Project Squirrel

Citizen Scientist Research Guide

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*Classroom instructions for conducting corn GUDs available in forthcoming;

Cornell University on Behalf of Cornell Laboratory of Ornithology, ed., *Birds, Butterflies, Bullfrogs, and Beyond: Bring Biology to Life Through Citizen Science* (Arlington: NSTA Press), 2013.

Cover photo: A Fox Squirrel, *Sciurus niger,* in Brookfield, Illinois

Acknowledgements

Project Squirrel was initiated by Joel Brown and Wendy Jackson in 1997, further developed by Marius van der Merwe, and expanded by Steve Sullivan in 2009. Over this time, thousands of citizen scientists have submitted observations and collected data that have resulted in the publication of several scientific papers and a better understanding of squirrel ecology in North America. None of this understanding would be possible without the regular and enthusiastic support of citizen scientists.

Project Squirrel has been supported by the University of Illinois at Chicago, the members of the Brown Lab at UIC, the Chicago Academy of Sciences and its Peggy Notebaert Nature Museum, and all of the citizen scientists from all ages and walks of life throughout the United States and in many other countries who have contributed data.

A white Grey Squirrel, *Sciurus carolinensis*, in Olney, Illinois

Message to Volunteers, Instructors, and Students

Thank you for your interest in Project Squirrel. As you read through this guide, I hope you will find that studying squirrels presents a range of fun and educational opportunities. Project Squirrel activities can involve people of all ages and add a scientific purpose to backyard wildlife observation. School teachers will find that Project Squirrel can be used as a tool to teach real-life application of math and science skills and as a foundation for a range of reading, writing, math, and geography exercises. University instructors are invited to incorporate Project Squirrel into ecology labs and field techniques courses.

Participation in this project will help you understand your neighborhood squirrels and general ecology more clearly, and when you contribute the data you collect, we will be able to illuminate regional patterns of biodiversity, demographics, and ecology. If you already love squirrels, this understanding is likely to help you enjoy squirrels even more. If you hate squirrels, this understanding should help you mitigate the problems squirrels can cause. Love them or hate them, squirrels are excellent organisms for documenting urban ecology, and it is my hope that this guide will encourage citizen scientists everywhere to develop their skills in observing and enjoying the ecology of their neighborhoods while contributing to a focused, long-term data set that is illuminating the relationships between humans and our urban environments.

I look forward to seeing your data sets over the coming seasons. Happy Squirreling!

Yours,

Steve Sullivan

Project Squirrel, Principal Investigator

Contact

ProjectSquirrel.org has everything you need to be a scientific squirrel watcher: links to data sheets, pictures, frequently asked questions, and more. You can efficiently report your squirrel data through ProjectSquirrel.org, and we hope you'll encourage your friends to go there and participate, too.

For additional questions, including support for GUD collectors, contact sciurus@uic.edu.

Introduction: Project Squirrel in a Nutshell

Project Squirrel is a long-term study that partners with citizen scientists to collect broad-scale, fine-resolution data about squirrel population density, diversity, and behavioral characteristics. These data can then be interpreted by researchers (and citizen scientists) who wish to learn more about local and regional ecology. Said another way, Project Squirrel is a way to see the world through squirrels' eyes--and the more people submitting data, the better our understanding.

Squirrels are ideal candidates for understanding ecology on both local and regional scales for a wide variety of reasons. Squirrels can be found in most American cities, and the different species of squirrels are easily identifiable. Also, squirrels are diurnal (active during the day) and active year round, making them easy for people to observe. Squirrel survival and behavior can provide information about other wildlife in an area as well; resources that are key to squirrel survival are also important to a wide range of other animals, and, similarly, predators that impact squirrels often impact many other species as well. Fundamental squirrel ecology is well understood, so it is possible to make and test hypotheses based on a solid foundation of previous research. Finally, most people have an opinion about squirrels—love them or hate them, people notice squirrels.

Because squirrels are easy to identify and observe, citizen scientists can contribute meaningful data to the project without extensive training. Scientists can then use the data to make generalizable conclusions about the local and regional ecosystems. It is hoped that citizen scientists' participation in the project and the conclusions drawn from the squirrel data will encourage better stewardship of neighborhood natural resources for the benefit of all biodiversity, decrease the tension between humans and neighborhood wildlife, and help people enjoy and appreciate the outdoors in an increasingly urbanized world.

A grey squirrel, *Sciuris carolinensis,* (note the white-frosted tail) in pursuit of a fox squirrel, *Sciuris niger,* (note the rufous coloration).

Background Information

Squirrel Demographics

Ecology includes the relationships and interactions of the biotic (living) and abiotic (non-living) parts of an ecosystem, and there are several kinds of data about squirrels that can contribute to a better understanding of the ecology of an ecosystem. A citizen scientist might collect data about squirrel demographics (e.g., the number of squirrels in a given area, the ratio of fox to grey squirrels, how the density and diversity of squirrel species change over the seasons and years) or squirrel behaviors (e.g., how a squirrel feeds or avoids predators).

Collecting squirrel demographic data is simple - just note how many individuals and what species of squirrel you see, and report your observations at ProjectSquirrel.org. Don't see any squirrels? That's a data point too, because the persistent absence of squirrels can tell a lot about the ecology of a region. You can report about squirrels as often as you like in as many places as you like. It is best that you report about a given location at least once a season because it is likely that the squirrel populations will change from one season to the next. Encourage your friends and neighbors to contribute data, too. The more observations we have, the more complete our understanding will be. Reporting your observations to ProjectSquirrel.org is simple, yet the data from your reports and those of thousands of other people form the foundation for significant research.

Squirrel Behaviors: Using Giving Up Densities (GUDs) to See the World Through an Animal's Eyes

Imagine a scientist puts a bowl of your favorite candy on a table near your bedroom door. How much might you eat? If the bowl is moved near your neighbor's bedroom, or in the middle of the street, how much might you eat? The amount of food left in the bowl when you are done foraging in it is called the Giving Up Density (GUD). When the foraging patch (bowl o f candy) is near your bedroom, where you feel comfortable, your GUD is likely to be low—there will be few pieces of candy left. However, near your neighbor's bedroom or in the middle of the street (where there are territorial conflicts or other dangers), your GUD will be high—many pieces of candy will remain in the bowl.

Scientists use Giving Up Densities to learn more about how animals interact with their surroundings. GUDs can provide clues about the costs and benefits of obtaining food from certain foraging patches, and this information contributes to an understanding of the relationships between biotic and abiotic parts of ecosystems.

Patch Use Theory

Patch use theory recognizes that animals live in heterogeneous environments and that resources occur in patches. Shelter, water, and food may be located in different places. Food resources are depleted as they are utilized, making foraging progressively less productive. Patch use theory predicts that a foraging animal will stop using a patch when the costs of foraging are greater than the benefits. Costs may include metabolic, predation, and missed opportunity costs (e.g., the inability to watch for predators while handling food, the difficulty of separating food from a substrate like husks or soil). The relative costs and benefits may change with factors like the health and reproductive status of an individual. For example, a starving individual is likely to take more risks for food than one that has recently fed.

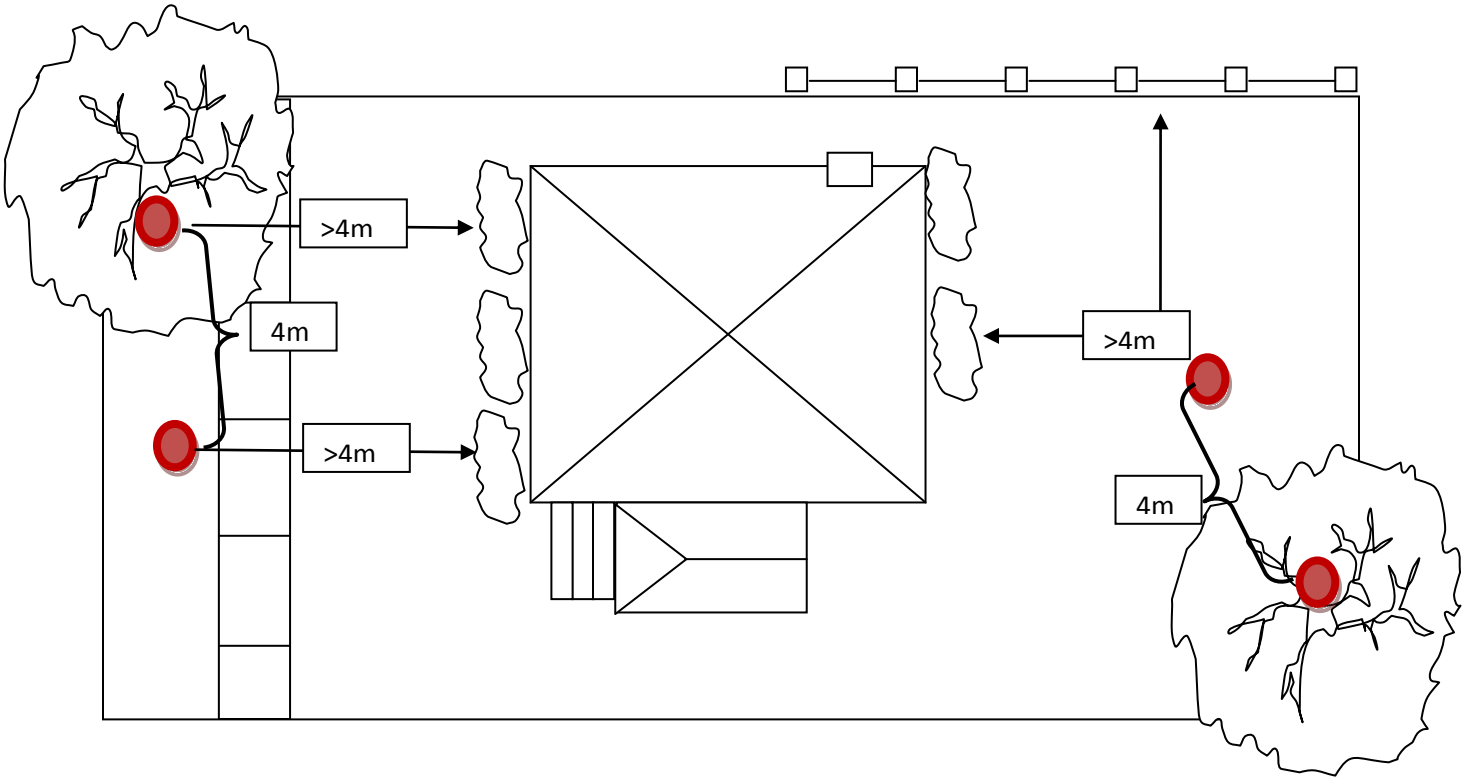
The benefits and costs of feeding perceived by an animal can be evaluated by measuring Giving Up Densities in experimental foraging patches. A GUD will be lower (less food will be left behind) when an animal thinks that foraging is more beneficial than other activities.

Scientists at Project Squirrel are using GUDs to learn about squirrel behavior and are interested in working with citizen scientists to collect additional data. This guide includes instructions for two possible experimental setups for collecting GUDs, corn GUDS and sunflower seed GUDs.

A Guide to Collecting GUDs in Your Yard

Study Site

Observe the features of certain areas in the yard and determine where you think squirrels might feel threatened. Is there an area close to traffic, pets, or other hazards? Is there a secluded area that seems protected from such dangers? Choose two study sites, one that you characterize as a "safe" site and one that you characterize as an "unsafe" site. Each site must have a tree that is at least 15 cm in diameter at breast height (dbh). You will place two foraging patches at each site, one at the base of the tree and one 4m from the base of the tree.



Habitat Information

Use a Habitat Information Sheet to record site-specific and abiotic data. These data allow scientists to make more accurate and detailed comparisons between data collection sites.

Timing

Put your foraging patches out in the morning and collect them in the evening. Because nocturnal wildlife might also be interested in the food provided at the foraging patches, do not leave the patches out at night. Data should be collected from the foraging patches for a minimum of four consecutive days. As much as possible, data collection should be conducted on days with similar weather forecasts.

Safety

Collecting GUDs is one of the safest ways to gather data on an animal because there is no need for the observer and the animal to come into direct contact. Because of the short duration of the project, there shouldn't be any long-term impacts on the foraging patterns of neighborhood wildlife.

Squirrels do not carry rabies, but it is never a good idea to approach a wild animal, no matter how cute, friendly, or needy it may seem. Whether or not they are rabid, most animals will defend themselves if they feel threatened. Squirrels seem friendly, but they may react to a given situation differently than you might expect. In addition to their amazingly sharp teeth and powerful jaw muscles, squirrels have razor-sharp claws that can easily break skin. You should especially avoid animals that are behaving strangely.

Squirrels are likely to carry fleas and may carry other parasites. For the most part you can prevent exposure to these organisms by doing what you normally do—avoid coming into contact with wild animals and their feces.

Breathing silica sand dust or dust from dried feces can be hazardous to your health.

Wash your hands thoroughly after working with the patches.

Feel free to contact the Project Squirrel Team with questions, concerns, and observations at any time at sciurus@uic.edu.

Data Management

Science is based on the ability to draw conclusions that allow us to make generalizable theories. All of the activities outlined in this manual are for one end: to collect useful data. *To be useful, data must be collected systematically under the most standardized conditions possible and recorded accurately.* Please be very careful while collecting, recording, storing, and transmitting data. Double check to ensure accuracy, especially when submitting data electronically on the Project Squirrel website.

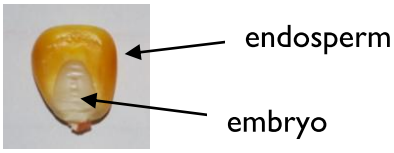
Corn GUDs

Four foraging patches are compared: Safe Site Near Tree, Safe Site 4m from Tree, Unsafe Site Near Tree, and Unsafe Site 4m from Tree. Each foraging patch contains an ear of corn as a food resource on each day of data collection. Each evening, the amount of corn left behind in each patch is measured, and the patches are reset for another round of data collection.

The animals must spend time consuming the corn, which reduces their ability to watch for predators. If they think the area is risky, they won't spend as much time consuming corn, and the GUD will be high – many kernels will be left. On the other hand, if the squirrels feel safe, they will spend more time consuming and the GUD will be low – few kernels will be left.

Corn as a Food Source for Squirrels

A corn kernel has two main parts, the endosperm (the starchy outside) and the embryo (the oily inside). When a corn kernel germinates in the soil, the embryo grows into a corn plant, and the endosperm feeds the plant until it forms leaves and begins to photosynthesize.



Because the oily embryo has more nutrients, it is preferred by squirrels over the endosperm. Squirrels often eat only the embryo from the middle of a corn kernel, leaving the endosperm behind. In this study, when a squirrel leaves an endosperm behind, it is referred to as a kernel with an excised (removed) embryo. Much in the same way that candy wrappers could be used to determine how much candy a person ate, kernels with excised (removed) embryos can be used to measure how much a squirrel ate. Sometimes, squirrels will eat very quickly and leave a pile of broken corn kernel scraps behind instead of leaving a kernel with the embryo neatly cut out. Removing embryos is a common behavior in squirrels; grey squirrels regularly excise embryos from white oak acorns to prevent germination.

In this study, data are collected about the amount of corn consumed by squirrels and the scraps left behind by squirrels. If squirrels do not forage from the patches, this is also important data and should be reported. Since all data are useful data, please report the amount eaten by squirrels, even if it is 0 grams.

Study Site

This method uses an ear of dried corn which is affixed to a feeder in a way that gives squirrels access but minimizes feeding by other species. The feeder is placed so that the waste generated by feeding can be easily collected.

Bait the Patches

Pre-bait the site to alert squirrels to a potentially good place to forage by simply scattering some dried corn, sunflower seeds, or some other palatable food for three days before beginning the GUD study.

Materials

Each study will have a set of the following:

- 4 cardboard or wood foraging patches (see Corn GUDs Foraging Patch Assembly Instructions)
- 16 ears of dried feed corn (4 per day for 4 days)
- 300g capacity balance
- Data sheets
    - 2 Habitat Information Sheets
    - 16 Corn GUDs Data Collection Sheets (at least one per foraging patch location (4) per day (4))
    - (optional) Corn GUDs Data Analysis Sheet
    - (optional) Corn GUDs Graph Sheet
    - (optional) Corn GUDs Class Data Sheet (used to compile data from all 16 Corn Data Collection Sheets)
    - (optional) Corn GUDs Project Squirrel Reporting Sheet

Collect the GUDs

GUDs will be collected in each of the four foraging patch locations (Safe Site Near Tree; Safe Site 4m from Tree; Unsafe Site Near Tree; Unsafe Site 4m from Tree) over four days. See "A Guide to Collecting GUDs in Your Yard" for information on selecting sites.

Put the four wood or cardboard foraging patches outside (one in each location) each day for at least six hours. During each day, observe each foraging patch location for a few minutes, and on the Corn Data Collection Sheet for each location, record the species and number of squirrels that were present. Collect all of the corn from each foraging patch at the end of each day, and bring the patches inside. Separate the corn from each patch into piles of "whole corn left behind by squirrels," "kernels with excised embryos," and "small pieces of kernels not on the cob."

Each evening at about the same time, use the data sheet to record:

- Total mass of corn kernel scraps left behind on the foraging patch
    - Mass of kernels with excised embryos
    - Mass of small pieces of kernels not on the cob
- Total mass of corn that was consumed by squirrels
    - Mass of all whole corn kernels left behind by squirrels
    - Total mass of the cob with all of the kernels removed

Put the foraging patches back out the next morning, and repeat the procedure for all four days of data collection. Enter the data into the online form at ProjectSquirrel.org. If desired, use the Data Analysis Sheet and Graph Sheet to draw conclusions about how much corn the squirrels were interested in eating at each foraging location and the Class Data Sheet and Project Squirrel Reporting Sheet to compile and organize data before reporting to ProjectSquirrel.org.

Sunflower Seed GUDs

Four foraging patches are compared: Safe Site Near Tree, Safe Site 4m from Tree, Unsafe Site Near Tree, and Unsafe Site 4m from Tree. Each foraging patch contains a substrate (sand) mixed with a measured food resource (sunflower seeds). Each evening, the amount of food left behind in each patch is measured, and the patches are reset for another round of data collection.

Squirrels love sunflower seeds because they are high in energy and low in toxic compounds. Because this experiment uses seeds that are not in the shell, squirrels won't try to cache the seeds. The animals must spend time searching for the sunflower seeds in a bin of sand, which reduces their ability to watch for predators. If they think the area is risky, they won't spend as much time looking for seeds, and the GUD will be high – many seeds will be left. On the other hand, if the squirrels feel safe, they will spend more time looking for seeds and the GUD will be low – few seeds will be left.

Materials

- Four foraging bins with lids, each large enough to hold four liters of sand
- Five 4-liter bags of screened sand
- Sand scoop
- 20 envelopes, each containing 12 grams of whole, shell-less sunflower seeds
- Handful of extra sunflower seeds (for pre-baiting)
- One sieve assembly (screen and base) for separating seeds from sand
- Data Collection Sheet

Foraging Patch Preparation

Select four foraging patches: Safe Site Near Tree, Safe Site 4m from Tree, Unsafe Site Near Tree, and Unsafe Site 4m from Tree. See "A Guide to Collecting GUDs in Your Yard" for information on selecting sites.

Pre-Baiting: Fill each of the four foraging bins with four liters of sand. Put a pinch of seed on top of the sand in each bin. Do not mix the seeds into the sand. Place the foraging bins out in the four selected locations. This will alert squirrels to a potential place to forage, which could make the squirrels more likely to forage at the patches on data collection days.

Bait the Patches

- Prepare the patches. Stir the sand and the measured sunflower seeds together (this should be all of the seeds in the envelope). Shake the bin to smooth the surface of the sand. The seeds should be distributed evenly in the substrate, though some may be visible on the surface.

  There should not be any broken seeds in the envelope, but if there are, please remove them and replace them with an equivalent amount of unbroken seeds from the pre-baiting seeds.
- Keep the trays covered until it is time to forage.
- Open the squirrel trays in the morning.

Collect the GUDs

This is where you start to see results. Did an animal find the patches? How much food did they leave behind? Do any patterns seem to be emerging? You will see amazing results from your yard, and later, your results will be combined with others to create a larger picture.

- In the evening, close the squirrel patches.
- Use the sieve assembly to screen the contents of the patch and count the remaining food.

- Record the GUD—the number of unconsumed sunflower seeds—along with any observations you make on the data sheet. If you find seeds that are in pieces of about ½ or more, record them as ½. Seeds that are less than about ½ should be recorded as 0.
- Cover the patches to prevent raccoons, cats, or other nocturnal animals from disturbing them and re-bait them in the morning for the next period of foraging.
- Be sure to keep the sand dry.

Citizen Scientist Research Guide

Appendix

Contents

Procedural Checklists for GUDs

Procedural Checklist for Corn GUD Collection

___Site Selection: Choose four foraging patch locations using "A Guide to Collecting GUDs in Your Yard" (pg. 7)

___Prepare: Build foraging patches.

___Bait: In the morning, place one ear of corn at each foraging patch.

___Allow foraging: Open the station between 6 and 9 a.m.

___Collect GUDs: Between 4 and 8 p.m., collect the remaining corn from each foraging patch.

___Record data: Record how much corn was consumed and whether the kernels are whole or have excised embryos.

___Repeat data collection, refilling the foraging patches each day.

___Report your data using the link at ProjectSquirrel.org.

Procedural Checklist for Sunflower Seed GUD Collection

___Site Selection: Choose four foraging patch locations using "A Guide to Collecting GUDs in Your Yard" (pg. 7)

___Prepare: Fill each foraging bin with four liters of sand.

___Bait: Mix one envelope of seed (12 grams) into the sand.

___Allow foraging: Open the station between 6 and 9 a.m.

___Collect GUDs: Between 4 and 8 p.m., sieve the foraging patch and count the remaining seeds.

___Record data: Record the number of seeds, other data, and observations on your datasheet.

___Cover the foraging patch.

___Repeat data collection, refilling the foraging patches each day.

___Report your data at ProjectSquirrel.org.

Habitat Information Sheet

Investigator Names:

Hypothesized Habitat Type ("Site"): (circle one)

Safe	Unsafe

Approximate diameter of tree at breast height (DBH): _____cm DBH

To calculate the diameter at breast height:

- Use a flexible measuring tape (or a piece of string that you later measure) to find the circumference of the tree (in cm) at approximately chest height, which will vary slightly depending on the height of the person making the measurements.
- Divide the circumference by π (approximately 3.14).

Kinds of trees within 20m of site:

- ☐ Nut bearing (trees like walnut, oak, or hickory)
- ☐ Seed bearing (trees like maple, elm, or locust)
- ☐ Fruit bearing (trees like crabapple, gingko, or hawthorn)
- ☐ Cone bearing (trees like pine, fir, or spruce)
- ☐ Tiny seed bearing (trees like cottonwood, willow, or ash)

Check off any of the following that are within 10m of the site:

- ☐ Building
- ☐ Fence
- ☐ Garbage cans or recycling bins
- ☐ Other trees
- ☐ Bird feeders

Note: If any of the features listed above are within 4m of the site, please select a new location.

If the following are present, indicate how busy you think they are during the day:

	Not Present	Usually Quiet	Sometimes Busv	Regularly Busv	Very Busy
Street	○	○	○	○	○
Alley	○	○	○	○	○
Sidewalk	○	○	○	○	○
Playground	○	○	○	○	○
Sports Field	○	○	○	○	○

Note: If any of the features listed above are within 4m of the site, please select a new location.

How many of the following do you think are within one block of the schoolyard in one day?

Cats	None	1-2	3-4	5+
Dogs	○	○	○	○
Hawks	○	○	○	○
Coyotes	○	○	○	○

How often do you see squirrels obtaining food from the following sources near your school?

	Never	Seldom	Often	Always
Bird feeders	○	○	○	○
Human Handouts	○	○	○	○
Garbage	○	○	○	○
Trees and other plants	○	○	○	○

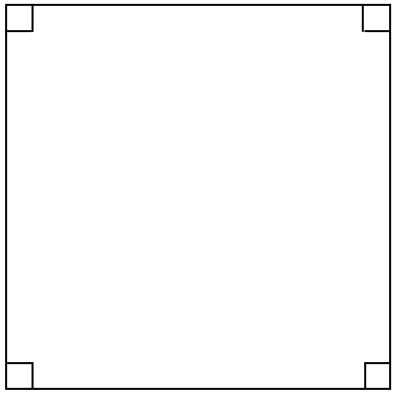
What other animals do you see in your school yard?

Corn GUDs Foraging Patch Assembly Instructions

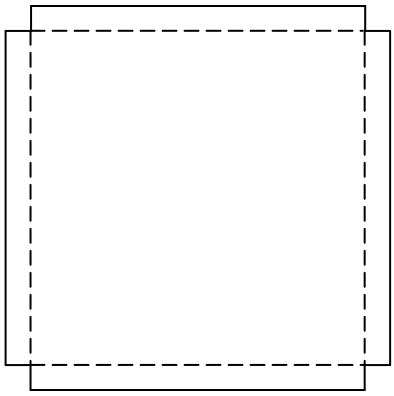
Materials per patch:

-cardboard square, 60 cm x 60 cm
-ruler
-pencil
-1 coarse-thread screw eye, 1" or longer
-utility knife or box cutter
-duct tape
-10 cm wire
-1 coarse-thread screw eye, 6" or longer

1. With a pencil, mark a 3 cm x 3 cm square on each corner of the 60 cm x 60 cm piece of cardboard.

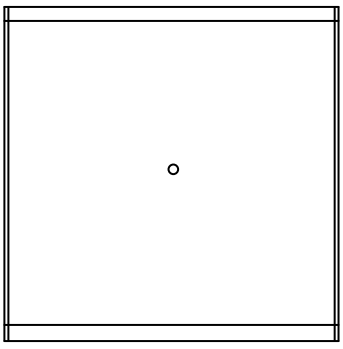


2. Carefully use a utility knife to remove the 3 cm x 3 cm squares. This should leave a 3 cm wide strip on each side of the large cardboard square.



3. Fold the 3 cm wide strips vertically, and secure the corners with duct tape. The assembled foraging patch should have a 3 cm tall lip on all four sides.

4. Mark the center of the assembled foraging patch with a pencil.



To set up the foraging patches in the schoolyard:

1. Since these patches are made out of cardboard, they will not work well on a rainy day. If it begins to rain after you have set patches up outside, bring them in to salvage the materials, or assemble new cardboard patches and start the setup over for a day of new data. If you make a patch out of wood, you can use it in any weather.

2. Twist a 1" screw eye into the bottom of each ear of corn. (This step should be completed after the initial mass of the corn has been recorded by students.)

3. Attach a 10cm piece of wire to the eye of the screw eye.

4. Take the assembled cardboard patch to the desired location. Twist a 6" screw eye through the middle of the cardboard patch to anchor the patch to the ground.

5. Attach the loose end of the 10cm piece of wire to the eye of the 6" screw eye to anchor the ear of corn to the center of the cardboard patch.

6. If desired, stake or weigh down the corners of the cardboard patch.

To collect foraging patches from the schoolyard at the end of the data collection period (at least 6 hours after the patch is placed in the schoolyard):

1. Unscrew the 1" screw eye from the bottom of the corn cob. Place the cob (with any remaining kernels) in a resealable bag labeled with the foraging patch location.

2. Unscrew the 6" screw eye from the ground.

3. Tilt the cardboard foraging patch slightly and pour all remaining corn fragments into the resealable bag.

4. Bring the foraging patch inside for the night.

Corn GUDs Data Collection Sheet

Investigator Names:

Hypothesized Habitat Type: (circle one)
Foraging Patch Location: (circle one)

	Safe	Unsafe
Near Tree		4m from Tree

Date: _____ **Day #** _____ **of data collection**

Time patch opened: _____ a.m./p.m. **Time patch closed**: _____ a.m./p.m.

Squirrel species observed in the schoolyard today:

- ☐ Grey Squirrel *Sciurus carolinensis* Number_____
- ☐ Fox Squirrel *Sciurus niger* Number_____
- ☐ Other _____ Number_____

Mass of corn cob (before foraging): _____g

Has feeding occurred today? (circle one) Yes / No

If yes, use the corn cob and all corn kernels (whole or in pieces) collected from the cardboard foraging patch to continue:

1. Set the corn cob to the side. Do not remove any kernels from the cob at this time.

2. Split the *remaining* corn into three piles:

   whole kernels kernels with excised embryos small pieces of kernels

3. Kernels with excised embryos and small pieces of kernels are the scraps of kernels that were nibbled on by squirrels. Find the masses of these two piles, and use them to calculate the total mass of corn kernel scraps left behind on the foraging patch:

 Mass of kernels with excised embryos (not on the cob):		 Mass of small pieces of kernels (not on the cob):		**Total mass of corn kernel scraps left behind on foraging patch:**
g	+	g	=	g

4. The squirrels may also have left behind kernels that are still whole, either attached to the cob or loose on the foraging patch. Remove the whole kernels from the cob and combine them with the pile of whole kernels that were loose on the foraging patch (already set aside during step 2).

5. Find the mass of this new pile that is made up of all of the whole corn kernels left behind by squirrels, either loose on the foraging patch or removed from the cob by you.

 **Total mass of all whole corn kernels left behind by squirrels**
g

6. Find the mass of the cob (with all kernels removed): _____g

Use the data collected to determine the mass of all corn that was consumed by squirrels:

Mass of corn consumed by squirrels: _____g

Corn GUDs Class Data Sheet

Location: safe; near tree			
Total corn consumed:		**Total corn kernel scraps:**	
Day 1:	g	Day 1:	g
Day 2:	g	Day 2:	g
Day 3:	g	Day 3:	g
Day 4:	g	Day 4:	g
Average:	g	**Average:**	g

Location: safe; 4 m from tree			
Total corn consumed:		**Total corn kernel scraps:**	
Day 1:	g	Day 1:	g
Day 2:	g	Day 2:	g
Day 3:	g	Day 3:	g
Day 4:	g	Day 4:	g
Average:	g	**Average:**	g

Location: unsafe; near tree			
Total corn consumed:		**Total corn kernel scraps:**	
Day 1:	g	Day 1:	g
Day 2:	g	Day 2:	g
Day 3:	g	Day 3:	g
Day 4:	g	Day 4:	g
Average:	g	**Average:**	g

Location: unsafe; 4 m from tree			
Total corn consumed:		**Total corn kernel scraps:**	
Day 1:	g	Day 1:	g
Day 2:	g	Day 2:	g
Day 3:	g	Day 3:	g
Day 4:	g	Day 4:	g
Average:	g	**Average:**	g

Corn GUDs Graph Sheet

Corn Kernel Scraps Left Behind by Squirrels			
NEAR	**FAR**	**NEAR**	**FAR**
SAFE		**UNSAFE**	

Corn Consumed by Squirrels			
NEAR	**FAR**	**NEAR**	**FAR**
SAFE		**UNSAFE**	

Using the data from the Class Data Sheet, create a bar graph showing the average amounts of corn scraps left behind by squirrels and a bar graph showing the average amounts of corn consumed by squirrels from each of the four foraging patches. Be sure to label the *y* axis for each graph.

Corn GUDs Data Analysis Sheet

Name: _____

1. **Use the graphs you created to compare squirrel feeding behavior in the safe location and the unsafe location.**

   In which location was more corn consumed? In which location did the squirrels leave behind more scraps? Explain.

2. **Use the graphs you created to compare squirrel feeding behavior near a tree and 4m from a tree.**

   In each location (safe; unsafe), where was more corn consumed, near the tree or 4m from the tree? What differences do you notice in the amount of scraps the squirrels left behind near the tree and 4m from the tree?

3. **Based on the data collected, are your hypotheses about the relative safety of each location supported or refuted? Explain.**

4. **Are there any interesting data that were surprising? Explain.**

   How do the "corn consumed" data compare to the "corn kernel scraps" data? Do the graphs look similar?

Corn GUDs Project Squirrel Reporting Sheet

Safe Location	Day 1		Day 2		Day 3		Day 4	
	SAFE	SAFE	SAFE	SAFE	SAFE	SAFE	SAFE	SAFE
	Near Tree	4m from Tree	Near Tree	4m from Tree	Near Tree	4m from Tree	Near Tree	4m from Tree
Date:								
Time patch opened:	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.
Time patch closed:	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.
For the following three rows, please provide an *estimate* of the number of squirrels in the schoolyard each day, based on the most common number of each species seen and recorded during students' observations. These three rows will not appear in the Data Reporting Sheet for the unsafe location, as the numbers you record here are an estimate of the number of squirrels seen by students from any one location in the schoolyard.								
# of gray squirrels observed:								
# of fox squirrels observed:								
# of other squirrels observed (note species):								
Did feeding occur?	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No
Initial mass of cob (before foraging):	g	g	g	g	g	g	g	g
Mass of kernels with excised embryos:	g	g	g	g	g	g	g	g
Mass of small pieces of kernels:	g	g	g	g	g	g	g	g
Total mass of whole kernels left behind (loose or on cob):	g	g	g	g	g	g	g	g

Use students' completed Data Collection Sheets to compile information from each group before submitting the data to Project Squirrel.

Corn GUDs Project Squirrel Reporting Sheet

	Day 1		Day 2		Day 3		Day 4	
	UNSAFE	**UNSAFE**	**UNSAFE**	**UNSAFE**	**UNSAFE**	**UNSAFE**	**UNSAFE**	**UNSAFE**
	Near Tree	**4m from Tree**	**Near Tree**	**4m from Tree**	**Near Tree**	**4m from Tree**	**Near Tree**	**4m from Tree**
Date:								
Time patch opened:	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.
Time patch closed:	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.	a.m. p.m.
Did feeding occur?	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No	Yes or No
Initial mass of cob (before foraging):	g	g	g	g	g	g	g	g
Mass of kernels with excised embryos:	g	g	g	g	g	g	g	g
Mass of small pieces of kernels:	g	g	g	g	g	g	g	g
Total mass of all whole kernels left behind (loose or on cob):	g	g	g	g	g	g	g	g

Use students' completed Data Collection Sheets to compile information from each group before submitting the data to Project Squirrel.

Sunflower Seeds GUDs Data Collection Sheet

Investigator Name:

Site location name (if working multiple sites)**:**

Hypothesized Habitat Type: (circle one)
Foraging Patch Location: (circle one)

	Safe	Unsafe
Near Tree		
4m from Tree		

Date: _____**Day #** _____ **of data collection**

Time patch opened: _____ a.m./p.m. **Time patch closed**: _____ a.m./p.m.

Squirrel species observed in the schoolyard today:

- ☐ Grey Squirrel *Sciurus carolinensis* Number_____
- ☐ Fox Squirrel *Sciurus niger* Number_____
- ☐ Other _____ Number_____

Mass of sunflower seeds *BEFORE* foraging: _____g

Mass of sunflower seeds *AFTER* foraging: _____g

Has feeding occurred today? (circle one) Yes / No