in order to construct meaning.	**e.** Draw conclusions and use evidence to substantiate them by using texts heard, read, and viewed.	X														
	f. Make and justify inferences from explicit and/or implicit information.	X														
1.2 Students interpret, analyze, and evaluate text in order to extend understanding and appreciation.	**a.** Generate and respond to questions.	X														
	b. Interpret information that is implied in a text.	X														
	e. Discuss and respond to texts by making text-to-self, text-to-text and text-to-world connections.	X														
1.3 Students select and apply strategies to facilitate word recognition and develop vocabulary in order to comprehend text.	**a.** Use phonetic, structural, syntactical and contextual clues to read and understand words.		X													
	c. Analyze the meaning of words and phrases in context.		X	X	X							X				
	d. Develop vocabulary through listening, speaking, reading and writing.	X	X	X								X				
	e. use content vocabulary appropriately and accurately (math, music, science, social studies, etc).		X	X							X	X				X
3.1 Students use descriptive, narrative, expository, persuasive, and poetic modes.	**a.** Use oral language with clarity, voice and fluency to communicate a message.	X		X					X							
	b. listen to or read a variety of genres to use as models for writing in different modes.	X														
	c. use the appropriate features of pursuasive, narritive, expository, or poetic writing.	X														X
	d. Write to delight in the imagination.															X
4.2 Students seek and write using standard language structures and diction appropriate to audience and task.	**a.** use sentence patterns typical of spoken and written language to produce text.															X

GREENSPACE UNIT																
Math Curriculum Stnadards and Framework - Grade 6		Classroom Activities				Outdoor Activities					Focus Activities					Journal
Content Standard	**Expected Performances**	Vacent Lot to Neighborhood Gem	Indoor Habitat	Amazing Plant Adaptations	Seeds on the Move	Neighborhood snapshots	Learn About the Lot	Stop, Look And Listen	Hula Hoop Transects	Urban Survival Challenge	Amazing Animal	Skull Skills	Critter Cuisine	Animal Olympics	Camoflague	Imaginary Creature
1.1. Understand and describe patterns and functional relationships.	a. (1) Describe, analyze and extend numeric, geometric and statistical patterns and use them to identify trends and justify predictions.								x							
2.1. Understand that a variety of numerical representations can be used to describe quantitative relationships.	a. (1) Locate, order and compare whole numbers, fractions, decimals and integers on number lines, scales and the coordinate grid.								x							
2.2. Use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.	a. (1) Estimate and predict reasonable answers and recognize and explain when an estimate will be more or less than an exact answer.								x							
	a. (2) Use a variety of computational strategies (mental computation, paper-and-pencil and calculator) to add, subtract, multiply, and divide multidigit numbers in the context of multistep word and practical problems.												x			
3.3 Develop and apply units, systems, formulas, and appropriate tools to estimate and measure.	a. (2) Select and use appropriate units, strategies, and tools to measure and solve problems involving length, perimeter, area, volume, capacity, weight, mass, temperature and angles.								x							

GREENSPACE UNIT: BACKGROUND INFORMATION

In this unit, students study the neighborhood environment, seeing how change is basic to life with ecological quality improved or degraded by human actions. A nearby Greenspace site serves as a wonderful example of city residents creating positive environmental change in their neighborhood. The children learn how an abandoned lot can be transformed into a neighborhood asset where people gather and enjoy nature. Students begin to appreciate how the landscape design of a Greenspace site strives to satisfy the needs of plants, animals and humans.

The children learn that every living thing needs a place to live. The place where a plant or an animal lives is called its **habitat**. Every habitat is made of two parts, the **abiotic**, or the non-living part, and the **biotic**, or the living part. Each habitat must provide plants and animals with their basic needs for survival. Animals require food, water, shelter and space in the proper arrangement and plants need sun, soil (or nutrients), air and water. During Greenspace planning, neighborhood residents select specific plants and animals they hope will thrive at the site. The restoration process creates new habitat for the target species through changes to the abiotic and biotic features of the lot. As **habitat diversity** increases, the site supports higher **species diversity**.

Students discover that living organisms are designed or adapted to live where they live. **Adaptations** are physical or behavioral characteristics exhibited by a plant or an animal that allow it to survive under a given set of conditions. Sometimes plants or animals are adapted to a very specific habitat, while others can survive in a range of environmental conditions. In a city, the most successful species often are able to thrive in the changed environment because they have less specific requirements. Urban species also cope with the built environment by substituting human-related items for their habitat needs.

Plants grow, breathe, reproduce and use food, as do animals. Unlike animals that have the ability to move around, most plants are rooted in the ground or stuck in one spot, unable to move from one place to another. They must grow and thrive in an area, producing more plants of their own kind. **Pollination**, **fertilization** and **seed dispersal** are important parts of **plant reproduction**.

Two main plant groups reproduce through seed production: 1) the flowering plants or the **angiosperms** and the cone-bearing **conifers**. To produce seeds, plants must be fertilized through pollination. On flowering plants, flowers contain the parts needed for seed production. The female structure called the **pistil** is where egg cells wait for pollen from the male part of a flower known as the **stamen** to fertilize them. Through pollination, viable seeds are produced, encased in a protective outer coating that packages nourishment for a developing embryo. A tiny plant with leaves, a stem and roots grows within the seed until it sprouts and starts to take nutrients from the soil and make its own food.

Plants exhibit a wide range of adaptive strategies to increase their chances of successful reproduction. Flowers use color, scent and special structures to help with pollination. Plants that rely on animal pollinators (insects, birds, bats, etc.) advertise with

colorful petals and patterns that serve as nectar guides. Flowers also attract pollinators with smell; some have sweet scents that appeal to butterflies, bees, moths and birds, while others smell like rotting flesh to entice flies. Certain flowers have petals that act like landing pads or special shapes that limit access to specific types of pollinators.

Once a plant is pollinated and seeds are produced, it is important for a plant to disperse the seeds to favorable locations where they have a good chance of growing. If seeds just drop to the ground, they will compete with the parent plant for resources. Seeds dispersed by wind, water and animals to areas where there is less competition and more suitable conditions have a better chance of germinating. The container in which a seed is packaged plays an important role in dispersal. Many seeds are designed for travel, having creative structures like wings or blades that propel them, fluffy hairs that act like parachutes, sharp hooks or barbs that let them hitchhike, casings that make them buoyant and sealed coverings that open up with the heat from a fire. Other seeds rely on sensory appeal, hidden within nutritious, colorful or pleasant smelling fruits that either are eaten and passed through dispersing animals, or are stored for future use.

Animals display a variety of structural and behavioral adaptations as well. Every animal needs to eat, but it also must avoid getting eaten. The wide range of survival strategies used by animals includes camouflage, mimicry, speed, flight, pattern, shape, poison, bad taste, sharp teeth, beaks, claws or quills etc. Meat-eating **predators** tend to have eyes placed in front of their head, giving them three-dimensional, binocular vision for zeroing in on their prey. **Prey** species tend to have eyes on either side of their head for a broader view that helps them spot danger. Predator-prey relationships influence population dynamics and species composition.

In relation to their diets, animals can generally be broken into four main groups: **carnivores** eat meat; **herbivores** eat plants; **insectivores** eat insects; and **omnivores** eat a variety of food. Eating is easier for humans because people eat with utensils and soften food by cooking it, but animals depend on either a beak or teeth for eating. Birds' beaks are adapted to the food items they consume. Hawks have hooked beaks for tearing flesh, fish eating birds have beaks like daggers, woodpeckers' beaks act like drills, ducks have bills that work like strainers, etc. Animals with teeth have specific types of teeth correspondingly arranged and shaped to fit their dietary needs. Incisors are located in the front of the mouth and are used for cutting, dagger-like canines are used for tearing and shredding meat and molars, in the back of the mouth, are used for grinding.

Omnivores (humans, raccoons, opossums, etc.) have a mixture of all three kinds of teeth. Carnivores (mountain lions, wolves, otters etc.) have sharp incisors, molars and canines for holding onto their prey and tearing food. Herbivores (rabbits, beavers, deer, etc.) lack canines entirely and possess only clipper-like incisors and grinding molars. Insectivores (moles, shrews, some bats, etc.) have mouths full of sharp little teeth for crunching insect exoskeletons.

Although adaptations help animals survive in the wild, they cannot protect them from many human threats. Human encroachment and habitat loss are the most common causes for wildlife species becoming of **special concern**, **threatened**, **endangered** or **extinct**. Animals adapted to a specific habitat are more vulnerable to habitat loss than those that can survive in a wide range of environmental conditions.

GREENSPACE UNIT: CLASSROOM ACTIVITIES

CLASSROOM ACTIVITY ONE

Title: Vacant Lot To Neighborhood Gem
Objectives: Students will appreciate how neighborhood residents have a positive impact on the urban environment by transforming vacant lots into Greenspace sites and community gardens. Children will identify abiotic and biotic components as they explore the concept of habitat.
Time: 10 minutes
Materials: Greenspace handout (Handout 2.1)
Preparation: Review Greenspace handout
Procedure:

- Review the definition of open space as an area that is not planned for development. Remind the students of the three open space colors: green, blue and brown.
- Explain that the next open space unit focuses on a special neighborhood lot that underwent many changes over the years. The area was first developed and then later abandoned. It remained a vacant lot (brown open space) until neighborhood residents converted it into a Greenspace site (green open space). Tell them again about the collaborative effort of Urban Resources Initiative, New Haven Land Trust, Livable Cities Initiative and the Community Foundation of Greater New Haven to help neighbors create "pocket parks" and community gardens.
- Ask the children what they think they would find in a vacant lot (trash, weeds, trees, flowers, soil, rocks, etc.).
- Distinguish between the biotic (living) and the abiotic (non-living) components of the vacant lot.
- Define habitat by explaining that every living thing needs a place to live. Habitat consists of living and non-living parts that provide animals and plants with their basic needs for survival (animals--food, shelter, water and space in the proper arrangement, plants--enough sun, soil, air and water).
- Explain that the residents drew up a plan to create a neighborhood gathering spot where they could enjoy nature. Describe how the neighbors needed to change the abiotic and the biotic conditions of the lot to create appropriate habitat for the wide variety of plants and animals they hoped would thrive in the new Greenspace site. Ask the children what they think were some of the first changes made to the lot (cleaning up, clearing, weeding, adding topsoil, planting and watering).

CLASSROOM ACTIVITY TWO

Title: Indoor Habitat

Objectives: Students will duplicate the Greenspace challenge on a smaller scale by creating a terrarium habitat that shows how living things are adapted to their environment.

Time: 20 minutes

Materials: Terrarium handout (Handout 2.2), glass tank with cover, magnifying boxes, spray bottle, water, charcoal, pebbles, soil, rocks, leaves, ferns, moss, lichens, bark, worms, sow bugs, pill bugs, slugs, salamanders, young toads, millipedes, beetles and centipedes

Preparation: Collect specimens, sort materials and review Terrarium handout.

Procedure:

- Show the students the plants and animals you collected and explain that, similar to the vacant lot, they need to create conditions suitable for the living things they are going to add to their site.
- Prepare the terrarium habitat by lining the bottom with pebbles (for drainage) and placing a layer of charcoal (to reduce odors) on top of the pebbles. Add a thick layer of soil on top of the charcoal and squirt with water until damp. Ask the children for guidance in placing the bark, dead leaves, rocks, moss, lichens, ferns and fungi in the terrarium.
- Have the students identify the biotic and the abiotic components of the terrarium habitat. Discuss how living things are designed to live where they live. Plants and animals have adaptations, special structural or behavioral characteristics that help them survive in their habitat. Some living things are adapted to living in specific habitats while others can survive in a variety of places. Explain how the moss, lichens, ferns and fungi are well suited to the moist, shady conditions in the terrarium.
- Add the living creatures to the tank after passing them around and describing each animal's specific adaptations.
- Use this activity as an opportunity to differentiate between vertebrates and invertebrate in a very silly way. Tell the children if they were to step on an invertebrate it would go crunch and then squish (exoskeleton/ no backbone) but if they stepped on a vertebrate it would go squish and then crunch (no exoskeleton/ backbone).
- Note that the terrarium contains the proper habitat for the plants and animals added to the tank. Compare it to the vacant lot in which the community created habitat for plants and wildlife by changing the conditions of the site.
- The terrarium remains in the classroom for observation. It should not be placed in direct sunlight and needs to be misted daily to maintain moist conditions. In addition, the critters need to be fed regularly.

(The terrarium will be used for Classroom Activity One, Park Unit.)

CLASSROOM ACTIVITY THREE

Title: Amazing Plant Adaptations
Objectives: Students will learn about plant adaptations and understand how plants are designed for survival.
Time: 10 minutes
Materials: Pictures of plants with special adaptations, poster board, scissors and tape
Preparation: Cut out and mount pictures of plants with distinctive features to create adaptation flashcards.
Procedure:

- Explain that plants grow, breathe, reproduce and use food, as do animals. But unlike animals, most plants are rooted to the ground or stuck in one spot, unable to move from one place to another. They must grow and thrive in an area, producing more plants of their own kind. Use flashcards to illustrate specific plant strategies for survival.
- Discuss how pollination, fertilization and seed dispersal are important parts of plant reproduction. Describe how most plants need pollen grains to be brought to them for fertilization so that seeds can grow. Wind carries some pollen grains to plants but others depend on insects and birds for pollination. Use flashcards to show plant pollination lures (beautiful colors, attractive shapes, special smells, etc.).
- Talk about seed dispersal and explain that if seeds fell to the ground under the parent plant and stayed there, the young would be competing for soil, water and sunlight with its parent. Plants need to spread their seeds so they have the best chance of survival.
- Use the flashcards to illustrate seed dispersal strategies and relate the discussion to the vacant lot. Remind students of the types of plants growing in the vacant lot. Ask them how the plants got there and why many of them continue to thrive despite weeding.
- Discuss the plants selected by the community to attract wildlife to the Greenspace site.

CLASSROOM ACTIVITY FOUR

Title: Seeds on the Move
Objectives: Students will understand and identify some seed adaptations by observing a seed and guessing how it is dispersed.
Time: 20 minutes
Materials: Seed dispersal handout (handout 2.3), seeds (maple, milkweed, oak, burdock, cranberry, etc.), Ziploc bags, labels, miscellaneous toys, sporting goods and household items (paratrooper, catapult, slingshot, toilet, helicopter, Velcro, life vest, sleeping bag, matches, etc.) and Seed Dispersal handout
Preparation: Collect seeds representing a wide range of dispersal strategies. Place in Ziploc bags labeled with plant names. Choose seed dispersal models using toys, sporting goods and household items.

Procedure:

- Pass out a seed in a labeled Ziploc bag to each student.
- Explain that many seed dispersal mechanisms are like familiar inventions. Go through each seed dispersal category by showing a model and asking students to raise their hand if they think their seed moves in that specific way. Check answers by naming the plants with the correct seed dispersal technique. Lay out the seed dispersal model with matching seeds to set up seed dispersal stations. Repeat until all the seeds have been matched.
- Demonstrate seeds in action whenever possible. Challenge students to keep a milkweed seed in the air by blowing on it from below.
- Allow students to visit all the seed dispersal stations.

At the end of this lesson the teacher may choose to assign the Greenspace Review Sheet 1.

CLASSROOM ACTIVITY EXTENSIONS

1. Neighborhood Survey: Have students conduct a survey of the neighborhood where your school is located. Divide students into groups and give them a category that they are in charge of surveying: edible plant life, mammals, reptiles, insects, etc. Each group should first ask themselves what they are specifically surveying and make a prediction as to the outcome they expect. Students should then agree upon the most effective way to survey their chosen topic. After plans have been made, organize mini field trips with the help of adult chaperones where students will go outside to do the surveying. Include a mapping assignment or oral presentation as you see fit. (City Safaris)

2. Scent activity: This activity challenges students to identify a variety of scents, and therefore encourages students to think about how plants and animals have adapted to use their sense of smell. Place a variety of small items in small canisters (empty film containers work well), making sure to smudge a bit of the scented item onto the lid of the canister. Split the class in half, arranging the first half of students, the "parent animals," in a circle around the outside of the room with their hands out to make space between each student. Arrange the second half of the class, the "baby animals," in a smaller, inner circle. Give the lids of the canisters to the "baby animals" and the cans to the "adult animals." Put unobvious codes on the bottom of each lid and canister so that you make sure to match them correctly. Explain that one of the ways that animals oftentimes find their parents in a group of similar animals is by sniffing them out. Blindfold the "babies" and have them walk around the outer circle until they correctly identify their "parent." Sample scented items might be grass, cinnamon, cookies, rose, strawberries, soap, soil, mint, bubblegum, apple, banana, licorice, orange, wood, pine, chocolate.

***Note:** You can easily do a similar sound activity by placing paperclips, macaroni pieces, etc., in film canisters and asking students to search out their "mates" by shaking canisters until they match up with a similar sounding partner.

GREENSPACE UNIT:
OUTDOOR ACTIVITIES

(To the Lot)
OUTDOOR ACTIVITY ONE

Title: Neighborhood Snapshots
Objectives: Students will become more observant of nature in their neighborhood.
Time: 20 minutes
Materials: Camera, film and a double set of neighborhood photos
Preparation: Take photographs at regular intervals along the route to the Greenspace site. Photos should include well-maintained yards, neglected areas, wildlife enhancements, distinctive landmarks, interesting vegetation, etc.
Procedure:

- Tell the children that they will be walking to a nearby open space that is a Greenspace site. Remind the students how the neighbors converted a vacant lot into a pocket park through planning, cooperation and hard work. Today the students will get to explore the site.
- Explain that on the way to the Greenspace, students should look for nature. They should try to spot plants and animals with special adaptations to the urban environment. They should be sure to point out live animals, nests, holes, plants growing around man-made objects, tree roots pushing up the sidewalk, etc.
- Divide the class in half with a set of photos for each group. Give each student two different pictures. Tell the children that you want them to try to record the directions to the lot using the photos. In order to do this, the students need to look carefully for the place depicted in their photo and let the rest of the group know when they find it. Photos will be stacked in order as matches are made.
- At the entrance to the Greenspace, ask the children what they learned about the neighborhood and if they were surprised at all by the nature around them. Ask if the walk helped them to better understand the challenges plants and animals face in the city. Explain that the photos directed them to the lot but they also revealed how people can improve or degrade neighborhoods. Some yards in the photos were landscaped and kept very tidy, while others were neglected and full of litter. Over time, enhancement efforts by a few residents can encourage a wave of positive change in a neighborhood.
- *Note: Be sensitive when describing neglected yards as some of the students may live in the houses you are passing by.

Adapted from Sense Of Place, p. 16

(At the Lot)
OUTDOOR ACTIVITY TWO

Title: Learn About The Lot
Objectives: Students will explore the Greenspace, searching for clues to the past as they develop an understanding of the processes, natural and anthropogenic, that shape how the site looks today.
Time: 20 minutes
Materials: Tags, Scavenger Hunt worksheets (Worksheet 2.1), pencils, clipboards, photos of the lot (before and after restoration)
Preparation: Prepare scavenger hunt clues that promote sensory exploration and reinforce concepts introduced in the classroom (human and natural change, biotic and abiotic, habitat and adaptation). Hide a tag on one object that matches each clue. Choose examples that lead the students throughout the entire lot.
Procedure:

- Describe the history of the site, pointing to spots in the lot that correspond to the narrative. Show before and after photos. Tell the students that the information helps them answer questions in the next activity so listening carefully is very important.
- *Note: Try to get a willing Greenspace participant to talk about the history of the lot with the kids. Having a volunteer there for the kids to meet and speak with is a great way to connect students with those neighbors that can serve as role models for them.
- Give directions for the scavenger hunt, explaining that the clues correspond to objects that are in the lot. The objects have numbered tags on them. The children try to write the appropriate number beside each clue. For example, a clue may be "a furry leaf". The children look for a furry leaf with a tag on it. When they find it, they write the number that is on the tag beside the clue.
- Set boundaries for the activity. The children may explore freely within the lot but they need to be very careful not to step on the plantings or damage the site in any way. They should be respectful of the neighbors' hard work.
- Students work in small groups or individually. Give each student a clipboard with a list of clues. Tell them that you will guide them through the activity if they need help. Set them free to find the answers. Check their answers when they have matched all the clues to numbered objects. Tell them to go ahead to the next activity on the worksheet if their answers are all correct.

OUTDOOR ACTIVITY THREE

Title: Stop, Look And Listen!
Objectives: Students will become more observant through sensory exploration.
Time: 10 minutes
Materials: Scavenger Hunt worksheets (Worksheet 2.1), pencils and clipboards
Preparation: Choose clues that reflect the site and encourage students to slow down and use their senses.
Procedure:

- Children are asked to use their senses in spotting specific details about the site. The children fill out their observations on the corresponding worksheet.

OUTDOOR ACTIVITY FOUR

Title: Hula Hoop Transects
Objectives: Students will sample the Greenspace site by setting up transects to determine species and habitat diversity.
Time: 20 minutes
Materials: Scavenger Hunt worksheets (Worksheet 2.1**),** pencils, clipboards, hula hoops, stakes, measuring tape, scissors, toothpicks and string
Preparation: Lay out transects within the Greenspace site by measuring the width of the lot and running three or four equally spaced parallel lines down its length. Stake out sampling areas at regular intervals along the transects to create a grid.
Procedure:

- Students are asked to lay a hula-hoop around the staked sampling areas and to draw what they see. Tell the children that they are doing the same thing scientists do when they collect data using a transect. Sampling an area at regular intervals gives scientists a good understanding of plant and animal diversity without counting every living thing. The students are using hula-hoop samples to estimate the variety and distribution of living things at the Greenspace site.
- Have the students think about how different the transect results would have been if they had sampled the vacant lot before it became a Greenspace. Remind them of the neighbors' hard work to increase both habitat and species diversity.
- Ask students to set up mini nature trails within their hula-hoop using toothpicks and string. Have them interpret the trail, describing points of interest. It is fun for the students to pretend they are leading a nature hike for ants.

Adapted From Sense Of Place, p. 39

(Back from the Lot)
OUTDOOR ACTIVITY FIVE

Title: Urban Survival Challenge
Objectives: Students will learn how living things in the urban environment satisfy their habitat needs by substituting human-related elements.
Time: 20 minutes
Materials: Urban Adaptations worksheets (Worksheet 2.2), pencils and clipboards.
Preparation: Look for examples of urban habitat substitutions along the route back from the Greenspace (nest on a building, puddle that could be used as a birdbath, high wire travel route for squirrels, uncapped chimney that's a good spot for bats, a garbage feast for an opossum, a storm drain that might be a raccoon home, an open garage for a skunk sleepover, etc.). Prepare an urban survival challenge list based on your observations.

Procedure:

- Divide the class in half for the walk back to school and give each student a worksheet. Students should work together in two large groups.
- Explain that the students need to try to find all of the urban survival strategies on the worksheet. Challenge them to try to find more than one example of the same adaptation. Give them hints along the way. Emphasize that it is a group activity so each half of the class needs to stay together.

OUTDOOR ACTIVITY EXTENSIONS

1. Excursion! Organize an afternoon or Saturday for the class to volunteer at a local Greenspace site or Community Garden. This will be a chance for students to get their hands dirty and see what it is really like restoring and maintaining one of New Haven's public open spaces. It will also be a great opportunity for them to connect with those people in their neighborhoods that are working to improve their communities and make positive change happen!

2. History of the Neighborhood: Follow up on the history students have already learned about the development of New Haven by organizing a project that gets students to investigate the history of their own neighborhoods. Ask students to interview elderly residents, as well as those people who volunteer through neighborhood Block Watch Groups, clubs and church organizations. Ask students to investigate the history of any abandoned lots, parks or Greenspaces in their neighborhoods. Challenge students to investigate and carefully record changes in the makeup of their neighborhoods over time.

FOCUS ACTIVITY ONE

Title: Amazing Animal Adaptations
Objectives: Students will learn about animal adaptations for survival and understand predator-prey relationships.
Time: 10 minutes
Materials: Pictures of animals with special adaptations, poster board, scissors and tape
Preparation: Cut out and mount photos of animals with distinctive features that illustrate a wide range of adaptations (camouflage, mimicry, speed, flight, shape, bad tasting, etc.).
Procedure:

- Discuss survival challenges for animals and describe predator-prey relationships. Explain that every animal needs to eat but it also must avoid being eaten. Animals have different adaptations, structural and behavioral, that help them survive. Use flashcards to show special adaptations for survival.
- Compare wild animals to people and ask students about human adaptations.
- Talk about human threats to wildlife, discussing reasons for animals becoming of special concern, threatened, endangered and extinct. Emphasize the devastating impact of human encroachment and habitat loss. Animals adapted to a specific habitat are more vulnerable to habitat loss than those that can survive in a wide range of environmental conditions. Urban wildlife species are successful despite loss of habitat because of their amazing ability to adapt to the changed environment.

FOCUS ACTIVITY TWO

Title: Skull Skills
Objectives: Students will learn about feeding adaptations and become familiar with different dietary categories.
Time: 10 minutes
Materials: Saltines and mammal skulls with matching stuffed animals (beaver, deer, fox, otter, raccoon, opossum, skunk, shrew, bat, etc.)
Preparation: Select skulls representative of an omnivore, herbivore, carnivore and insectivore and match stuffed animals to each of the skulls.
Procedure:

- Begin by explaining that animals must eat to survive. Animals do not use the same strategies for eating as humans. They do not use forks, knives and spoons or cook their food. An animal depends on a beak or its teeth for survival. Not all animals eat the same foods. Introduce the terms herbivore (eats plants), carnivore (eats animals), insectivore (eats insects) and omnivore (eats plants and animals).
- Discuss how the type of beak or teeth affects what an animal eats. Beaks and teeth are adapted to the food items an animal eats.
- Show students the function of different types of teeth by having them eat a saltine. Give a cracker to each student and ask the children to bite into the saltine and then

stop. Ask them which teeth they used to bite the cracker (front incisors are cutting teeth). Tell the students to continue eating the saltine. Ask them which teeth they used to chew their cracker (large, flat molars and smaller premolars are grinding teeth). Point to the canines and explain that these dagger-like teeth are used for tearing and shredding and were not needed for eating a saltine.

- Review the structure and function of the different teeth. Explain that an animal's teeth reflect its diet and that sets of teeth are so distinctive that an animal can be identified by its skull. Show students a mystery animal skull, pointing out the teeth and ask them what kinds of food they think the animal eats. Remind them that the size of the skull is the same as the animal's head. Point out the position of the eyes on the different skulls. Tell them that all carnivores have eyes placed in front of their head, giving them three-dimensional, binocular vision for zeroing in on their prey (eyes in front, you must hunt). Prey species tend to have eyes on either side of their head for a broader view that helps them spot danger (eyes to the side, you best hide). Give the students clues about each animal to help them identify it. When the students get the correct answer, place the matching stuffed animal beside the skull. Repeat with each skull, creating a skull display with matching animals.

FOCUS ACTIVITY THREE

Title: Critter Cuisine

Objectives: Students will role-play to experience the dietary needs of herbivores, carnivores, insectivores and omnivores.

Time: 20 minutes

Materials: Animal shopping lists, bins of plastic food, toy cash registers, shopping baskets and play money

Preparation: Sort food by type into separate bins (insects, mammals, birds, reptiles, amphibians, etc.). Organize shopping lists and distribute money into shopping baskets.

Procedure:

- Bins filled with different food items are spread around the classroom. Each student is given a shopping basket and play money. They will be assigned an animal and given a shopping list for a visit to a special grocery store that sells very unusual food items. They need to shop carefully using their grocery list to purchase the appropriate food items for that creature. Caution them not to go overboard because they only have a limited amount of money and they will have the chance to shop for more than one animal.
- Give each student a grocery list. Students move from station to station trying to find all of the food items on their shopping list. When they are finished shopping, students line up at the checkout and pay for the food. Compare their grocery list to the contents of the shopping basket and if the items are incorrect or incomplete, students are sent back to the store. If they have all of the items for their animal, they select a shopping list for a new animal. Students should choose animals from the different dietary categories.

FOCUS ACTIVITY FOUR

Title: Animal Olympics
Objectives: Students will appreciate animal adaptations as they challenge the best of the animal kingdom.
Time: 15 minutes
Materials: Stopwatch, tape-measure and Animal Champions handout (Handout 2.3)
Preparation: None
Procedure:

- Explain to the students that they are athletes competing in events with the best of the animal kingdom. In order to win a medal, they must beat wildlife with amazing adaptations.
- Students participate in a series of events. At the end of each race, compare their results to the best of the animal world. Congratulate them on a strong effort but the students lose every event. Make them feel better by comparing their times to some of the slowest animals.

(Adapted from NatureScope – Amazing Mammals Part I, pp. 6-7)

FOCUS ACTIVITY FIVE

Title: Camouflage
Objectives: Students will better understand the adaptive strategy of camouflage.
Time: 15 minutes
Materials: None
Preparation: None
Procedure:

- Announce to the students that they have been changed into prey animals that are not fast, ferocious or poisonous. Their only defense against predators is to blend in with the environment. Being well-camouflaged is their only chance for survival.
- Clearly define the boundaries and the rules for the game. Give students one minute to find a hiding spot while the facilitator looks away. Stress that the student hiding closest to the facilitator without being spotted wins.
- The facilitator turns around after the children have had a chance to hide and points to any student he/she spots. Those students are out of the game.
- The facilitator then holds up a certain number of fingers and shouts, "Fingers!" Each student must sneak a look at how many fingers are being held up. The facilitator tries to spot more students as they peek out at the fingers. Those children are out of the game.
- The facilitator puts down his/her fingers and asks the remaining students to come out of their hiding places holding up the correct number of fingers. The student who is closest with the matching number of fingers wins.
- Repeat if time allows.

Adapted from Keepers of the Earth, p. 15

At the end of this lesson the teacher may choose to assign the Greenspace Review Sheet 2.

FOCUS ACTIVITY EXTENSIONS

1. Animal Charades: Encourage students to think more about how animals communicate nonverbally through playing a game of charades with them. Write out words on note cards (hot, cold, afraid, angry, happy, hurt, sad, hungry, full, sleepy, etc.) and give one to a student when it is their turn to act out the word. Remind students that they may not use any sounds at all! Afterwards ask students to think about the challenges and advantages of nonverbal communication. Ask students if they ever choose to use nonverbal communication instead of verbal communication in order to make a better connection with students and wildlife.

2. Predator/Prey Game: Have students stand in a circle. Ask them to choose an example of a predator and a prey. Once you have decided on the two animals, choose two students from the group--one to be the predator and the other to be the prey. Blindfold these two students and explain that the predator is going to try to hunt down the prey while the prey tries to stay away from the predator. They must walk very quietly and stay inside the circle in order for the game to work. Explain to the other students in the circle that they must be totally silent in order for the competition to really exist between the two animals and that their job is to tap the predator or the prey softly and quietly when either one comes into contact with the circle. After one set of students has competed you can pick two new students to participate.

***Note:** You can add an extra element to the game by setting up a system where students in the circle are allowed to make one natural sound (bird call, leaves rustling, sound of rain, etc.) instead of tapping them if the predator or prey get too close to them during the competition.

GREENSPACE UNIT:
NATURE JOURNAL

ASSIGNMENT TWO

Title: Imaginary Creature
Objectives: Students will design an imaginary creature for their special tree that overcomes urban challenges with some very unusual adaptations.
Time: Conducted between last day of Greenspace Unit and first day of Park Unit.
Materials: Nature journal, pencil and markers or colored pencils
Preparation: None
Procedure:

Tell the students to invent an imaginary creature that lives in their tree. Its habitat is the area around the student's house. It is adapted to live where it lives. Students should:

(1) Make up some very unusual features about their imaginary creature that help it survive. They need to think about ways it might look or act that would help it meet the special challenges of living in the city.
(2) Draw a picture of their animal.
(3) Write a description of why it looks and behaves the way it does.

Emphasize that they should have fun and be creative. Their imaginary creature can be whatever they want it to be.

***Note:** Facilitator/Teacher should have students write assignment in notebooks on the last day of the Greenspace Unit. Assignments should be collected, corrected, and a classroom discussion should be held before the start of the next Unit.

GREENSPACE UNIT:
HANDOUTS, WORKSHEETS & REVIEW SHEETS

GREENSPACE HANDOUT 2.1 Greenspace Write-ups

I. The Arch Street Garden

Walking around the Arch Street greenspace today, it is difficult to believe that it used to be a series of derelict vacant lots. The transformation of these lots to a biologically diverse and aesthetically pleasing space is a credit to the residents of Arch Street and URI staff.

The story of Arch Street begins in 1994 when a dynamic and dedicated group of residents formed a blockwatch association to try to improve the safety and security of their neighborhood. In 1995 and 1996, this group applied for and received Greenspace grants from URI. The residents opted to use these grants to plant trees and flowers along the street and in front of their homes.

In 1996, the Arch Street Block Watch Association was awarded a 4000 dollar Neighborhood Forests Grant, to be administered by the Urban Resources Initiative. Under this grant, the block watch identified a core tract of public land, three vacant lots (one of the lots had an abandoned house which was subsequently removed by the city) from 41-51 Arch Street (the area exceeds 1750 square meters), for restoration. As with many vacant lots in the city, this derelict space attracted undesirable activities, including drug dealing. One of the residents' main restoration goals was to create a space that would send a signal to drug dealers and gang members--that their presence was not welcome on the street. Four key players, Jose and Carmen Candelario, Sherman Barry and Evelyn Rodriguez have been with the project since its inception. After years of involvement, the Candelario's moved out of the area but the others are still actively involved with the project.

Turning the vacant land into a community resource presented a huge challenge. The front part of the lot lacked vegetation and the rest of the lot was ankle to waist high in weeds. The back of the lot contained some mature trees, including a beautiful American elm (that is still there today). When the houses that previously occupied these lots were demolished, the replacement soil was fill, comprised mostly of sand and waste material. The residents had to spread new soil and compost before they could begin planting.

The layout of the space has grown and changed over time—it is a reflection of the needs and capabilities of the people who have been involved in the project. That being said, from the beginning the "arch" theme influenced the form of the greenspace. In fact, the residents began their efforts by creating an *arch* shaped path in the back of the lot! This was followed by the addition of the octagonal shaped planting bed that is in the center of the park. Quaking aspen were planted on either side of the path that leads into the garden (with the intent that as they matured they would form an *arched* pathway). It was later decided that this did not "work" and the aspen were moved to the back of the lot where they are a part of a small grove of trees. The Colorado Spruce trees that are in this

grove are a reminder of a URI intern who worked on this site who came from that state. The berm that runs across part of the site was added with the help of Jody Bush. This feature has turned out to be a hit with kids in the area—it is used for playing and hanging out with friends. The sprinklers that are scattered throughout the site were paid for and constructed by the neighbors without any outside assistance.

By 1999 the entire area had been planted, and paths had been laid out. In 2000, under the guidance of Jody Bush, the Yale School of Architecture worked with Arch Street residents to come up with a design for a fence to run along the front edge of the park. The residents selected the design proposed by student Celia Corkery. It should be noted that the residents contributed financially to this effort through fundraising events. This fence is intended to reflect the park's arch theme while clearly defining the space as belonging to the neighbors (at the same time allowing outsiders to come in and enjoy the amenity). Metal leaves with the names of key contributors line the top of the fence—there is still plenty of room for new leaves to be added as Arch Street continues its development.

Yale Architecture students also designed the benches that are at the back of the site. The curved shape of the benches is meant to be reminiscent of a casita (which is what the residents originally wanted in this space but these three-sided structures are not permitted in the city of New Haven). The benches were designed with the neighbors' concerns about attracting loiterers in mind. The seats can be put up when they are not used, sending the message that this is not a place for non-residents to sleep or hang out. Residents' anxiety about these issues reflects an on-going concern about the presence of drug dealing and other crime in their neighborhood. Environmental restoration is one of the strategies that they are using to restore their community. Many of the same folks who work on this environmental restoration project are engaged in organizing crime fighting strategies through the neighborhood block watch.

The skills of the group continue to develop. In the summer of 2002, a concerted effort was made to put in deeper edging around the planting beds to reduce maintenance (it prevents the lawn from growing up into the beds as quickly). A compost pile was also started at the back of the space—the residents had been hesitant to embrace this addition due to problems with rats. Working with URI interns, they learned about the ecological value of composting as well as how to maintain the pile so that it would not attract rodents.

The role of the URI intern in providing technical support and leadership of Arch Street should not be overlooked. The residents appreciate their technical expertise as well as their commitment to the site. An additional benefit of the internship program is that it provides an opportunity for local youth to be in contact with college students. All that being said, the learning goes in both directions. The intern spends their summer drawing on the experiences and knowledge of the residents of Arch Street.

Visiting Arch Street today, it is difficult to imagine that this space was ever the site of derelict housing and drug dealing. But it was. If it weren't for the incredible energy and community spirit of the people who live on the street it may well still look that way. Together these folks have transformed an environmental wasteland into a neighborhood oasis.

GREENSPACE HANDOUT 2.1 Greenspace Write-ups (cont.)

II. The Park on Nash

The Park on Nash's story begins on a fourth of July evening in the late 1960s when a fire consumed 71 Nash Street. For the next thirty years, the lot was colonized by weeds and used as a dumping ground for people's trash. In 1999, under the leadership of Nash resident Ron Oster, the Nash Street Neighbors group was formed. The group applied for (and received) a URI greenspace grant. Their main goal was to transform a trash-strewn lot into a community gathering space.

Before the residents could begin to think about planting anything on the lot, they had to spend time cleaning up the debris and pulling out the weeds. Once this task was accomplished, the residents discovered some unexpected challenges. For example, they realized that the foundation of the house had sunk, creating a large depression in the center of the lot. This hole would have collected water in the rain and so the residents had to use fill and topsoil to build up this area.

At the end of the first year, the group had cleared the site, put in a storage shed, created a path, and a small kiosk with a bulletin board for community news. Quite impressive for one year's work! The park's second and third year of existence saw even more additions to the park including an outdoor grill, a perennial bed, and a pond. Plantings such as the honey suckle that run along the wooden fence and the butterfly bushes reflect the community's desire to attract wildlife to the site.

One of the most amazing characteristics of this space is the way that the residents reused objects from the lot and from other homes. For example, the stonewall at the front edge is made from stones dug up from the lot and the brick path has its origins in three nearby chimneys, two of which were just across the street. A resident donated the marble top which sits on the barbeque. Some of the plants such as the hydrangeas and privet were actually transplanted from neighbors' yards.

In 2002, the Nash Street group turned "emeritus". That is, they no longer receive the support of an intern and their focus is on maintaining and programming the space (using a grant that they received from the Community Foundation). That being said, the lot continues to develop. Resident Donald Desmond continued his work on the beautiful stone wall that marks the entry way and part of the front edge of the park and the neighbors constructed a wooden gazebo that can be utilized at their many community events.

One of the factors that has contributed to the success and sustainability of this site is the way that leadership roles have been shared amongst the group. Ron Oster has been extremely generous with both his time and skills. He contributes to the development and maintenance of the park and has helped to build the group's technical capacity so that they can take on new roles and responsibilities.

The Nash Street Neighbors have met their goal of creating a vibrant community-meeting place. Children are often seen playing in the park and a range of events including an annual pumpkin carving (which attracts kids from all over New Haven!), URI trainings and a string quartet breakfast make this one of the most lively and unique public spaces in the city.

GREENSPACE HANDOUT 2.2 Terrarium

I. Terrarium Setup

WHAT YOU NEED:

Aquarium (glass) with **lid** (mesh)
Pebbles (pea-sized), well washed
Charcoal, broken into small pieces
Topsoil

HOW TO SET IT UP:

1) Place a layer of small pebbles on the bottom for drainage
2) Add some small bits of charcoal to absorb odors
3) Pour in a two-inch layer of topsoil

WHAT TO PUT IN:

Plants – small woodland ones that are common in the local environment (moss, lichen, fern, ivy (not poison ivy!) and other short woodland plants that won't outgrow the container)

Animals – small reptiles, amphibians and invertebrates that are native to local forests (garter snake, American toad, redback salamander, centipede, millipede, isopod, earwig, harvestman, cricket, ground beetle, ant, earthworm and other tiny forest floor inhabitants)

Decorations- interesting rocks, bark and colorful leaves that serve as hiding places for terrarium dwellers

HOW TO ARRANGE IT:

1) Plant the plants carefully and decoratively after identifying and describing them to the class
2) Water the terrarium until the soil is moist (not wet!)
3) Add rocks, bark and leaves to create points of interest
4) Place animals in the container one at a time after showing and describing them to the class
5) Put the cover on the container and check for a tight fit
6) Keep the terrarium out of direct heat and sunlight

HOW TO MAINTAIN IT:

1) Moisten the terrarium daily by misting through the mesh lid with a water-filled sprayer (a shallow dish of water may be added as an additional water source for reptiles and amphibians)
2) Every few days, add small crickets and worms as a supplementary food supply for reptiles and amphibians
3) Check on the animals periodically to see where they are hiding

GREENSPACE HANDOUT 2.2 Terrarium (cont.)

II. Terrarium Guide

FERN
(class Filicinae)
Ferns are one of the oldest plants, dating back 350 million years ago. Coal, an important energy source, is a product of the decomposing remains of these ancient plants. Today, ferns are found in most habitats but grow best in moist places. Their delicate fronds, green with chlorophyll, make them easy to recognize. Ferns are non-flowering and reproduce with spores that cluster on the leaves. New ferns also sprout from underground stems and rooting leaf tips.

MOSS
(phylum Bryophyta)
Mosses grow in damp, shady places forming soft, dense blankets on the ground, on rocks, and in trees. Mosses act as sponges and prevent soil erosion by absorbing water and holding onto soil. When mosses die, the plant material decomposes to create new soil. Mosses are non-flowering plants with chlorophyll and reproduce using spores that emerge from capsules on a parent plant.

FUNGUS
(phylum Mycota)
Fungi do not have chlorophyll and cannot make their own food. They rely on other sources for their nourishment, generally dead plant or animal materials. Fungus plants are important recyclers. As they break down dead organisms, the decay process returns nutrients to the soil, enriching the environment for living organisms. A fungus plant sends out a network of white threadlike strands, called mycelia. The mycelia develop swellings filled with millions of spores that float away to produce new fungi. These swellings, the fruiting bodies of the fungus plant, are known more commonly as mushrooms.

LICHEN
(phylum Mycota)
A lichen consists of two plants, an alga and a fungus, living together in a symbiotic relationship that benefits both organisms. The alga is a green plant that provides food for both through photosynthesis. The fungus supplies the structure on which the alga grows, offers protection from wind and sun, and retains moisture. The phrase, “a fungus met an alga and they took a ‘liken’ for each other”, summarizes this special relationship. Lichens play a critical role in the first stage of plant succession. They are small, tough plants that can grow on rocks and wedge themselves into cracks. As they grow, they expand and contract, excreting acids that cause rocks to crumble. Over a period of time, the rock material breaks down to become soil for higher plants. Lichens can survive in harsh environments, growing in poor soil, under snow, in deserts and at high altitudes. Even though they can withstand temperatures from – 450 degrees F to 424 degrees F, lichens cannot tolerate polluted air. Lichens are used as indicators of environmental health.

GREENSPACE HANDOUT 2.2 Terrarium (cont.)

AMERICAN TOAD
(Bufo americanus)
The American toad lives in cool, damp woods and fields. A toad is an amphibian that spends most of its time on land but returns to the water to mate. During breeding season, males attract females with a trill call. Females lay up to 15,000 eggs in long jelly-like strings in the water. The young emerge as tadpoles with tails for swimming, gills for breathing and file-like teeth for eating water plants. Over time, the tadpole develops four legs, lungs replace the gills, the tail shrinks and the mouth becomes large and gaping with a long sticky tongue for catching insects.

An adult toad's blotchy, brown skin makes it well camouflaged for life away from the water. A toad hops rather than jumps but it has other defenses that compensate for its lack of speed. When attacked, a toad emits a milky juice from its skin glands that burns and irritates an enemy's eyes and mouth, causing the predator to spit out the toad. A toad also can puff itself up and dig itself backward into the ground to hide. It feeds primarily at night, consuming large numbers of garden pests.

REDBACK SALAMANDER
(Plethodon cinerus)
Redback salamanders are members of the large family of woodland or lungless salamanders, the Plethodontidae. They are small, slender animals, rarely growing more than four inches in length. They vary in color with some individuals being entirely gray (the lead-back phase), gray on the sides with a brick-red stripe down the back (the redback or striped phase) or entirely bright orange-red with a mottled-tipped tail (erythristic phase). These forest animals are abundant in damp areas but can be difficult to spot when they burrow down in the leaf litter to avoid dry conditions. Redbacks breathe through their skin and must stay moist. They forage for small insects and other invertebrates on the forest floor.

Redback salamanders are terrestrial amphibians that lay eggs on land, depositing clusters of up to fifteen eggs that look like bunches of grapes in logs, under boards and in the leaf litter. The young undergo metamorphosis, passing through the larval stage within the egg capsule. The mother watches over the eggs during their development.

Redbacks are preyed upon by many animals, including shrews, snakes and birds. One effective defense mechanism displayed by redbacks is their ability to detach most of their tail. The wiggling tail distracts a predator while the salamander escapes. Redbacks regenerate their tail over time. Coloration is another type of defense. Redback and leadback phases are well camouflaged, while the erythristic phase mimics the toxic red eft.

SLUG
(class Gastropoda)
Slugs are invertebrates and are closely related to snails but, unlike snails, they lack a protective shell. The only shell they have is a small piece, called a mantle, tucked under a fold of skin on the back of their slimy, soft body. To prevent drying up during the daytime, slugs hide in damp areas under logs, rocks, and plants, or cover themselves with

slime and burrow underground. Slugs come out at night to feed, using their long tongue covered with teeth, or radulae, to scrape plants. Slugs leave behind a shiny trail, discharging mucous as they move along on top of the slime. Slugs have two sets of antennae. They use their large antennae with eyes on the end for seeing and their small antennae for smelling and feeling. Both sets of antennae retract into the body when touched.

EARTHWORM
(genus Lumbricus)
An earthworm is an invertebrate with a segmented body. Earthworms have regenerative powers and are able to replace damaged or destroyed segments depending on the location. Four sets of bristles, or setae, on the underside of all but the first and last segments provide traction for movement and help worms anchor themselves in their underground tunnels. Worms move using two types of muscles that tighten to allow the worms to become longer and thinner and then shorter and fatter. They lack eyes and ears but have light-sensitive skin at either end and can feel vibrations. Worms breathe through their skin, so they must stay moist. The clitellum, a glandular swelling in the front quarter, produces mucous to keep the body moist. It also creates a jelly-like ring that becomes a cocoon for eggs during reproduction. An earthworm is hermaphroditic, having both male and female sex organs, but two worms are required for fertilization. Worms deposit cocoons in the soil from May to July.

Worms are important soil dwellers. They tunnel through the soil, eating decayed leaves, soil and small pieces of animal and plant material. Their burrowing helps to aerate the soil and improves water percolation by loosening and mixing up the different soil layers. Worms excrete excess soil and organic matter at the ground's surface in irregular humps, called castings. Worm activity fertilizes the soil by increasing the content of organic matter and by bringing mineral-rich soil to the surface. Earthworm tunnels also provide homes for small animals and insects.

ANT
(family Formicidae)
There are more than 20,000 species of ants worldwide. In fact, there are more ants than any other creature on Earth. Ants thrive in a wide range of temperatures, altitudes, moisture levels, and habitats, both natural and man-made. Ants come in a variety of colors and sizes but all are insects, having three main body parts, head, thorax and abdomen, with each part having a pair of jointed walking legs. Ants are incredibly strong and can lift up to fifty times their own body weight.

All ants are social and live in colonies with different members having specific jobs. The queen ant develops from a fertilized egg. The queen goes off on a mating flight to gather sperm and then sheds her wings. The queen establishes a colony by laying eggs. Males develop from unfertilized eggs and do not work or even feed themselves. After mating with the queen, the male ant dies. Female workers develop from fertilized eggs. They are wingless and dedicate themselves to the queen and her colony. The workers care for the developing young as the eggs hatch into larvae, pupate and, finally, emerge

as adults. Female workers watch over the colony, keeping it clean, enlarging it and defending it from enemies.

Ants communicate by using smells. Their bodies contain many different chemicals, each with its own specific odor and meaning. To communicate, ants stroke antennae with one another and exchange drops of fluid by licking each other. Antennae allow ants to taste, smell, touch, and feel vibrations in the air. Ants depend on their antennae for survival.

CRICKET
(genus Gryllus)
Crickets vary in size, shape, color and habits but in general, they are flat-backed insects with long antennae and large, conspicuous hind legs. Crickets are excellent jumpers but they also fly using their membranous wings. Crickets are best known for their musical ability to produce sounds by rubbing one body part against another.

A common type of cricket is the field cricket, abundant in woods, grass, gardens, and under rocks, logs and garbage cans. It is a blackish colored insect that feeds on invertebrates as well as plant material. The female has a long ovipositor that she uses to lay eggs in holes in the ground in fall. The eggs overwinter and hatch as nymphs in the spring. Crickets are known for their chirping, but actually, only the male makes the sound. The male produces the sound by rubbing the file-like vein on one wing against the scraping ridge on the other. Crickets chirp the loudest and the most often in warm weather. In fact, it is possible to estimate the temperature in Fahrenheit by counting the number of chirps in fifteen seconds and adding it to 37 (this works best with the snowy tree cricket).

DADDY LONGLEGS
(class Arachnida)
Daddy longlegs or harvestmen are in the arachnid group of the phylum Arthropoda, along with spiders, ticks, mites and scorpions. They are cousins to spiders but are not true spiders. Spiders have bodies clearly divided into two parts, abdomen and cephalothorax (head and chest fused together), with four pairs of jointed legs attached to the chest. Harvestmen have eight legs and two body parts but they lack a distinct “waistline” between the two sections. They do not spin webs and usually hunt at night for small insects, larvae, worms, spiders, fruit and dead material.

Daddy longlegs have several defense strategies. They are very fast runners but if they are attacked, their legs can break off and continue to twitch as a distraction, allowing the daddy longlegs to escape. They can survive with the loss of several legs. Harvestmen also have glands near the base of the front legs that squirt out a foul-smelling liquid as far as 10 inches to deter predators.

Daddy longlegs do not build nests. In the fall, the female lays twenty to thirty pale green eggs in the leaf litter or soil that overwinter and hatch in the spring. The adults hide out during the winter, grouped together in protected places such as woodpiles, but most do not survive.

GREENSPACE HANDOUT 2.2 Terrarium (cont.)

PILLBUGS AND SOWBUGS
(genus Armadillidum and genus Porcellio)
Pillbugs and sowbugs are isopods, a type of crustacean. An adult isopod looks like an armored car with seven pairs of legs that are barely visible as it scampers around. Its oval back is covered with gray plates with two tiny specks for eyes and a small pair of antennae. A female isopod carries her eggs in a pouch on her underside. Baby isopods are miniature versions of adults and as they grow, they molt.

Isopods are found in dark, damp places under rotting logs, rocks, rubber mats and garbage bags. They are scavengers, feeding on soft, moist, decaying plants and fungi. Pillbugs and sowbugs look a lot alike but there are some differences that help to distinguish them. Sowbugs have a little pointy "tail" which pillbugs lack. Sowbugs also have a less rounded back. The main difference between the two types of isopods is that pillbugs can roll up into a ball but sowbugs cannot because their plates are too flat. Pillbugs form a ball as a defense mechanism and also to keep from losing moisture. Another behavior, called bunching, is used by both pillbugs and sowbugs to prevent water loss. Isopods group together in a large pile when conditions are very dry.

CENTIPEDE
(genus Scutigera)
The word centipede means "one hundred feet", but the number of feet on centipedes varies from species to species with some having as few as 34 or as many as 254 feet. Centipedes have only one pair of legs on each of the leg-bearing segments. Their long, slender legs are well adapted to their predatory lifestyle. Most centipedes are less than one half inch long but they are fast movers. The first pair of legs is not used for running. These legs have been modified for grasping prey and act like sharp claws. They contain poison ducts that secrete chemicals used to immobilize prey. Their sting is quite painful, so be careful when handling centipedes!

Centipedes have a protective and yet flexible exoskeleton that allows them to shorten and flatten so they can squeeze into tight crevices. As they grow, their armor is shed and replaced. Few species of centipedes have eyes. They survive using their sense of touch and special smelling cells in their long antennae. Centipedes come out at night to avoid the sun. To protect themselves from water loss, centipedes live only in dark, humid places. During the daytime, they seek shelter under rocks, bark, logs and the leaf litter. At night, they are ferocious carnivores, hunting for slugs, insects and other invertebrates.

MILLIPEDE
(genus Spirobolus)
Although millipede means "one thousand feet", millipedes do not actually have 1000 legs. The millipede has two pairs of short, stubby legs on each body segment except for the first four, for a total of 30 or more pairs of legs. The millipede's legs give it power to push through the soil and leaf litter. Despite its extra legs, a millipede is not nearly as fast as a centipede. Its cylindrical body moves across the woodland floor with slow, flowing movements. The millipede's head is designed for gliding along the soil surface with the assistance of efficient mouthparts that tear and chew the leaf litter. The millipede prefers

softer plant material that has been partially digested by fungi and bacteria. Millipedes are scavengers of the forest floor and important members of the woodland nutrient-recycling team.

Millipedes are protected by a stiff exoskeleton, containing a high percentage of calcium. They seek out areas with calcium rich soil and eat high-calcium plant material. Retaining moisture is a concern for millipedes as well. They try to control water loss by living in dark, damp habitats and avoiding the sunlight. Millipedes hide under logs, bark, rocks and the leaf litter. Exposed millipedes respond to danger in distinct ways. Because they are so slow, millipedes usually protect themselves by forming a tight coil with their head in the center. Millipedes also display this behavior when conditions are dry and they need to retain moisture. If a predator tries to bite them, millipedes use their stink glands to release a noxious liquid that smells and tastes awful.

EARWIG
(genus Forficula)
Earwigs are easily distinguished from other insects by their large, hardened "tails" that are shaped like forceps. Be careful when handling earwigs because they can pinch with their "tail" and they also secrete a foul smelling liquid. Earwigs are less than an inch in length and brownish, blackish in color. They have wings but they rarely fly. Earwigs are active at night, feeding mostly on plants or scavenging dead organisms. During the daytime, earwigs hide under logs, bark, rocks and boards. Females lay their eggs in the ground, guarding them until the nymphs hatch.

BEETLE
(order Coleoptera)
Beetles make up the largest order of living things, containing 290,000 species. Beetles live in almost every habitat and come in all shapes and sizes. Beetles are distinguished from other insects by a line that runs straight down the middle of the back. This line marks the place where the beetles' hard or leathery wing covers come together. When beetles are resting, the wing covers conceal their flying wings. Not all beetles fly but those that do use a single pair of wings. Beetles exhibit a wide range of dietary preferences but they all have chewing mouthparts. Some beetles are plant pests and a real nuisance, while others are beneficial by helping with pest control. All beetles undergo complete metamorphosis. The larvae vary from resembling a worm, looking like a smooth caterpillar, or being fat, soft, and curved in a form called a grub. The pupa are pale, mummified versions of the adult beetle.

The ground beetle family contains some of the most common beetles. A typical ground beetle is the woodland variety. Most species are black, but some are iridescent. Almost all ground beetles, both adults and larvae, are predators. They hunt at night for small invertebrates and hide under rocks, logs, and other ground cover during the day.

GREENSPACE HANDOUT 2.3 Seed dispersal

Mechanism	Examples	How Method Works
Parachute/Paratrooper (Flies)	Dandelion, Cottonwood, Milkweed	Light, feathery seeds are carried by the wind.
Helicopter (Propelled)	Maple	The samaras lift and spin to the ground.
Toilet (Digestion/Excretion)	Grape, Strawberry	Birds or animals eat berries. Undigested seeds pass through their digestive tracks.
Slingshot/Catapult (Shoots)	Jewelweed	The seeds "explode" when a ripened pod is touched.
Velcro (Hitchhiker)	Burdock, Tick trefoil	The barbed hooks at the ends of these seeds attach to the fur of animals.
Boat/Buoy (Floats)	Coconut, Cranberry	These seeds float in water and are carried downstream.
Salt Shaker (spinkled)	Sweetgum	Seeds are released from tiny holes.
Suitcase (Packaged)	Catalpa, Locust	Multiple seeds travel together in a case.
Treasure Chest (Buried)	Acorn, Chestnut, Beech	Small mammals collect seeds, which serve as winter food supply. Some of these seeds are not retrieved and germinate.
Matches (Fire)	Pine	Fire heats up the pine cones and then they release the seeds.

GREENSPACE HANDOUT 2.4 Animal Champions

SPEED:
Students run the 100 yard dash. Compare their times to the speed of wild animals. The fastest land mammal is the cheetah. Cheetahs can reach speeds of 75 mph. A cheetah could run the 100 yard dash in 4 seconds. A peregrine falcon can dive through the sky at 240 mph. Both the cheetah and the falcon have streamlined bodies. A snail travels 0.03 mph. It would take a snail a day and a half to travel one mile.

JUMP:
Children stand at a starting line and jump. Measure how far each student can jump and compare their distances to the best animal jumpers. A red kangaroo can broad jump over 40 ft. and high jump over 10 ft. A mountain lion can broad jump 30 ft. and high jump 18 ft.

Measure how high students can jump by holding measuring tape up to a tree. Children run and jump as high as they can as they get close to the tree. Did anyone come close to the kangaroo or mountain lion?

Students jump from a bench onto a piece of paper. Make the paper smaller and smaller to test the accuracy of their jumping. An antelope in Africa called a klipspringer can jump from one rock and land on an area the size of a dime. Mountain goats and bighorn sheep are accurate jumpers as well.

STRENGTH:
Children try to lift up each other. Ants are probably the strongest animals. They can lift 50 times their body weight. Chimpanzees are strong too, lifting 6 times their body weight.

BREATH HOLDING:
Time how long students can hold their breath. A sperm whale is the champion breath holder. It can hold its breath for two hours. A Weddell seal can hold its breath for 60 minutes.

WING FLAP:
Students flap their arms as many times as possible in one minute. A hummingbird can flap its wings 4,500 times in one minute. Bumblebees can flap their wings 15,000 times in one minute.

LARGEST MAMMALS:
Measure the height of each student and ask them their weight. The blue whale is the largest animal ever to live. It can be 100 ft. long and weigh over 150 tons. The African elephant is the largest land mammal alive today, standing more than 10 1/2 ft. tall at the shoulder and weigh more than 6 1/2 tons. The giraffe is the tallest land mammal at more than 19 ft. high.

GREENSPACE WORKSHEET 2.1 Scavenger Hunt

I. Arch Street Community Park

Part 1: Scavenger Hunt

Welcome to Arch Street. Using the clues below, search for objects with tags in the lot. Write the number on the tag next to the matching clue. Work with a partner. Please be careful to walk around the plants without trampling them.

Tag Number Clue

_____ A bird bath

_____ Food being made for plants

_____ Evergreen plant with sharp needles that stays green all year

_____ Look for pillbugs and redback salamanders under this object

_____ Black eyes on a stem

_____ A climbing vine

_____ A plant that shares its name with the City of New Haven, and is so old that it grew in the lot when the houses were still there.

_____ Seeds on purple-flowered plant

_____ A waxy leaf

_____ Moist place for mushrooms

_____ A rock turned into a seat

_____ Tree with smooth bark and shaking leaves

_____ A fiery red bush

_____ All that remains of an unwanted tree

_____ A short plant that brings good luck

GREENSPACE WORKSHEET 2.1 Scavenger Hunt (cont.)

Part 2: Observation Challenges

Find a nice spot to sit down in the lot and use your observation skills to find some answers to the following challenges.

Live animals: 1. _____
2. _____
3. _____

Arches in the lot: 1. _____
2. _____
3. _____

Non-living things: 1. _____
2. _____
3. _____

Colors on living things: Red _____
Purple _____
Yellow _____
White _____

Natural sounds: 1. _____
2. _____
3. _____

Human-related sounds: 1. _____
2. _____
3. _____

GREENSPACE WORKSHEET 2.1 Scavenger Hunt (cont.)

II. Park on Nash Street

Part 1: Scavenger Hunt

Welcome to the Park on Nash Street. Using the clues below, search for objects with tags in the lot. Write the number on the tag next to the matching clue. Work with a partner. Please be careful to walk around the plants without trampling them.

Tag Number Clue

_____ A bird bath

_____ Flower with a target for pollinating insects

_____ Shady spot where few plants grow

_____ Look for pillbugs and redback salamanders under this object

_____ Plant with soggy roots

_____ A climbing vine

_____ Plant protected by thorns

_____ Best area for butterflies

_____ Pathway made from a chimney

_____ Oldest plant that was a live even before the house burned down

_____ A piece of basement wall turned into a seat

_____ A place that can be burning hot

_____ Tree with rough bark

_____ Red fruit shaped like a ping-pong ball

_____ Fluffy seed near the water

_____ Sapling with injured bark

GREENSPACE WORKSHEET 2.1 Scavenger Hunt (cont.)

Part 2: Observation Challenges

Find a nice spot to sit down in the lot and use your observation skills to find some answers to the following challenges.

Live animals: 1. _____

2. _____

3. _____

Non-living things: 1. _____

2. _____

3. _____

Colors on living things: Red _____

Purple _____

Yellow _____

Orange _____

White _____

Pink _____

Natural sounds: 1. _____ Human-related sounds: 1. _____

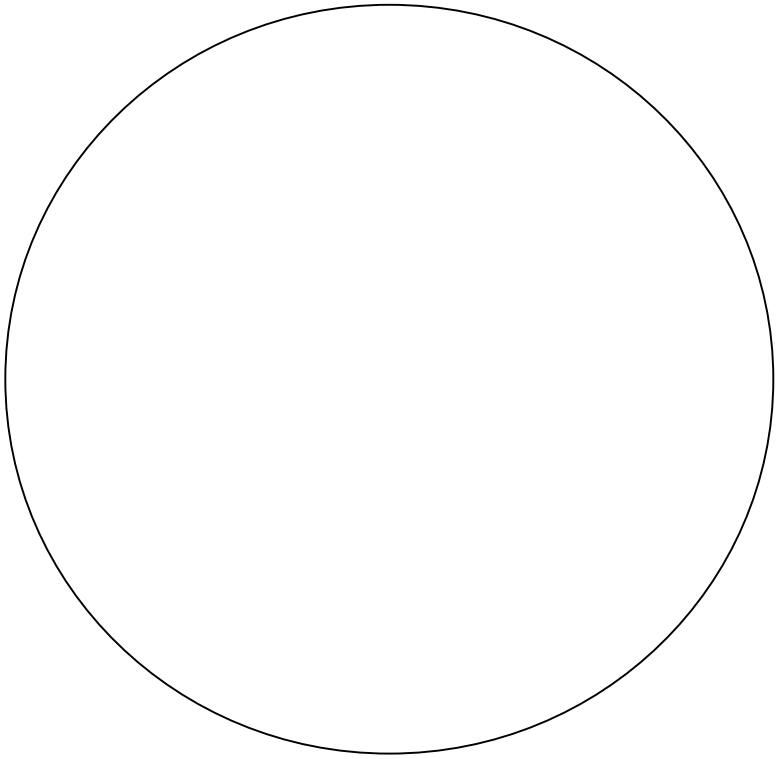
2. _____ 2. _____

3. _____ 3. _____

GREENSPACE WORKSHEET 2.1 Scavenger Hunt (cont.)

Part 3: Mini-Nature Trail

Lay down a hula-hoop somewhere in the lot. Look at all the living and non-living things inside the circle of the hula-hoop. Look for five interesting spots within the hula-hoop, for example: an animal's home, a fragrant flower, or a special rock. Set up a mini-nature trail for an ant by marking each special place with a small stick. In the space below, create a mini-nature trail guide by sketching in the nature trail. Include drawings of the five special spots within your hula-hoop. Take your partner on a guided tour of your mini-nature trail and explain the importance of each special place.



GREENSPACE WORKSHEET 2.2 Urban Adaptations Worksheet

Plants and animals in a city must find habitat or a place to live in an environment that looks very different from what you usually see in nature. Buildings, sidewalks and streets take the place of field, forest and water areas. To survive in a city, plants and animals must adapt or change how they live. They share the space with people and take advantage of anything the city has to offer.

Try to find different ways that plants and animals survive in a city. Use the checklist to record evidence of living things in "unnatural" places. Look for live animals and the signs they leave behind (nests, holes, food, droppings, tracks etc.). Locate plants in unusual places, growing in strange ways as they struggle to find sun, soil and water in the built environment.

Check off where you find evidence of plant and animal life.
Write down what you see.

_____ **Storm drains:** underground burrow and travel route for rats, raccoons etc.

_____ **Roofs:** travel route, perching site and home for squirrels, raccoons, birds etc.

_____ **Gutters:** growing spot for plants and water source for plants and animals

_____ **Chimneys:** perching spot and home for birds, bats, squirrels and raccoons

_____ **Window and building ledges:** bird nest and perching site

_____ **Porches:** invertebrate, snake, mouse, rat, skunk, opossum and raccoon home

_____ **Garages:** home for invertebrates, mice, rats, skunks, opossums and raccoons

_____ **Street or traffic lights:** bird nest and perching site

_____ **Utility poles and wires:** squirrel and bird nest, perching and travel spot

_____ **Bridges:** bird perching area and home for birds and bats

_____ **Sidewalk cracks:** burrow for invertebrates and area for plants to grow

_____ **Puddles:** water source for plants and animals

_____ **Garbage:** source of food and nest materials

_____ **Human handouts:** source of food, water and nest sites

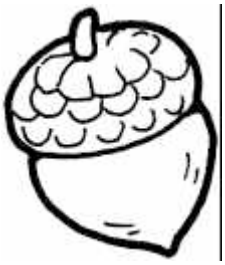
_____ **Other**

GREENSPACE REVIEW SHEET 2.1 Greenspace Review

Every living thing needs a place to live. The place where an animal lives is its HABITAT and it must have all the biotic and abiotic things an animal needs to survive. Draw these parts of the squirrel's habitat:

FOOD
SHELTER
WATER
SPACE

What might this help this seed get to a place with soil and sunlight so that it can grow into a new oak tree?



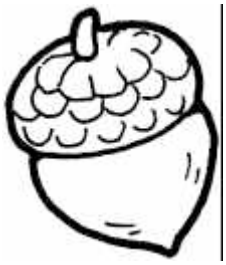
GREENSPACE REVIEW SHEET 2.1 Greenspace Review (cont.)

ANSWER SHEET

Every living thing needs a place to live. The place where an animal lives is its HABITAT and it must have all the biotic and abiotic things an animal needs to survive. Draw these parts of the squirrel's habitat:

FOOD *(Students should draw plant products, especially nuts and seeds)*
SHELTER *(Students should draw a tree or leaf nest)*
WATER *(Students may draw a lake, pond, river, puddle)*

What might this help this seed get to a place with soil and sunlight so that it can grow into a new oak tree?



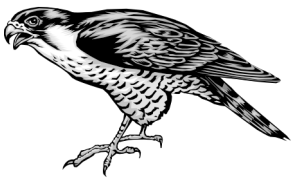
A squirrel may take this seed from underneath the tree that it fell from (where it is too shady for it to grow) and bury it in another place. If the seed is buried in a place with enough sunlight and good soil, it may grow into a new oak.

GREENSPACE REVIEW SHEET 2.2 Greenspace Review

What am I? Predator or Prey?

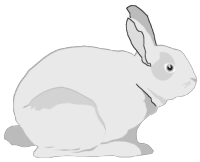
Draw a line from the circles to the animal that would say the words in the circle.

I am an Herbivore.



I am a Carnivore.

I have eyes in the front of my head so I can quickly attack.



I have eyes on the side of my head so I can spot any danger around me.

I am the PREY.

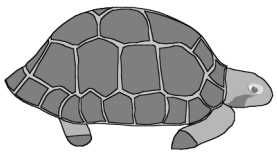
I am the PREDATOR.

You are an animal with ADAPTATIONS! To protect yourself from a predator, what color would you be if you lived:

On the trunk of an old tree_____

On a fresh, new leaf_____

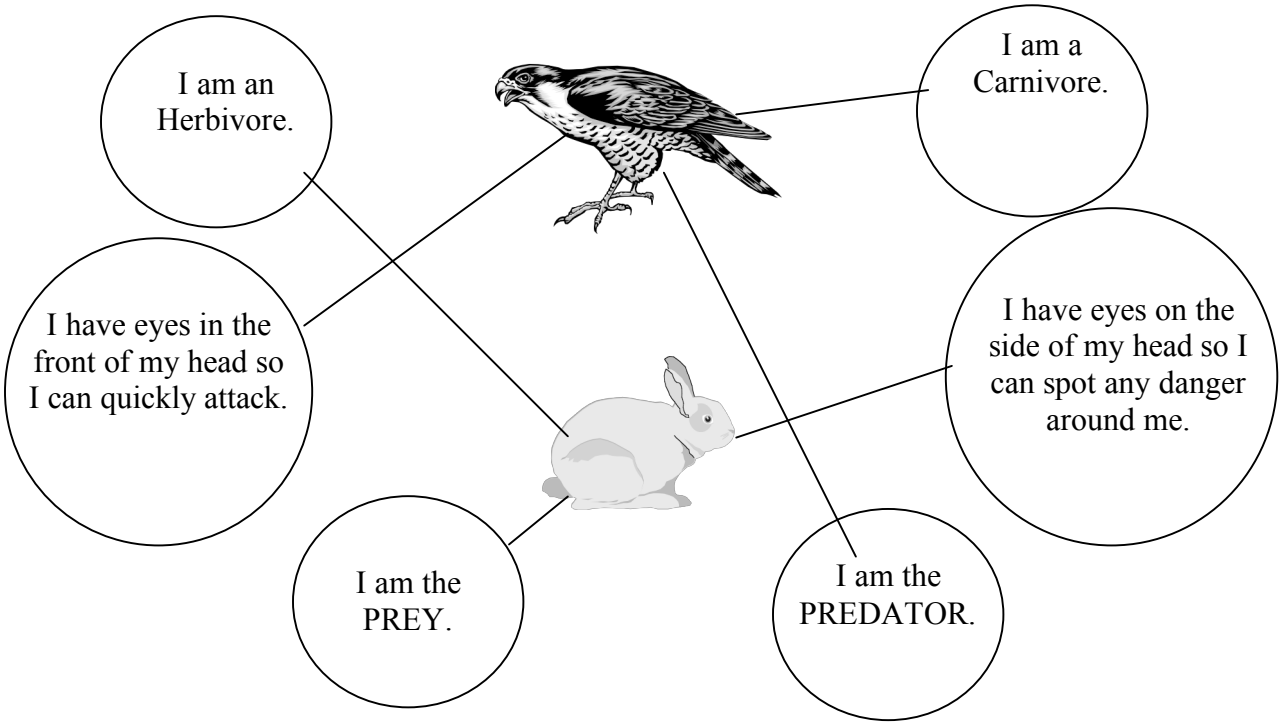
What's in a Habitat?
Put a CIRCLE around those things that are biotic (living).
Put a SQUARE around those things that are abiotic (not living).



GREENSPACE REVIEW SHEET 2.2 Greenspace Review (cont.)

ANSWER SHEET

What am I? Predator or Prey?
Draw a line from the circles to the animal that would say the words in the circle.



You are an animal with ADAPTATIONS! To protect yourself from a predator, what color would you be if you lived:

On the trunk of an old tree ____*BROWN*____
On a fresh, new leaf ____*GREEN*____

What's in a Habitat?
Put a CIRCLE around those things that are biotic (living).
Put a SQUARE around those things that are abiotic (not living).