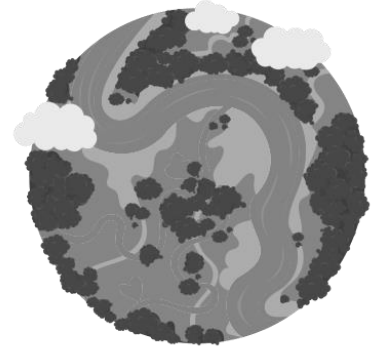


TOWER HILL

B O T A N I C G A R D E N

ADAPTATION FASCINATIONS

Teacher Guide



OVERVIEW

Thank you for registering for *Adaptations Fascinations*. During this guided program students will explore adaptations that increase an organism's chance of survival and reproduction as well as the various symbiotic relationships these adaptations support and create. Students will discover and categorize these relationships in a forest, pond, meadow, and cultivated garden habitat. We recommend you complete the pre- and post-visit activities on the following pages to enhance your visit and support the 6th to 8th grade classroom integration of the concepts addressed during the program. Please note all programs are 90 minutes in length and will take place outdoors in rain or shine over areas of rough, uneven terrain. Please ensure students are dressed appropriately.

LEARNING OBJECTIVES

- Students will be able to make field observations that can be used to understand the nature of an ecosystem.
- Students will be able to classify symbiotic relationships within an ecosystem.
- Students will be able to identify and classify adaptations for plant survival and reproduction.

NARRATIVE

All living things have specific adaptations that aid in their survival and reproduction. These adaptations are observed in specialized structures or behaviors which are understood through the process of natural selection, or how organisms evolve into their most advantageous form over time. Understanding these adaptations is necessary to uncovering the various ways in which the abiotic and biotic components of an ecosystem are linked. These symbiotic relationships between organisms can have neutral, positive, or negative impacts and affect the physical and behavioral adaptations of different plant and animal life.

During your trip Teacher Naturalists will guide small working groups of 10 to 15 students to four different habitats; cultivated garden, aquatic, forest, and meadow. Students will be encouraged to observe, explore, investigate, and ask questions throughout. Each student will be provided with a hand lens, clipboard, and to use during their visit. Teacher Naturalists will challenge students to become scientists by using scientific instruments, collecting data, and exploring relationships within each habitat. During the field trip Teacher Naturalists will engage students in the following teaching points using a combination of field observations, investigations, and games.

- An ecosystem is an interconnected community of biotic and abiotic components and the physical environment. Relationships within an ecosystem can be helpful, harmful, or have a neutral effect.
- Plants and animals have specialized structures and behaviors that help to increase their chances of survival and reproduction. Genetic factors and environmental conditions within an ecosystem can influence the growth and survival of an organism.
- As primary producers plants are the basis of the food web. Matter and energy are transferred among biotic and abiotic components of an ecosystem and the food we eat was once energy from the sun.

STANDARDS

All programs are designed to align with state and NGS standards. The *Adaptation Fascinations* field trip program addresses the following Massachusetts Science and Technology/Engineering Curriculum Standards.

Grade 7

- 7MS-LS1-4: Construct an explanation based on evidence for how characteristic animal behaviors and specialized plant structures increase the probability of successful reproduction of animals and plants.
- 7MS-LS2-2: Describe how relationships among and between organisms in an ecosystem can be competitive, predatory, parasitic, and mutually beneficial and that these interactions are found across multiple ecosystems.
- 7MS-LS2-3: Develop a model to describe that matter and energy are transferred among living and non living parts of an ecosystem and that both matter and energy are conserved through these processes.

Grade 8

- 8MS-LS1-5: Construct an argument based on evidence for how environmental and genetic factors influence the growth of organisms.
- 8MS-LS1-7: Use informational text to describe that food molecules, including carbohydrates, proteins, and fats, are broken down and rearranged through chemical reactions forming new molecules that support cell growth and/or release of energy.

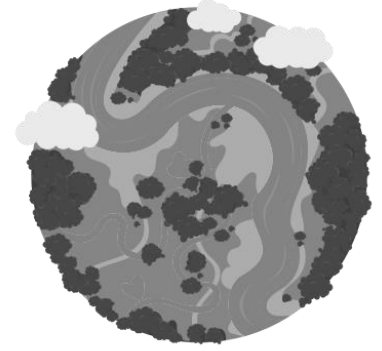
VOCABULARY

Students will be introduced to the following vocabulary words during the program. Reviewing these terms beforehand will serve to enhance the group's experience during your visit.

- **Ecosystem:** A community or network of living and non-living things
 - **Adaptation:** A physical feature or a behavior which helps a plant or animal survive and reproduce
 - **Seed Dispersal:** Process through which plants spread their seeds to grow new plants
 - **Pollination:** Process through which plants become fertilized and are able to make seeds
 - **Natural Selection:** Evolutionary process by which organisms adapt to their environment by the selection of favorable traits
 - **Photosynthesis:** The process by which plants create their own food.
 - **Symbiosis:** A relationship between two living things
 - **Mutualism:** A relationship that is beneficial to both living things involved
 - **Parasitism:** A relationship between two living things where one benefits but one is harmed
 - **Commensalism:** A relationship where one organism benefits and the other is unharmed and does not benefit
 - **Decomposer:** An organism (fungus, invertebrate, bacteria) that recycles natural material
 - **Producer:** An organism (plant) that makes its own food and is the first level of the food chain
 - **Consumer:** An organism that feeds on plants or other animals for energy
 - **Monoecious:** A plant with both male and female reproductive parts on the same individual
 - **Dioecious:** A plant with male and female reproductive parts on separate individuals
 - **Angiosperm:** A plant that flowers and produces seeds enclosed within a fruit
 - **Gymnosperm:** A plant that has seeds which are unprotected by an ovary or fruit
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TOWER HILL

BOTANIC GARDEN



ADAPTATION FASCINATIONS

Pre & Post Activity Guide

The following pre- and post-visit activity ideas and recommended resources are designed to support the 6th to 8th grade classroom integration of the concepts addressed in the *Adaptation Fascinations* program. In order to complete the post-activities we recommend you collect students' Adaptation Fascination field notebooks upon departure from the site. We love to see your students' work and continued learning experiences. Please send any drawings, photos, poems and other examples of student work to the Manager of Youth Education at 11 French Drive, P.O. Box 598, Boylston MA, 01505.

PRE VISIT ACTIVITIES

Plant Pals

Students will understand the complex relationships between plants and animals within an ecosystem

Materials:

- Field guides
- Tablets
- Chart paper
- Markers

Have students flip through field guides or conduct online research and choose a native plant to base their assignments on. Students should study their plant of choice and be prepared to give a detailed description including preferred environmental conditions, adaptations, and key relationships between their plant and animals, humans, other plants and the abiotic components of the environment.

Task students with creating a fake social media account for their plant on the platform of their choosing. Accounts should include specific adaptations for survival and reproduction. This can take the form of bios, captions, stories, statues, photos, etc. Students should also create friends or followers and a blocked list. These relationships should mimic the symbiotic relationships their plant has in its natural environment. Once students have created a profile page for their plant, have students present their work or hang in the classroom to create a gallery walk.

Ready, Get Set, Adapt!

Students will think creatively about what plants need to successfully survive and reproduce.

Materials:

- Field notebooks
- Hand lenses
- Clipboards
- Pencils

Review with students the basic needs of a plant (CO₂, water, nutrients, sunlight). Visit the schoolyard or local greenspace and allow students to free explore; observing the plant life present in their area of study. Challenge students to compare and contrast different plant species and study the basic morphology of the species they observe through discussion or botanic illustration. Students should communicate how these differences suit plants for life in different environments.

Return to the classroom and split the class into small teams. Explain that they should use their field notes and observations to create an environment for a new species of plant to live. Allow students to create a 2D or 3D model of their plant along with a summary of the habitat it lives in. Create choice cards or come up with environmental change scenarios and challenge students to communicate how their species would adapt to survive under these new environmental conditions. Explain that their adaptations should be plausible and demonstrate an understanding of evolution and natural selection.

POST VISIT ACTIVITIES

Tower Triage

Students will use data collected during their trip to create a conservation plan.

Tower Hill is in trouble! Alert students that Tower Hill is facing a series of ecological issues, causing disruptions to the ecosystem. Students must formulate and present a plan to stop these threats without causing new or further damage to the local flora and fauna and their homes. Students should include in their plan a full summary of the effects the problem is causing; including direct and indirect effects to the biotic and abiotic components of the ecosystem. Students should be prepared to use the data they collected during their trip and do independent research on the content in each of their scenarios.

Scenario 1

An outbreak of *whitefly* has struck the conservatory plants during the winter months. This has resulted in the death of more than half of Tower Hill's flowering plant collection. Moreover, many of the plants that still survive are host to whitefly eggs that have yet to hatch. As Director of Horticulture, you are responsible for planning control measures for the outbreak. Your proposal should include remediation plans, the effects of invasive species, and outline how native pollinators are affected.

Scenario 2

A gardener has accidentally used the incorrect brand of fertilizer on the grasses surrounding the wildlife pond. This brand has been recalled by the manufacturers based on its toxicity levels and the potential for *bioaccumulation*. These toxins are now collecting in the soil and the pond water which supports many plant, fish, frog, and bird species. As the Landscape Horticulturist you are responsible for creating a plan to treat the problem. Your proposal should consider the effectiveness of new plantings and should outline the threats posed to the ecosystem.

Scenario 3

Aphids have invaded the vegetable garden and are killing off the majority of the seasonal crops. The vegetable garden not only provides food for groundhogs, birds and more, but the local food bank

depends on regular donations of the fresh produce in the summer months. As the Vegetable Garden Manager you are responsible for a plan to restore the vegetable garden without using pesticides. Your proposal should outline potential control methods and include the importance of the garden as a habitat and a food source for both animals and people.

Adaptation Creations

Students will creatively apply what they learned about plant adaptations to the creation of new technology.

Have students review their field notes from the trip and reflect upon the specialized animal and plant adaptations they learned about at Tower Hill. Lead a group discussion on how some of these adaptations have inspired humans to build, create, and innovate; for example Velcro and burdock. Split students into groups and have students do background research to come up with more innovations inspired by the natural world. Students should be thinking about a new technology or invention they might create that is also inspired by the unique structures found in nature.

Challenge students to explain their ideas via media, text, or art. Groups should present their inventions to the class and be prepared to share how their inventions were inspired by the plant adaptations they observed and how their inventions help to work toward a sustainable future.

***Extension:** The Biomimicry Institute researches and highlights different ways plant and animal adaptations can be used and adapted by humans to create sustainable infrastructure. Explore the Biomimicry Institute's website with students; in particular the student competition section.

EDUCATOR RESOURCES

- *Project Wild* by The Council for Environmental Education
 - *The Middle Years* by Tim Grant and Gail Littlejohn
 - *Engaging Imagination in Ecological Education* by Gillian Judson
 - *The Biomimicry Institute* at biomimicry.org
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For more information, contact the Youth Education Manager at 508.869.6111 or youtheducation@towerhillbg.org