Do Different Seed-Eating Animals Choose Different Types of Seeds?

Submitted by: Maggie Douglas, Pennsylvania State University, Department of Entomology

Grade levels targeted: 7 - 9

National Science Standards addressed by the activity:

- Populations and ecosystems, Regulation and behavior, Diversity and adaptations of organisms
- Understanding about scientific inquiry, Abilities necessary to do scientific inquiry

Entomology Literacy Elements and supporting concepts addressed by the activity:

- Explain how insects provide environmental services to humans
  - Insects are important in terrestrial and freshwater food webs
- Understand and provide examples of insects' economic value
  - Natural enemies are used for biological control of pest insects and plants

Observations:

Many plants reproduce by making and spreading seeds. Some of these plants are weeds that are troubling for us because they compete with the plants we grow for food. Weeds often produce many seeds but only a small number survive – what happens to the rest? It turns out that many seeds are eaten by animals before they have a chance to sprout. In fact, scientists have estimated that seed-eating animals eat up to 80-90% of all seeds that reach the soil surface! Seeds are eaten by different kinds of animals including insects (e.g. ants, ground beetles, and crickets) and larger animals such as mice and birds (Fig. 1 to 5). Weed problems would be much worse without these weed seed eaters.

Question: Do different types of seed-eating animals choose different types of seeds?

Hints to form the hypothesis:

Think about some of the animals that might eat seeds: ants, crickets, ground beetles, mice, and birds. How are they different from one another? What factors might limit which foods they can eat? What qualities in a seed would be attractive to them? How might they search for their food?

Hypothesis:

Larger animals like mice and birds will choose larger seeds, while smaller insects like ants, crickets, and ground beetles will choose smaller seeds.

Materials:

- **For seed assays:**
  - 10 small petri dishes or round lids from plastic containers (e.g. yogurt container lids)
  - Heavy duty double-sided tape (e.g. double-sided carpet tape from a hardware store, or heavy duty Scotch ® double-sided tape)

- Large seeds (such as whole sunflower seeds from the bird section of a pet store)
- Small seeds (such as radish, broccoli, or locally-collected weed seeds if they are available at the time)
- A small amount of dry dirt or sand (sand is better if your seeds are dark-colored)

- **For exclusion cages:**
- 5 basket-style strawberry pint containers* (Fig. 6)
- Old coat hangers, cut into pieces 5-6 inches long and folded in half (you will need 10 of these)

*****If these containers are not easy to come by in your area, other materials could be used to construct a cage. For instance, 0.5 inch metal mesh (available at hardware stores) can be made into a cylindrical cage (Fig. 7). Or, plastic containers could be cut to make slits big enough for insects to pass through but not mice or birds.

The Experiment:

1. Flip the petri dish (or container lid) over and apply double-sided tape to the surface. You may need to trim the tape so that it fits onto the dish or lid neatly.
2. Count out 40 small seeds and 10 large seeds for each of the 10 petri dishes.
3. Place the seeds on the sticky tape and sprinkle lightly with dirt or sand to cover up the rest of the sticky surface. These are your seed assays. (Figs. 8 and 9)
4. Find an area for your experiment. This could be a nearby garden or farm, but could also be in landscaping or a lawn. It just needs to be a place where the seed assays can lie flat.
5. Choose five spots in your area, separated by 10 paces or so. In each spot you will place one "open" assay and one "caged" assay. The caged assays will allow only insects to enter, while the open assays will allow both insects and larger animals to enter.
6. If you are using petri dishes, push or turn them into the soil so that the top of the dish is even with the soil surface. If you are using plastic container tops, you may need to push a nail through them into the soil to hold the seed assays in place.
7. Put cages over one of the assays at each spot and fasten them down at the bottom with the metal "anchors" made from the clothes hangers. Push the anchors into the soil.
8. Wait about one week and then collect up your seed assays. Count and record the number of large and small seeds remaining on each one – look closely! (Table 1) Calculate the average percentage of large and small seeds that were eaten in the caged versus uncaged cards (Appendix 1).

Results:

- Create a bar graph to compare the percentage of large and small seeds that were eaten in the caged versus open seed assays (Fig. 10).

Discussion:

- Interpret the graph. Was your hypothesis correct? What did you learn about insects versus other seed-eating animals? Remember that the caged assays allowed only insects to enter while the uncaged assays allowed both insects AND other animals to enter.
- Did animals eat many of the seeds? What features of your area might encourage or discourage these animals? (*Hint*: think about amount of food and shelter nearby)

- What do you think gardeners and farmers can do to encourage weed seed eaters? Are there any reasons why they might *not* want to encourage weed seed eaters?
- Do you think it is important to conserve different types of weed seed eaters? Why or why not?

Expanding the project:

- Instead of comparing caged versus uncaged seed predation, students could compare seed predation in different environments (grass versus a garden, forest versus field, etc.).
- Students could use pitfall traps (cups sunk in the ground and filled with water or antifreeze) to learn which insect seed predators are present in the area during the same time that seed assays are out.
- Students could also use empty pitfall traps to collect live seed eaters, and present them with a seed "cafeteria" to see which seeds they like the best.
- Students could repeat the activity at different times of year or during different phases of the moon. Some research indicates that mice, for instance, are less active during full moons because their own predators are active when there is a lot of moonlight.
- This activity would be especially suitable in a school or home garden where students could better think about the importance of seed predation to control weeds.

Resources:

"Weed Seed Predators: Potential Contributors to Weed Control" –

http://aee.psu.edu/ag-educators/resources/weed-management/potential-contributors/view

"Promoting Weed Seed Predation and Decay" - http://www.extension.org/pages/18544/promoting-weed-seed-predation-and-decay

"Weed seed predation in agricultural fields" - http://www.weeds.iastate.edu/mgmt/2006/seedpredators.shtml

"Ground and Tiger Beetles (Coleoptera: Carabidae)" - http://ento.psu.edu/extension/factsheets/ground-beetles

Estimated time required:

- Experiment spans one week
- 1-2 hours to set up the experiment
- 3-4 hours to collect and analyze results
- Additional time for discussion

Estimated cost: ~ $20 - $40

Contact: Maggie Douglas,mrd276@psu.edu - please contact me with any questions or comments on this activity!

Figure 1: Ants (Order Hymenoptera: Family Formicidae)

Source: Brian Valentine, http://www.anthillwood.co.uk/antfood.htm

Figure 2: A ground beetle (Order Coleoptera: Family Carabidae)

Source: http://creamridge.rutgers.edu/multi/img_coleoptera.shtml

Figure 3: A cricket (Order Orthoptera: Family Gryllidae)

Source: http://www.ccs.neu.edu/home/fell/insects.html

Figure 4: A mouse

Source: http://www.flickr.com/photos/tomhensr/2461564757/

Figure 5: A blackbird

Source: http://setiathome.berkeley.edu/forum_thread.php?id=47596

Figure 6: Strawberry container to use as an exclusion cage

Source: http://www.socontainers.com/PICS_10-17-10/RECTANGLE%20PINT%20GREEN%20PLASTIC%20BASKET.jpg

Figure 7: A cage made out of wire mesh

Source: Maggie Douglas

Figure 8: A petri dish with double sided tape and seeds attached

Source: Maggie Douglas

Figure 9: The same petri dish with dirt sprinkled on to cover up the sticky surface

Source: Maggie Douglas

Figure 10: An example of a bar graph of the results

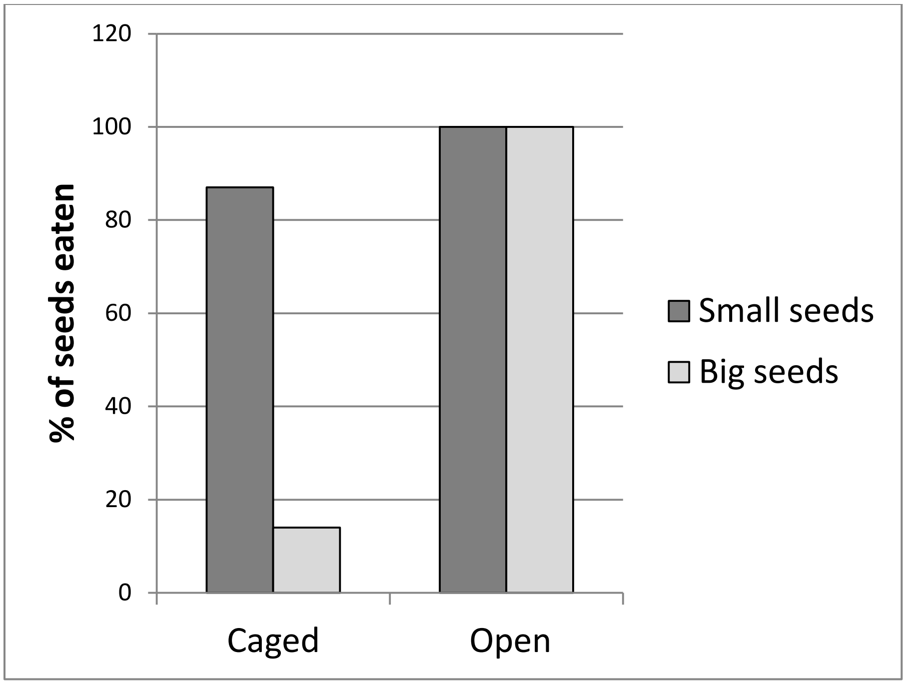

Table 1: Sample data and calculation sheet

Seed assay	# small seeds left	# big seeds left
Caged 1		
Caged 2		
Caged 3		
Caged 4		
Caged 5		
TOTAL		

Seed assay	# small seeds left	# big seeds left
Open 1		
Open 2		
Open 3		
Open 4		
Open 5		
TOTAL		

Appendix 1: How to calculate the % of seeds eaten

EXAMPLE:

Say that 15 small seeds were left in the five caged assays (total).

Average # of seeds left = 15 seeds ÷ 5 assays = 3 seeds left/assay

Average # of seeds eaten = 10 starting seeds – 3 seeds left = 7 seeds eaten

Average percentage of seeds eaten = (7 seeds eaten ÷ 10 starting seeds) X 100 = 70% seeds eaten