What's Slithering Around on Your School Grounds? Transforming Student Awareness of Reptile & Amphibian Diversity

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Abstract:
Tomasek et al describe the protocols used in an ongoing research project on amphibian and reptile diversity at Cool Springs Environmental Education Center near New Bern NC. Herpetofaunal surveys have been conducted for the past five years on a 1700-acre site owned by the Weyerhaeuser Corp. Four protocols have been utilized too capture and compile a list of reptiles and amphibians--these protocols can be duplicated to some degree on almost any school site with some small acreage.

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If you decide to implement a similar study using your school grounds, parents' private property, or perhaps a local public park, students will learn to conduct field surveys and will learn more about habitat types, relationships between habitat and wildlife, niche partitioning, common and scientific names of local amphibians and reptiles, and their migratory patterns. Students will gain experience in making detailed observations, asking questions, and analyzing data. Most importantly, as students learn about the types of wildlife in the area they study, their environmental awareness will be piqued and stretched.

Why Study Reptiles & Amphibians?

Most children are curious about frogs and turtles. Many fear snakes and the majority of students probably believe old tales and myths like "Toads give you warts" or "The only good snake's a dead snake." Allaying these fears and dispelling misconceptions would be a great educational benefit; however, there are many other reasons to conduct these studies. In the late 1980s scientists came to realize that certain frog populations were declining and some species had declined to the point of extinction (Green, 2003). Is this a natural fluctuation or have human impacts been the cause of the decline? As humans continue to alter the environment with such practices as draining wetlands, constructing new impoundments, introducing exotic species or building new homes and industries, it is not well known how amphibian and reptile populations will be impacted.

Figure 1. Possible research questions to investigate

RESEARCH QUESTIONS

Grades K – 4

- What reptiles and amphibians are found in my community?
- What habitats do they prefer?
- What are the life cycles of amphibians (frogs and salamanders)?

Grades 5 – 8

- K-4 questions listed above
- What species are native and which ones have been introduced?
- What different species of amphibians and reptiles are found in a certain habitat?
- Does it appear that a species is moving between habitats?
- Does this migration correlate with a certain time of year?
- Do habitats of certain species overlap or are any mutually exclusive?
- What is the relationship between weather patterns and movement of amphibians and reptiles?

Grades 9 – 12

- K–8 questions listed above
- Based on the habitat being studied, what amphibians and reptiles are predicted to be common in my community?
- If predicted common species are not found, what is the limiting factor for that particular species?
- How does species distribution relate to habitat?
- How does human presence impact the habitat?
- Could these habitat changes contribute to population changes?
- How do soil temperature, moisture, pH, or composition affect amphibian and reptile populations?

Extensions for all grades

- What can we do to increase the amphibian and reptile diversity in our community?
- How can we restore certain habitats?
- Compare your findings with those of another school in either your same ecoregion or within a completely different ecoregion.
- Depending on land use plans for your area, build "what-if" questions.
- Use GIS to put herpetofaunal observations into a spatial context.

We do know that these organisms are vulnerable to air and water pollution and many of them are sensitive to environmental changes (Mitchell et al, 1999). The purpose of this type of study is to determine local species diversity and relative abundance estimates of reptile and amphibian species. Long-term data (collected over several years) are invaluable in distinguishing between patterns of seasonal activity (natural cycles in populations) and actual population declines. Changes in a population may indicate the presence of environmental stressors (Mitchell et al., 1999).

Figure 1 outlines a variety of research questions that can be tackled by students. The basic research question for the study at Cool Springs is: What is the status of reptile and amphibian biodiversity in the local community? Simply put, what kinds of and how many reptiles and amphibians live in, breed in, feed in, or travel through the Cool Springs environmental site?

Sampling Strategies & Techniques

If comparisons are to be made across time and space, standardized techniques and sampling efforts need to be used. Four protocols used at Cool Springs Environmental Education Center will be described:

* artificial cover

* drift fences with pitfall and funnel traps

* PVC pipes

* aquatic minnow traps.

Table 1. Sampling bias of each collecting technique

Coverboards	Drift Fence/Pitfall Traps	Funnel Traps	PVC Pipes	Aquatic Minnow Traps
Terrestrial reptiles & amphibians	Migrating reptiles & amphibians as well as small surface-active species	Large snakes	Tree frogs	Aquatic larval stages of amphibians as well as aquatic snakes

The effects of these different capture techniques on estimates of species richness and diversity for several amphibian and reptile populations in forested wetlands have been well studied. Because survey of amphibians and reptiles is the sampling goal, multiple types of traps or artificial cover will capture a greater diversity of organisms, minimizing observer bias and error (Greenburg, Neary & Harris, 1994). Table 1 lists transects/traps and the organisms most commonly found in each type.

The materials for each of these sampling methods can be obtained inexpensively from local businesses. Artificial cover can be pieces of plywood and tin (scraps or purchased from hardware stores). A drift fence is nothing more than an erosion control fence purchased for approximately $26.00 per 100 feet at hardware stores such as Lowe's or Home Depot. Pitfall traps can be items such as buckets or plastic containers. PVC pipe is approximately $0.35 per foot and home improvement store employees will often cut it to the size specified. Aquatic minnow traps can be purchased in the fishing department at Wal-Mart and other discount shopping stores for less than $10.00 each.

The greatest margin of error in this project is with species identification. The level of difficulty will vary with region. In some areas of the country there is naturally a low level of species diversity and accurate species identification should not be difficult. In other parts of the country, like the Appalachian Mountains, the converse is true. Prior to having your students check transects, it would be beneficial to spend some time helping students learn the names and characteristics of common amphibians and reptiles in your area. Pictures from field guides will be helpful as well as practice with live organisms. Local field guides would be the most helpful. Most states have brochures and Web pages with pictures of the local herpetofauna. There is probably a nature center or environmental center in your community that can help you with field identification. Perhaps faculty from a nearby college would be interested and willing to get involved as well. Here are two excellent Internet sites to help with identification:

http://www.npwrc.usgs.gov/narcam/idguide/index .htm

http://www.cortland.edu/herp/

It is important to know about the safety issues surrounding reptiles and amphibians in your area such as venomous snakes, toads with toxins, or turtles that bite, and to share this information with your students. Again, local field guides and professionals would be your best source of information.

Protocols

Artificial Cover

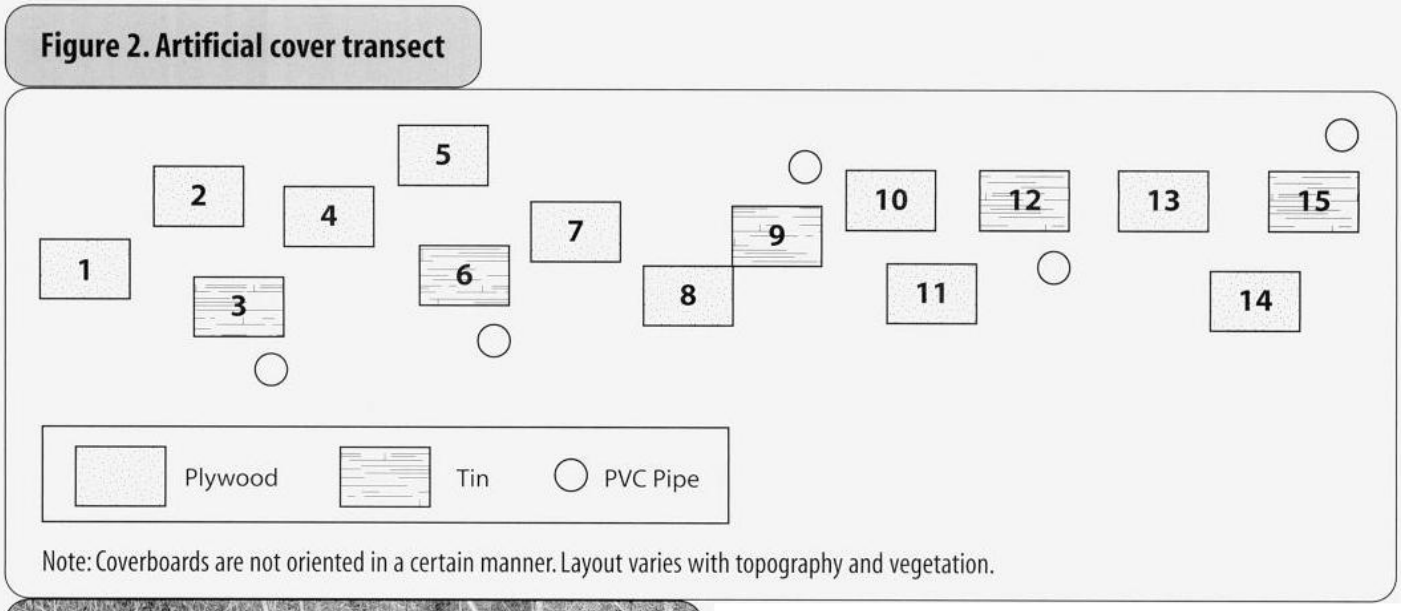
The first sampling method is artificial cover. Coverboard transects have been used successfully in ridge forest and pine forested sites (more so than in wetland sites), particularly for salamanders and ground skinks (Lamb et al, 1998; Mitchell, Erdle & Pagels, 1993). Coverboards, serving as rocks and logs, are utilized by many amphibians and reptiles for shelter and show general inhabitants of an area. Two types of artificial cover are used:

* 2' X 4' untreated ½" or ¾" plywood

* 2' X 8' galvanized roofing tin.

Smaller pieces of board (2' x 2') will catch salamanders but larger boards yield more diversity. The materials are laid ten meters apart, flat on the ground and arranged in an alternating pattern (wood, wood, metal, etc., see Figure 2). A coverboard transect consists of ten pieces of plywood and five pieces of tin with each tran sect being 150 meters long.

When installing a coverboard some protocols suggest that the leaf litter be removed, the mineral soil leveled, and the coverboard material placed so that its entire surface is in contact with the earth. At Cool Springs, coverboards are placed directly on top of leaf litter. Because this type of transect provides habitat and is not a trap, it can be checked when convenient. Coverboards are not disruptive to the natural habitat. If it is misty or rainy most amphibians and reptiles are foraging in the leaf litter and therefore not likely to be found under coverboards. Low temperatures will also drive these organisms deeper underground and away from coverboard habitat.



To turn over coverboards, students should use a device (a snake stick, iirm yard rake, or hoe) instead of using their hands. Students should stand on one side of the artificial cover piece and reach to the opposite side of the material lifting so that anything underneath will run out away from the students. Several other students need to be ready to capture any amphibians or reptiles. Some reptiles should not be handled by the tail because they often detach their tail as a defense mechanism.

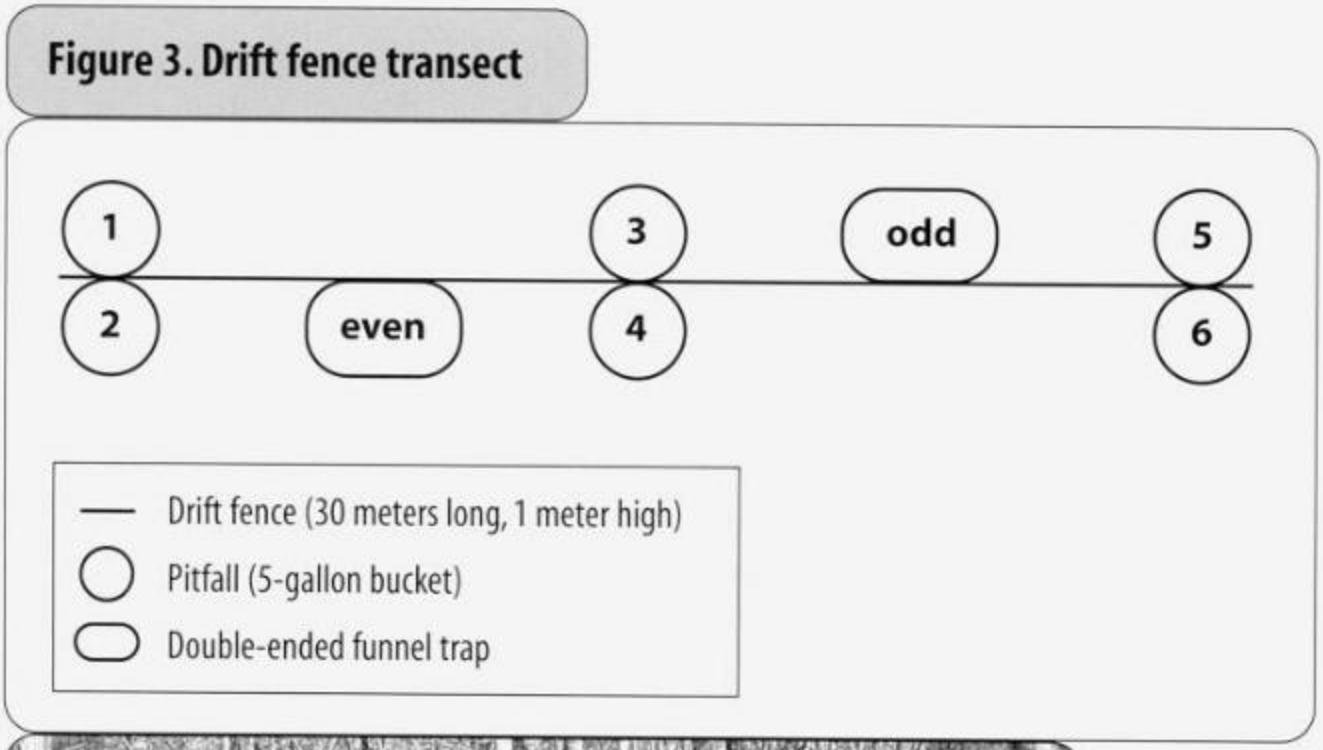
When students are ready to release an animal the coverboard should be replaced and the animal placed next to the coverboard so that the organism can crawl back under without being crushed. Generally, high humidity (air moisture), calm wind conditions, high soil and liter moisture, and mild (above freezing) temperatures are the optimal conditions that prompt salamanders to move from their soil retreats to coverboards (Dreoge, 1997). The Terrestrial Salamander Monitoring Program provides an excellent Web site about salamanders and artificial coverboard monitoring. A list of target salamander species for a coverboard plot is given at http://www.pwrc.usgs.gov/sally.

You should expect to find different types of amphibians and reptiles under different types of coverboard. It is common to find more frogs and salamanders under wood (Lamb et al., 1998), while snakes will often nest under the tin pieces because of added warmth. If a nest of snake eggs is found, care should be taken not to disturb nests until the eggs have hatched. Once the eggs have hatched they can be removed to count the total number of eggs and the number of eggs successfully hatched. Students can then calculate the hatching success rate. Some amphibians and reptiles will be found throughout the year but early spring and very late fall (prior to the first hard freeze) should be the best sampling periods to collect the largest number of individuals since this is when physiological conditions are optimal for organisms to move.

Drift Fences with Pitfall & Double-Ended Funnel Traps

The second sampling method is a drift fence with pitfalls and double-ended funnel traps (a terrestrial use of minnow traps). The drift fence sampling method is most effective between water sources and upland forests, prairies and savannas, or any other important transition zone for reptiles and amphibians. This method shows how amphibians and reptiles migrate from a water source to a terrestrial environment. The idea behind this transect is that amphibians and reptiles moving across the area will run into the drift fence and be forced to move along the fence, falling into the pitfalls or moving into the funnel traps. A combination of pitfalls and funnel traps will usually collect 90% of the species in an area (Greenburg, Neary & Harris, 1994). By using the numbering as indicated in Figure 2 (odd numbers on one side and even numbers on the other), a researcher can quickly determine whether animals are moving to or from a water source.

Each 30-meter erosion control fence is 1 meter tall and comes with stakes already attached. The drift fence should be installed as straight as possible both vertically and horizontally. The orientation will vary with topography. The drift fence must be flush with the ground to prevent specimens from crawling under the fence. Sinking the material into a small trench might be beneficial. At Cool Springs, three pitfalls are sunk flush with the ground on each side of the drift fence at 10-meter intervals (a total of six pitfalls). The pitfalls are 5-gallon (19.5 L) white plastic buckets with the handles removed. These can be purchased from a home improvement store or donated by a local restaurant. Smaller buckets can be used but the smaller pitfalls capture less than half the number of species as the larger pitfall traps (Mitchell, Erdle & Pagels, 1993). Multiple holes are punched in the bottom of each bucket to facilitate drainage during rain events (you want to avoid drowning the organisms). A piece of wood (stick from the surrounding area) is placed in the bucket for organisms to climb on in case of flooding. A wet sponge is also placed in the buckets so that organisms do not dry out. Pitfall traps are covered with bucket lids during non-sampling times. Placing a stone or brick on the bucket lid prevents the wind from blowing the lids off and



One double-ended funnel trap is placed on each side of the drift fence between two buckets (see Figure 3). These wire minnow traps are set into a slight depression in the ground so the openings at each end are flush with the ground. These traps are covered with a scrap of indoor/outdoor carpet to provide relief from the heat for any trapped organisms. A piece of cardboard could also be used but this tends to decay more quickly. Leaf litter can be placed in the floor of the funnel traps. Both funnel and pitfall traps should be placed as close to the fence as possible.

At Cool Springs, pitfalls are uncovered and funnel traps are placed on Monday. Transects are checked daily, data are recorded, and animals are released on the opposite side of the drift fence. Traps are covered and funnels are removed on Friday. Another method of survey is to open the pitfalls in the afternoon and check them the next day. You can also watch the weather for a predicted evening rain event, open the pitfalls the afternoon before the predicted rain, and check the traps the next day (check for amphibians in the morning and reptiles in the evening).

Surface-active organisms such as lizards and frogs are more likely to be caught in pitfalls whereas large snakes and large frogs are more likely caught in funnel traps (Greenburg, Neary & Harris, 1994). Trap type efficiency may vary among habitats and regions (Bury & Corn, 1987).

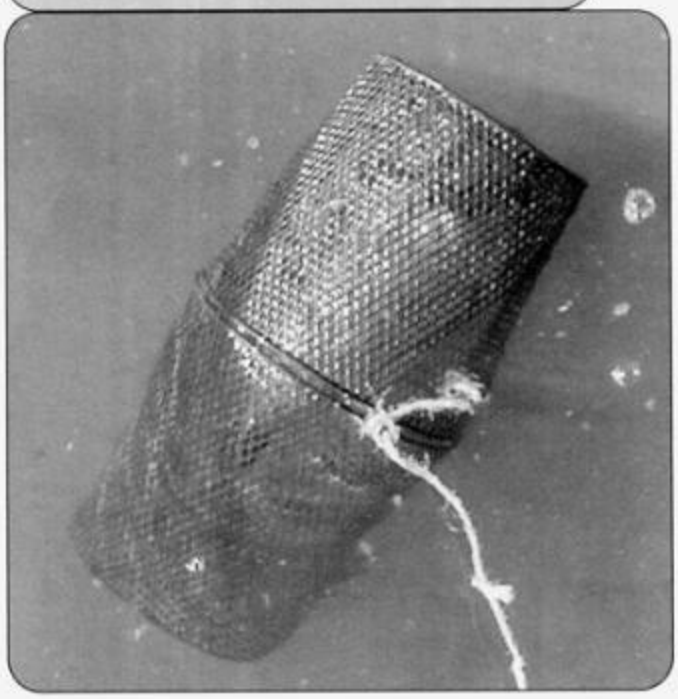
Students should be warned about sticking their hands in buckets. A stick should be used to stir the contents of the bucket or flip the sponge because spiders, biting insects, or venomous snakes may fall into the buckets.

PVC Pipes

The third sampling method is PVC pipes (Figure 4). Pipe pieces are made from 1½" PVC pipe cut into 5-foot sections. One end is tapered for ease in forcing the pipe into the ground. Pipes need only be forced into the ground enough to make them stable. They should be placed in the ground within one foot of a tree. Ten PVC pipes placed 10 meters apart constitute a single 100 meter transect. This type of transect should be placed in the same habitat as the drift fence and checked every two weeks. These same pipes are used next to tin coverboard pieces in the artificial cover transect described above. With younger students, PVC pipes can be shorter (as short as 3 feet). Within one month you should see frogs. At Cool Springs, frogs have been found in PVC pipes every month of the year. To check pipes, place a gallon Ziploc® plastic bag over the upper end of the PVC pipe. After removing the pipe from the ground, turn it over and gently knock the pipe with your hand several times causing frogs to fall out into the baggie. The baggie should be sealed quickly to avoid losing any specimens. A small amount of distilled water in the bag will allow time to identify and count frogs before releasing them back onto a tree. If there is very little area on your school property for the other types of transects, this single transect will still yield tree frogs to study if they are native to your geographic region. Hollow PVC pipes provide hiding sites for a variety of tree frogs that would probably not otherwise be encountered at transect sites by the coverboard technique (Lamb et al., 1998).

Figure 4. PVC pipe transect with Jeff Hall looking for tree frogs

Figure 5. Aquatic minnow trap with plastic bottle for flotation



Aquatic Minnow Traps

The fourth sampling method is minnow traps used to capture aquatic amphibians, amphibian larvae, and small aquatic snakes. These can be set in a variety of aquatic habitats if present on your school property, including streams, vernal pools, or small ponds. Minnow traps do not have to be baited. Placing an empty, capped 20-ounce plastic water or soft drink bottle in the trap will allow aquatic snakes a place to rest without drowning

(Figure 5). One trap per 10 meters of shoreline is recommended for a small pond. Minnow traps should be checked daily.

Data-Collection Procedures

Ziploc® bags should be handy at each transect to use when identifying organisms. The bags can be moistened with a few sprays of distilled water from a plant mister. Using this method, amphibians and reptiles will be safer while your students identify them. All organisms should be released in the same place they are found.

Depending on the research question being investigated, data-collection forms should be created to reflect appropriate data needed. See Figure 6 for an example of a data collection sheet. Analysis of data depends on accurate and detailed data collected. If multiple transects are utilized a numbering system should be used to distinguish one transect from another on the data sheets. Carefully labeling traps, pipes, coverboards and transects will make it easier to keep track of the collected data.

Data-collection throughout the study period should be consistent. A specified number of days between sampling or sampling tied to certain weather conditions are two examples. If sampling must be infrequent, spring and fall would be the best time periods yielding the greatest species diversity. The fall sampling period could begin one month prior to the average hard freeze date for the area and continue until the first hard freeze. The spring sampling period could start following the complete thawing of the soil column (temperatures rising above 0°C). Sampling could stop about two months after that date or if daytime temperatures begin to regularly exceed 10° C (Dreoge, 1997).

Conclusion

Small reptiles and amphibians that live in the forest provide a pivotal link in the food chain. Their loss or decline may have consequences affecting many other plant and animal communities. An increasing or stable number of amphibians and reptiles would indicate that the forest has a balance of invertebrates, leaf litter, moisture, pH, debris, burrows, and other habitat features. Any declines could possibly indicate that the habitat has changed. Investigating this change would help your students understand the important relationships among all living organisms and possibly lead to community service projects. If environmental data is collected at your school, students can investigate the relationships between environmental conditions and biological diversity. Since amphibians and reptiles are ectothermic, changes in the environment could have a direct effect on their existence. Soil and air temperature, relative humidity, soil moisture and percentage of sunlight reaching the forest floor would all be valuable types of environmental data to collect. Given the longevity and low fecundity of salamanders their populations alone are much more likely to represent significant environmental changes than any other group of North American amphibians (Dreoge, 1997).

Figure 6. Data Collection Sheet

Observer's Name(s) _____

Date _____ Time: Beginning _____ Ending _____

Transect Surveyed (Number and Type) _____

Environmental Parameters

Air Temp _____ °C Relative Humidity _____ % Wind Speed & Dir. _____

Cloud Cvr _____ % Rain w/in last 24 hrs _____ mm Rain w/in last 7 days _____ mm

Soil pH _____ Soil Temp (top 3 cm) _____ °C Soil Moisture _____ %

Water pH _____ Water Temp _____ °C

Cover piece, PVC or trap number	Name of Organism(s)	How many?	Size	Age class (adult, juvenile, or larvae)	Notes

The simplicity of procedures, moderate set up time, ease of data collection, and inexpensive readily available materials required by this project can lead to attainable science for elementary through college students. The materials can be easily moved to accommodate different sites or new surveys. As students participate in the collection of data that is used in inquiry-based research they learn to appreciate amphibians and reptiles for their role in the environment. This biodiversity survey will enable students to feel like researchers, helping them to understand the depth of knowledge that is needed about all species before we can truly understand the impact caused by the human species. This inquiry-based project provides an opportunity to change students' feelings about amphibians and reptiles (from "Yuck" to "Cool!") and could lead to life-changing experiences for your students. Your school grounds will be turned into a working research station and you can put the science back in science teaching!

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