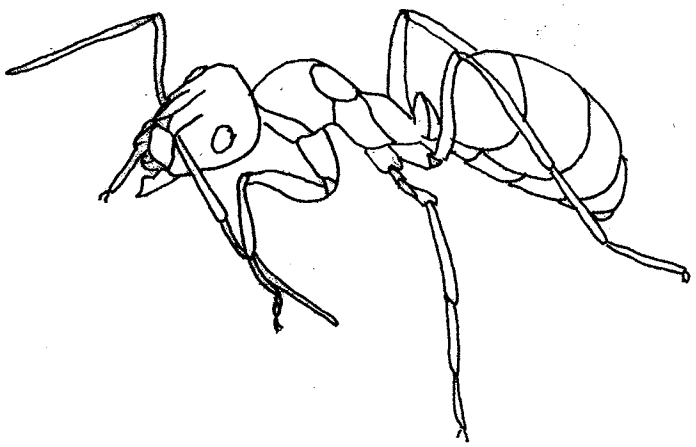
Ant food choice experiment

BEES Program
(Biology Experiences for Elementary Students)



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Ant food choice experiment
Grade level = any
Grades 1-2: use 2 foods
Grades 3 and over: can use 3 (or 4) foods

Overview: This life science unit allows students to individually design and run a simple experiment. The basic set-up for the experiment is the same for all students, but the choice of foods or materials to test with ants is chosen by each student. The materials are simple (e.g., a square sheet of cardstock) and the experiment is designed to be run in the schoolyard. This experiment cannot be done during winter or rain.

This experiment will take place over parts of two 30-45 minute sessions – with time between for ants to find the experiment. In the first session, the experiment is, we gather data and interpret results. Time is allowed for ants to find the experiments

Relevant Science Objectives

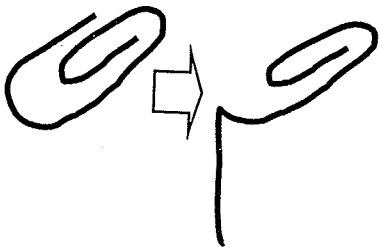
- Oklahoma PASS Science objectives
  - Science Processes and Inquiry (designing, carrying out and analyzing an experiment)
  - Life Science

Background

Ants live in colonies composed primarily of females. Most ants are workers. Workers perform a variety of tasks, including nest maintenance, care of young, nest defense, and collecting food. Most ants are omnivorous (eat a variety of foods) and are opportunistic (will collect any potential foods they find).

In this experiment, each student will put out bits of 2 or 3 types of food and count the number of ants attracted to each food type. Everyone in the class could potentially run a different experiment. Students in younger grades can work in pairs.

Materials:



- provided by BEES
  - cardstock squares
  - paperclip 'stakes'
  - data books for students
  - food items (e.g., peanut butter, jelly, ketchup)
  - 'I'm an ant scientist' stickers
- provided by classroom or students
  - rulers
  - pencils
  - (optional) a SMALL amount (about 1 teaspoon) of food for choice tests
    - school lunch items or students bring items from home
  - (outside) trash can to dispose of used cardstock

Specific goals of the program:

1. Let students run unique food choice experiments with ants.
2. Have students understand that they are doing all the steps in doing scientific research (i.e., background knowledge, generating a hypothesis, collecting replicated data, data analysis, and drawing conclusions based on results).
3. Teach students an experimental design (Latin squares lay-out) and discuss other types of research that might use this design. Also discuss why there is variation in the data.

Starting the program: Question & Answer group session

Have the students stay at their desks because they will need to work on a worksheet and fill in data sheets. As a class, ask students a series of questions:

1. What do you like to eat?
2. If given a choice, which would you choose: an orange or a piece of bread?
   (or use other foods as choices)
3. Now you can tell me what you like, but how can you tell what animals like the best?
   (think of your pets)
4. (hopeful answer): let them choose

5. Let's try a choice test.
6. Select 3 student volunteers.
7. Have each volunteer write the name of their favorite food on the board (note: all three foods must be different). Students stand near their 'food'.
8. Have the other students, volunteers and teacher vote on their favorite food among the three foods on the board.
9. Have the volunteers count the votes and record the vote under the written food.
   - (note: if appropriate: make graphs)
   - Is there a difference among the foods?
   - Ask if these are everyone's favorite foods.

10. We're big and our foods are small enough that we can see them all and choose among them. You are going to try and figure out what ants like. Ants are very small, so they may not be able to see all the choices.

11. So.... We want to design buffet table with the (2 or 3) foods so that the ants have an equal chance of finding any food first.

12. How many of you have ever played Sudoku?
    This is a type of puzzle that uses patterns of numbers.
13. We're going to play a similar game called 'Latin squares'

(Hand out the Latin squares exercise sheet – one per student. Note: The sheets should be modified for use in younger grades by deleting the 4x4 squares.)

14. The rules to Latin squares are simple.
    - The grids have an equal number of rows and columns.
    - Count the number of rows (or columns).
        - This is how many foods you can test on that pattern (e.g., a 3x3 grid tests 3 foods)
        - This is also the limit to the numbers used to fill the grid.
            - e.g., if 3 columns, use numbers 1, 2, and 3.
    - Each number can only occur once in each row and in each column.
    - There may be a number of equally good solutions.

1	2
2	1

15. Let's play Latin squares. (use worksheets; or do this on the board if time is limited)
16. Let's start with the 2x2 grid (also do this one on the board).
    - What should I put in this square (a 1 or a 2)?
    - continue on…..
    - Repeat, starting with the opposite number. (2 instead of 1 or vice versa).
    - Note that there are 2 solutions.

2	1
1	2

17. Now do the 3x3 grid.
    - Do the 1st grid together and the 2nd grid individually, if time permits.
18. Look at the pattern. No matter which side an ant approaches the buffet (grid), it will have equal access to all the types of food.
19. Have the students fill in one of the 2x2 and 3x3 Latin square patterns on the hand-out sheet. (The 4x4 patterns are optional and can be done individually.)

20. Now you're ready to start setting up your experiment. Students can test 2 (use a 2x2 grid) or 3 (3x3 grid) foods.

    Here are some examples of foods: (Note: we use about 8 different foods, so students have a choice; but we also try to have all foods represented)
    - use foods from a meal (e.g., the school lunch)
    - use easy-to-use packaged foods (tuna, peanut butter, jams, honey, yogurt)
    - slice up fruits
    - test foods and altered foods
        - add salt, sugar, pepper, cinnamon, vanilla and other flavorings

21. Briefly go over the experiment. (You will test your foods on a Latin square grid and you have just designed the grid that you need. We'll go outside to do this, but first, we need to get everything ready).

22. Hand out the data notebooks and have students start filling them in (name, date, foods to test)
    - What foods will you test? Every student needs to select 2 (or 3) foods. (List the selection of foods on the board). Every student (or student pair) makes their own choices.

- Students list their foods to their notebooks.
- Students fill out their foods on the Latin square grid in their notebooks, using foods instead of numbers.

23. Each student needs to transfer their Latin square design from their grid to the cardstock square.
    - First, draw the grid on the cardstock.
        - provide guidance, if needed. (An example of a pre-gridded paper is helpful)
    - Next, copy your Latin pattern onto the cardstock, using foods – not numbers (have an example of this also, but use foods that are not available, so that students will not copy them: e.g., sardines and corn).

2	1	3
1	3	2
3	2	1

24. Before heading outside, make sure that students bring the following:
    - data book
    - pencil
    - cardstock grids
    - paperclip 'stakes
    - as a class: food items (except those provided by BEES)

25. Let students select locations within a designated area. Suggest that they spread out.
    - STAKE OUT THE GRIDS BEFORE ADDING FOODS (to avoid a big mess).
    - Add the foods. Add the same, **small** amount of food to the centers of each square. DO NOT cover the squares!

Leave the experiment out for as long as feasible. If there are lots of ants around, 30 minutes may be enough.

26. Check the experiment. Count all the ants feeding in each square. Record the counts on a datasheet in your notebook, using the corresponding grids.

CLEAN-UP:
- Save the paper clips 'stakes' – these can be re-used (after rinsing and drying). There will be a 'used' paperclip container.
- Students need to blow off ALL the ants from the cardstock at the site of their experiment (so the ants can return to their nests).
- After the ants are off, students throw away the cardstock experiment. A trash can at the site of the experiment is extremely helpful for this!!

Return to the classroom

27. Analysis. Count up all the ants feeding at each of the foods at the end of the experiment.

Depending on the level of the students, data can be represented as
- totals only

- graphed on a number line
- graphed as bars on graph paper

(note: a number line and unlabeled graph paper are in the data book)

28. Class discussion of results
    - Who got ants?
    - Did anyone not get any ants?
        - Why did some people get ants and others didn't?
        - Why did the number of ants differ among experiments? (Let students answer, but here are some possibilities)
            - factors affecting ants may be:
                - closeness of experiments
                    - especially if neither of a student's foods were preferred
                - distance to an ant nest
                - type of ants
                - whether or not cardstock touches the ground
            - other factors: weather (current and past)
    - Make a list of all the foods on the blackboard, with 2 additional columns – for 'like' and 'didn't like'
        - Ask each group to give the food with the most ants (liked) and least ants (didn't like) and keep tally on the blackboard
    - What foods did ants like? (write a list on the board)
    - What foods did ants not like? (write a list on the board)
        - Are there any foods in both lists?
    - Did you correctly predict which food the ants preferred? (have someone count raised hands)

29. Nutritional quality of foods (for older students; especially if using foods with nutritional labels)
    - Examine the nutritional labels of the selected foods. Determine which foods are high in fats, protein, and carbohydrates (or sugars, because everyone 'knows' that sugar is the preferred food of ants).
    - Note foods that are high in fats, protein, sugars and salt* on the board.
        - Compare preferred foods with the major nutritional component(s).
            - What nutrients do ants prefer?
    - *Note: some ants seek salt, so salt might be a confounding factor (especially for canned meats, such as tuna, and possibly peanut butter). An option is to bring salt and try salted versus unsalted foods.

30. How could this information be used?
    - baits for ant traps or lures to get ants away (from your house)
    - ant repellants?
    - ant food for ant farms.

31. Can you think of another experiment that you could use a Latin square design for?
    - testing food choice in other animals
    - testing nesting materials chosen by birds
    - crop experiments (where there might be a difference in wind or other conditions around the edges

Note: it's good to count other insects attracted to the experiment.
    - How can you tell if an insect is attracted or is just passing through (and maybe stopping for a rest)?
        - (if it occurs more frequently on food(s) than in the surrounding area, it is probably attracted.
    - Do all the attracted insects like the same foods?

Have students and the teacher fill out questionnaires. Each student receives an 'I'm an ant scientist' sticker.

Latin square patterns

Name _____