**Young Investigators in Nature**

Give your students an authentic nature-based inquiry experience where they will ask a question and design an experiment in their local environment. In small groups, students choose a comparative question, and then develop methods to collect data in the field. Students analyze their data back in the classroom and draw conclusions and share their findings. From exploring biodiversity, adaptation, energy flow, and much more, this program is a great fit for any life science lesson.

**Target Grades**: 1-12

**Program length**: 2-3 hours

**Recommended group size**: Up to 80 students broken into small groups

**Parks where available**: Cox Arboretum

**Objectives:**

Students will be able to:

* Build teamwork skills through collaborative investigation
* Observe and ask questions about the natural environment
* Develop appropriate data collection techniques
* Employ scientific equipment to gather data and extend the senses
* Use appropriate mathematics to analyze data to develop informed conclusions
* Communicate through teamwork to share research observations, methodology, and conclusions
* Develop critical thinking skills through reviewing the work of others

# Inquiry Program Process:

**Step 1: In classroom, divide class into groups of 3-5 students, select question**

Divide your class into student working groups, and have them pick from the question list for your grade level. These questions are tied to Ohio's Learning Standards, which should build strong connections with what they are learning in the classroom. Feel free to tweak questions to best fit your classroom experience, but revisit the tools your students will have onsite to make sure they have the proper instrumentation to work with. Allowing different groups to choose the same question will allow students to compare methodology, results, and conclusions, while discussing experimental design and bias.

**Step 2: In classroom, develop experiment**

Once in groups, with question chosen, provide students the contents of the backpacks. If you need, a loaner backpack is available for pickup at Cox Arboretum for classroom use for students to see it first hand, while designing their experiment; contact 937-275-5059 to make arrangements. Feel free to give advice as they work through design, but refrain from giving them too many specifics: Allow their creativity to come through their design, while making them aware of common bias.

**Step 3: Arrive to Cox Arboretum Field Trip; Collect Data**

When students arrive to the park, they will be immediately paired with a volunteer familiar with the trails and various habitats of the park. Students will need to tell the volunteer what habitats they need to explore, and they will be guided there. Volunteers serve to get students to where they need to be, keep them out of harm (like poison ivy), and help to facilitate time management. Each group should have a chaperone to assist with behavioral issues and provide extra support. Students use their entire time at the park to collect as much data as they can. You, as the teacher, can travel around the park, taking photos of students embarking on experiments, and cheering them on.

**Step 4: In classroom, students analyze data, answer question**

Perhaps the next day in the classroom, students analyze data, and look for conclusions. Depending on their age, they may need help with mathematics. Older students can compute descriptive statistics, like average, median, and mode. Older students can take data to the next level by implying statistical tests, like students' t-test, chi-square, and others.

**Step 5: Present Findings**

Science is a communication process to further knowledge: Research is useless unless it is shared. Providing students the chance to share what they have discovered validates their voice, and helps build confidence. Additionally, the class gets to hear what the other groups have experienced. For presentations, depending on age-appropriateness and skill, each group of students should present their question, experimental design, prediction, data collected, methods of analysis, and their conclusion. It is strongly encouraged that each student take a section, so that everyone has had an opportunity to speak. Share their findings in a parent newsletter or bulletin board on the outside wall.

# Inquiry Packs

Total of 8 available for reservation

Contents: 1 set of binoculars, tube of stake flags, pH pen, collapsible insect net, collapsible insect container, fossil ID card, color chart, 2 creek nets, 2 creek containers, 10 bug tubes (9 dram), ice cube tray, macroinvertebrate key with biotic index, flower type diagram, 100ft measuring tape, 8m/27ft measuring tape, clipboard, tree height gauge, stopwatch, digital calipers, digital weight scale, thermometer, pocket microscope.

# K-1st Grade:

**K Content Statements:**

* ESS1: Weather changes are long-term and short-term
* ESS2: Moon, sun, and stars can be explored at different times of the day and night
* LS1: Living things have specific characteristics and traits
* LS2: Living things have physical traits and behaviors which influence their survival
* PS1: Objects and materials can be sorted and described by their properties
* PS2: Some objects and materials can be made to vibrate to produce sound

**1 Content Statements:**

* ESS1: Sun is the principle source of energy
* ESS2: Water on earth is present in many forms
* LS1: Living things have basic needs which are met by obtaining materials from the physical environment
* LS2: Living things survive only in environments that meet their needs.
* PS1: Properties of objects of materials can change
* PS2: Objects can be moved in a variety of ways, such as straight, zig zag, circular, and back and forth

**Comparative Questions:**

How do leaf shapes differ between a garden and a forest?

Are there more flowers growing in sunny areas in the forest or shady areas in the forest?

Does a larger object drop faster than a smaller object?

Do older trees have different bark than younger trees?

Do insects fly more in straight lines or zig-zag patterns?

Do more trees have (rough, smooth, sticky) bark?

Do more (evergreens/deciduous) trees have smooth or rough bark?

Do more young/old trees have smooth/rough bark?

Do flowers planted in the gardens have brighter colors than flowers in the prairie?

Do flowers in the planted gardens have a stronger smell than flowers in the prairie?

Are flowers in the planted gardens larger than flowers in the prairie?

Do pillbugs prefer moist logs or dry logs?

# 2nd Grade

**Content Statements:**

* ESS.1: The atmosphere is primarily made up of air.
* ESS.2: Water is present in the atmosphere.
* ESS.3: Long- and short-term weather changes occur due to changes in energy.
* LS.1: Living things cause changes on Earth.
* LS.2: All organisms alive today result from their ancestors, some of which may be extinct. Not all kinds of organisms that lived in the past are represented by living organisms today.
* PS.1: Forces change the motion of an object.

**Comparative Questions:**

Are there more creatures in moving water or still water in the creek?

Do you catch more creatures in the creek when working with a partner or working alone?

Are there more crayfish chimneys by the ponds or by the stream?

Are there more bird nests in the garden area or the forest?

Are there more squirrel nests around buildings or in the forest?

Which fossils are more common in the park: horn corals or brachiopods?

Are more fossils found in large rocks or by themselves?

Are more lichens found in urban habitats or natural habitats?

Do most flying insects have two wings or four?

Do Woodpeckers prefer to feed off unhealthy trees or healthy trees?

# 3rd Grade

**Content Statements:**

* ESS.1: Earth’s nonliving resources have specific properties.
* ESS.2: Earth’s resources can be used for energy.
* ESS.3: Some of Earth’s resources are limited.
* LS1: Offspring resemble their parents and each other.
* LS2: Individuals of the same kind of organism differ from their inherited traits. These differences give some individuals an advantage in surviving and/or reproducing.
* LS3: Plants and animals have life cycles that are part of their adaptations for their survival in their natural environments.
* PS.1: All objects and substances in the natural world are composed of matter.
* PS.2: Matter exists in different states, each of which has different properties.
* PS.3: Heat, electrical energy, light, sound, and magnetic energy are forms of energy.

**Comparative Questions:**

Are there more sheet spider webs or circular spider webs in the forest?

Is the soil near a decomposing log different than the soil along the trail?

Is the soil in the pond different than the soil along the trail?

Are there more plant or animal fossils?

Is there more plant material in the forest or prairie (garden area, wetlands; comparing two habitats)?

In a creek bed, are there more signs of deposition or erosion?

Do butterflies prefer nectar from milkweed-type flowers or daisy-type flowers?

Do Red-winged Blackbirds prefer to eat seeds or insects?

Which body of water has larger tadpoles?

Are there more dragonfly nymphs or adults around the pond?

# 4th Grade

**Content Statements:**

* ESS.1: Earth’s surface has specific characteristics and landforms that can be identified.
* ESS.2: The surface of Earth changes due to weathering.
* ESS.3: The surface of Earth changes due to erosion and deposition.
* LS.1: Changes in an organism’s environment are sometimes beneficial to its survival and sometimes harmful.
* LS.2: Fossils can be compared to one another and to present-day organisms according to their similarities and differences.
* PS.1: When objects break into smaller pieces, dissolve, or change state, the total amount of matter is conserved.
* PS.2: Energy can be transferred from one location to another or can be transformed from one form to another.

**Comparative Questions:**

Are there more types of fossils found in large rocks or by themselves?

Are certain fossils found more grouped together or apart?

Is there more evidence of weathering in the forest or prairie (garden, wetland, etc.; comparing two habitats)?

Is there more evidence of erosion in the forest or prairie (garden, wetland, etc.; comparing two habitats)?

Which plants have more chloroplasts; plants in the forest or prairie?

Are flowers deeper in color in wetter conditions or dryer conditions?

Which body of water has larger tadpoles?

Which body of water has a higher concentration of aquatic insects?

Which type of water has a higher temperature and pH, moving or still water?

Are there more creatures under logs or in the leaf litter in the forest?

# 5th Grade

**Content Statements:**

* ESS.1: The solar system includes the sun and all celestial bodies that orbit the sun. Each planet in the solar system has unique characteristics.
* ESS.2: The sun is one of many stars that exist in the universe.
* ESS.3: Most of the cycles and patters of motion between the Earth and sun are predictable.
* LS.1: Organisms perform a variety of roles in an ecosystem
* LS.2: All of the processes that take place within organisms require energy.
* PS.1: The amount of change in movement of an object is based on the mass of the object and the amount of force exerted.
* PS.2: Light and sound are forms of energy that behave in predictable ways

**Comparative Questions:**

Are there more creatures under logs or in the leaf litter in the forest?

Are there more predators or prey in the pond?

Which body of water has a higher concentration of aquatic insects?

Are more creatures found in shallow areas of the stream, or deep areas of a stream?

Which type of water has a higher temperature and pH, fast moving water or slow moving water?

In the forest, are more forest floor plants growing in sunny areas or shady areas?

Would a turtle prefer to warm itself on a dark colored rock/ground or a light colored rock/ground?

Is there more poison ivy growing along trails in sunny areas or shady areas? (please study poison ivy without touching it)

# High School

**Biodiversity**

Are there more forest floor plant life growing in sunny areas in the forest or shady areas in the forest?

Is there more plant diversity in the area around redbud trees than areas without redbud trees?

Are there more creatures in moving water (creek) or still water (ponds)?

**Trophic Levels**

Are there more predators, scavengers, or herbivores living in the creek (or pond)?

Are there more herbivorous birds than carnivorous birds in a prairie?

Are there more carnivores living under forest logs or under leaf litter in the forest?

**Environmental Health/Quality**

How do different invasive species impact the ecosystem quality of natural areas? (students choose invasives)

Do ponds further from developed areas have better quality than those closer to developed areas?

Which has more avian biodiversity: Urban areas or wild areas?

**Geological Time & Processes**

Is there more evidence of weathering in the forest or prairie (garden, wetland, etc.; comparing two habitats)?

Is there more evidence of erosion in the forest or prairie (garden, wetland, etc.; comparing two habitats)?

Are certain fossils found more grouped together or apart?

**Evolution - Adaptation**

Are there more sheet spider webs or circular spider webs in the forest?

How does the texture vary between narrow-leaved plants vs. broad-leaved plants in a prairie?

Which flower types better attract more butterflies or bees? Does this change through the year?

Which seeds disperse the furthest? (choose either prairie plant or tree)

Do more bees or bee mimics land on humans?