# "I Walk the Line!": The Termite Activity Revisited

**Submitted by:** Robert W. Matthews

**Grade:** Can be adapted to all levels, kindergarten to college

**Background and instructional objectives:**

For over 40 years biologists have known that termites will follow ink lines drawn by some ballpoint pens, like little trains on tracks. Over the years, the phenomenon has been recounted many times in science education materials, but both printed and on-line materials have come to include a great deal of redundant, sometimes conflicting, and occasionally highly inaccurate information about this behavior. Posted and published classroom activities range from many "gee whiz" demonstrations and cookbook-style confirmations of the phenomenon to a few inquiry-based investigations.

A fundamental goal of current science education efforts is to provide authentic hands-on inquiry-driven experiences that encourage students to think and act like scientists. Because termite trail-following behaviors are reliable and adaptable to student instruction at many levels, it is worth revisiting this activity to strengthen its potential for engaging students with real science.

Specifically, it is important to approach this activity in inquiry-driven ways that will help students:

- Observe the behavior of termites and make logical inferences about its causes
- Identify variables
- Design and conduct controlled experiments to gain a deeper understanding of termite behavior
- Analyze and discuss experimental data
- Apply knowledge and understanding of trail-following behavior to ecological and evolutionary adaptations of termites and by extension to other animals as well

**What you will need for this activity:**

- Termites. These can be ordered from Carolina Biological Supply or other biological supply firms, or obtained locally. Keep them in a Petri® dish or other small, shallow container with a moist paper towel to maintain necessary humidity.
- Several types and brands of pens, pencils, crayons, or other markers. Mix together in a bowl or bucket so students will select them randomly.
- White copy paper. One sheet per student or working group.

- Small soft bristle paint brushes, or pipe cleaners for students to use to move termites about on the paper and to transfer to and from the holding container.

**Advance preparation:** Order termites to arrive up to a week prior to scheduled activity and keep them moist (not wet) at room temperature.

**How to do the activity:**

Students can work individually, in pairs, or in small groups. Give each a sheet of plain white copy paper. Without necessarily identifying the insects as termites initially, dispense several workers onto the paper. Demonstrate how to handle and transfer termites carefully with a soft brush. Allow students to observe the termites' behavior for 2-4 minutes. Then return termites to the holding container and discuss what was observed. [Termites appear to wander about blindly or randomly.] Identify insects as termites and, in the process, elicit what students know about termite biology and answer any questions. [Responses will probably include that termites eat wood, are social insects, live in colonies, live in the ground in the dark, etc.]

Pass around a container with a variety of colors and brands of various pens. Have each student or group choose and take one, and use it to draw an approximately 3-inch diameter circle (baseball size; be sure the ends are connected) on their paper. Then dispense the same termites into the center of the circle. Observe and record the termite's behavior.

After 2-5 minutes again return termites to the holding container. Discuss what was observed. Did termites cross the line and leave the circle surrounding them? [Answers will vary; on some papers some termites will have followed the circle, while on others the circle was ignored.] What was different? Guide students to notice they used different kinds and colors of writing implements. Compile a quick tally of which types of writing tools and colors were associated with different specific behaviors observed. Adapt and lead discussion accordingly.

Guide students to design and then conduct one or more controlled experiments to investigate various specific hypotheses about the causes of trail following. Stress the need to systematically consider all possible alternative causes of trail following and to progressively exclude competing factors. For example other sensory input (vision, touch, sound, etc.) must be eliminated as well as extraneous variables such as light cues. Decisions about experimental procedures, how and what to quantify and record, number of replications, form of data analysis and presentation organization, etc. are part of the teacher-guided inquiry process.

At the conclusion of the experiments, assess whether learning goals were met. One way to do this is through a formal written or Powerpoint presentation by each group.

**Correspondence with National Science Standards (by grade in school):**

Science standards for every state as well as the National Science Standards can be found at http://www.carolina.com/category/teacher+resources/correlations+to+educational+standards.do
Specific National Science Standards that may be met by this activity include:

K–4 Content Standard A: Science as Inquiry
• Develop abilities to do scientific inquiry and understanding about scientific inquiry

K–4 Content Standard C: Life Science
•The characteristics of organisms

•Abilities necessary to do scientific inquiry
•Understanding about scientific inquiry

5–8 Content Standard C: Life Science
•Structure and functions in living systems
•Regulation and behavior

•Diversity and adaptations of organisms

9–12 Content Standard A: Science as Inquiry
•Abilities necessary to do scientific inquiry
•Understanding about scientific inquiry

9–12 Content Standard C: Life Science
•Behavior of organisms

**Integrated Curriculum:** Possible tie-ins exist with math (e.g., measuring, quantifying, and graphing) and chemistry (e.g., evaporation coefficients, pheromone chemistry).

**Teacher Resources:**

Callis, K., Henkel, M., and R. Lund. 2009. Magic termites: exploring scientific inquiry. *Science Scope* March 2010, pp. 61-66.

Chen, J., Henderson, G., Laine, R. A. 1998. Isolation and identification of 2 phenoxyethanol from a ballpoint pen ink, a trail following substance of *Coptotermes formosanus* Shiriki and *Reticulotermes* sp. *Journal of Entomological Science* 33:97-105.

Johnson, A. D. 2009. *40 Inquiry Exercises for the College Biology Lab*. NSTA Press, Washington, DC. (Chap. 1, pp. 3-18, "A brief introduction to inquiry", Unit 1. "Designing Scientific Experiments", pp. 97-105.

Shanholtzer, S. F. and M. E. Fanning. 1991. Termites and the scientific method. Page 195, In: *Tested studies for laboratory teaching*. Volume 12. (C. A. Goldman, Editor). Proceedings of the 12th Workshop/Conference of the Association for Biology Laboratory Education (ABLE), 218 pages

Tillberg, C. V., Breed, M. D. and S. J. Hinners. 2007. Pheromones. Chapter 11, pp. 129-132. In: *Field and Laboratory Exercises in Animal Behavior*. Elsevier Academic Press, New York.

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