



## *Termite Behavior: Running in circles!*

Dear Educator,

Thank you for participating in the Virtual Outreach Program at Michigan State University Museum. In the pages that follow, we have assembled resources that we thought would be useful for you in getting ready for this virtual fieldtrip. You will find detailed instructions about the tasks that must be performed before the virtual field trip begins, useful information about the program, curriculum benchmarks addressed by the fieldtrip, a jeopardy game designed by our team to assess students following the fieldtrip, and suggestions of follow-up activities to reinforce the concepts discussed in the fieldtrip.

Our IP address is **35.8.122.60**. If you have any questions, please feel free to get in touch with us at [virtualoutreach@museum.msu.edu](mailto:virtualoutreach@museum.msu.edu) or call us at (517) 353-3882. We are looking forward to the fieldtrip with you and your class!

This program is a LADDERS program:

LADDERS is a platform that exercises inquiry-based science teaching. This is done using virtual fieldtrips where students are exposed to museum resources that connect them to real science and real scientists. Using videoconferencing technology, you and your students have the opportunity to visit Michigan State University Museum, a Smithsonian Affiliate and Michigan's largest natural history/cultural museum. Learn more about LADDERS on our website!

<http://laddersprogram.org>.

Preparations: What to do before the virtual fieldtrip!

- 5 days before the fieldtrip: You will need to order termites; in the following pages, you will find all the information on where to call to order termites. Termites take about 3 days to be delivered to your school, but plan early!!
- 1 day before the fieldtrip: Get all materials ready: see the list of what you will need in the following pages.
- The day of the fieldtrip: Prepare the room and get all material ready on each table; it's best if students are seated in groups of 3 or 4 per table.

Description of the virtual fieldtrip program

Termites will actually follow the trail of certain pens, but not all pens. Why is that so? Is it because termites prefer red ink? Or blue ink? Do they just like to follow circles? Or is it the crease made in the paper by the writing instruments that termites follow? Students will answer those questions and solve this mystery of what termites follow by designing their own experiments and applying scientific thinking to this problem.

Objectives of the program: Students will

- Explore the scientific method by observing termite behavior
- Develop a sense of inquiry
- Understand how to answer questions using experiments

Materials you need for the virtual field trip:

The following supplies will help make the virtual trip a successful experience for your students:

- Termites (ordered from the Carolina Biological Supply Company – see information below)
- Paper (at least 3 sheets per pair of students)
- Papermate brand pens of different colors (the brand is important!): we recommend that each table/group of students can have at least 2 Papermate pens of different colors (i.e. one red and one black pen)
- Smelly markers (at least 2 markers per table of students)
- Pencils (at least 1 per pair)
- Other types of pens, at least 5 per table
- Paintbrushes to grab the termites
- Timers (1 per group) – optional but recommended so that students can time behaviors

For the success of this program, it is important that students have a **variety of writing instruments** to work with.

Ordering termites before the virtual field trip (5 days before!):

You can order termites by going through the following company:

Carolina Biological Supply Company  
2700 York Rd.  
Burlington, NC 27215-3398  
Telephone for Orders: 1-800-334-5551  
When calling for orders:  
On the first menu, press 1  
On the second menu, press 1 again  
You should get a sale representative right there.

We suggest you purchase 1 pack of 25 termites (\$14.50; item #143734). They take a few days to deliver. If you have several classes that will do this program and/or you would like to order more termites, packs of 100 termites (\$27.95; item #143736) are also available.

The termites will usually last a week or two in a container if they have some wood and a moist paper towel (which needs to be wetted every few days). They keep best if placed in a dark place. Because you will only be working with worker termites (and not queens), there is no danger of

any damage to your school walls – these termites would not survive well without the structure of their colony and their queen. To dispose of your termites humanely after you are done with your unit, we suggest placing the termite container in the freezer for 4 hours.

Termite Background Information:

Eastern termites (scientific name: *Reticulotermes flavipes*) are small, soft bodied, usually pale-colored insects. They live in colonies in the ground or in wood, and are part of a social caste system. Their food consists primarily of wood or other vegetable material. The workers are sterile and lack compound eyes. To communicate, termites use chemicals (called pheromones) that they can leave on a substrate; different pheromones convey different messages. Workers do the main work of the colony - collecting food, feeding the queen, soldiers, and young as well as constructing galleries. Termites can cause considerable damage to buildings, furniture, utility poles, fence posts, and other materials. However, termites are also important decomposers breaking down dead trees and other plant materials into nutrients useful to plants. The cellulose in the termite's food is digested by microorganisms (called protists) living in the termite's digestive tract. This association is an excellent example of symbiosis.

Useful definitions: (from biology-online.org)

- Pheromone: A chemical substance secreted externally by some animals (especially insects) that influences the physiology or behavior of other animals of the same species; this chemical is used as a method of communication. Examples include pheromones present in dog urine which marks its territory or can also be used in organisms to attract a mate of the opposite sex.
- Symbiosis: The relation between two different species of organisms that are interdependent; each gains benefits from the presence of the other. An example is the hermit crab whose shell offers a niche for anemones to exist; the anemones can defend the crab in return with their stinging capabilities.

Michigan Science Curriculum benchmarks addressed by this fieldtrip:

Discipline 1: Science Processes (S)

Standard: Inquiry Process (IP)

Standard: Inquiry Analysis and Communication (IA)

Standard: Reflection and Social Implications (S.RS)

Discipline 3: Life Science (L)

Standard: Evolution (EV)

Standard: Ecosystems (EC)

(see next page for a detailed outline of the benchmarks addressed for each grade level)

## Benchmarks addressed by this field trip

### **GRADE 4 – MICHIGAN SCIENCE CURRICULUM BENCHMARKS:**

#### Discipline 1: Science Processes (S)

##### Standard: Inquiry Process (IP)

- S.IP.04.11: Make purposeful observation of the natural world using the appropriate senses
- S.IP.04.12: Generate questions based on observations
- S.IP.04.13: Plan and conduct simple and fair investigations
- S.IP.04.14: Manipulate simple tools that aid observation and data collection

##### Standard: Inquiry Analysis and Communication (IA)

- S.IA.04.12: Share ideas about science through purposeful conversation in collaborative groups
- S.IA.04.13: Communicate and present findings of observations and investigations
- S.IA.04.14: Develop research strategies and skills for information gathering and problem solving
- S.IA.04.15: Compare and contrast sets of data from multiple trials of a science investigation to explain reasons for differences

##### Standard: Reflection and Social Implications (S.RS)

- S.RS.04.14: Use data/samples as evidence to separate fact from opinion
- S.RS.04.15: Use evidence when communicating scientific ideas

#### Discipline 3: Life Science (L)

##### Standard: Evolution (EV)

- L.EV.04.21: Identify individual differences in organisms of the same kind

##### Standard: Ecosystems (EC)

- L.EC.04.11: Identify organisms as part of a food chain or food web

### **GRADE 5 – MICHIGAN SCIENCE CURRICULUM BENCHMARKS:**

#### Discipline 1: Science Processes (S)

##### Standard: Inquiry Process (IP)

- S.IP.05.11: Generate scientific questions based on observations, investigations, and research
- S.IP.05.12: Design and conduct scientific investigations
- S.IP.05.13: Use tools and equipment appropriate to scientific investigations
- S.IP.05.16: Identify patterns in data

##### Standard: Inquiry Analysis and Communication (IA)

- S.IA.05.12: Evaluate data, claims, and personal knowledge through collaborative science discourse
- S.IA.05.13: Communicate and defend findings of observations and investigations using evidence
- S.IA.05.14: Draw conclusions from sets of data from multiple trials of a scientific investigation
- S.IA.05.15: Use multiple sources of information to evaluate strengths and weaknesses of claims, arguments, or data.

##### Standard: Reflection and Social Implications (S.RS)

- S.RS.05.11: Evaluate the strengths and weaknesses of claims, arguments, and data
- S.RS.05.12: Describe the limitations in personal and scientific knowledge
- S.RS.05.13: Identify the need for evidence in making scientific decisions

#### Discipline 3: Life Science (L)

##### Standard: Evolution (EV)

- L.EV.05.11: Explain how behavioral characteristics of animals help them to survive in their environment
- L.EV.05.12: Describe the physical characteristics of organisms that help them survive in their environment.

### **GRADES 6 AND 7 – MICHIGAN SCIENCE CURRICULUM BENCHMARKS:**

#### Discipline 1: Science Processes (S)

##### Standard: Inquiry Process (IP)

- S.IP.06/7.11: Generate scientific questions based on observations, investigations, and research
- S.IP.06/7.12: Design and conduct scientific investigations
- S.IP.06/7.13: Use tools and equipment appropriate to scientific investigations
- S.IP.06/7.16: Identify patterns in data

##### Standard: Inquiry Analysis and Communication (IA)

- S.IA.06/7.12: Evaluate data, claims, and personal knowledge through collaborative science discourse
- S.IA.06/7.13: Communicate and defend findings of observations and investigations using evidence
- S.IA.06/7.14: Draw conclusions from sets of data from multiple trials of a scientific investigation
- S.IA.06/7.15: Use multiple sources of information to evaluate strengths and weaknesses of claims, arguments or data

##### Standard: Reflection and Social Implications (S.RS)

- S.RS.06/7.11: Evaluate the strengths and weaknesses of claims, arguments, and data
- S.RS.06/7.12: Describe the limitations in personal and scientific knowledge
- S.RS.06/7.13: Identify the need for evidence in making scientific decisions

## Resources for teachers

### Activities designed by LADDERS that can help reinforce the concepts of the program:

- **Watch the video “Meet the scientists”** to meet a researcher, Dr. Chris DiFonzo, who works on insects at Michigan State University. Dr. DiFonzo is interviewed by a middle-school student. This video is posted on the TeacherTube website at this link: [http://www.teachertube.com/view\\_video.php?viewkey=ab04b259284d19740165](http://www.teachertube.com/view_video.php?viewkey=ab04b259284d19740165)
- **Let students ask questions directly to scientists on our blog discussion group:** This internet bulletin board allows students to post their own questions, participate in ongoing discussions, see questions and comments from other middle school students that also participated in this activity. We also encourage any educators to use this to connect with other teachers and provide us with feedback. Scientists studying evolution will answer the students questions so that the students are directly in contact with real science. Log in at: <http://laddersprogram.blogspot.com/>
- **Play the Termite Jeopardy Game:** This game was developed by our LADDERS team to evaluate how well the students understood the concepts presented specifically in this program. The game follows the general rule of a jeopardy game, and includes questions of varying difficulties about designing experiments, termite behavior, and insect communication. We also have an interactive Powerpoint version of this jeopardy game available on our website that you can download (<http://laddersprogram.org>). You can also post your class’s results on the blog discussion group and compete with other schools.

### Ideas for other activities that are linked to this program:

- Let the students do some reading and/or research on the internet about the interesting biology of termites; this can lead into a unit on social insects.
- Examine other insects from the environment: crickets, ants, bees, etc. Insects surround us, and their behaviors are easily observable without the need of fancy equipment
- Start an ant farm and let students observe foraging behavior, building of the colony, etc.
- Observe pollination behavior of various insects (from April to September for most areas): students can ask lots of questions about pollination behavior, and design observations and experiments to answer their questions. Popular questions are typically things such as “how many pollinators visit a type of flower?”, or “does a given pollinator only visit one type of flowers, or many types of flowers?”.
- Geography lesson on where Eastern termites can be found in the United States, and what keeps them from being more common in the Northern parts of the US (termites do best in warm weather and high moisture).
- Social Implications study by looking at termites as a pest that destroys thousands of buildings/houses a year, esp. in areas such as New Orleans.

### Websites that contain valuable information about termites:

<http://www.ldaf.state.la.us/divisions/aes/pesticide-ep/fti/default.asp>

<http://www.animalbehavioronline.com/termitebiology.html>

<http://www.ianrpubs.unl.edu/epublic/pages/publicationD.jsp?publicationId=338>

<http://ohioline.osu.edu/b1209/index.html>

**JEOPARDY GAME!**  
**Termite behavior: Running in circles**

Instructions to set up the game:

- Draw a jeopardy board on the chalkboard by making a 5-column X 6-row grid. There are 5 categories with 5 questions each, plus category headers. Write “100, 200, 300” and so on down the grid.

Example of a grid to draw on the board:

Figure It Out	Termite Behavior	Cool Facts	Termite Social Life	Science in Action
100	100	100	100	100
200	200	200	200	200
300	300	300	300	300
400	400	400	400	400
500	500	500	500	500

Instructions to play the game:

- Split up class into smaller groups or “teams” (4 students per team is ideal)
- Randomly choose one team to start. This team gets to pick a category and question in that category (100, or 200, etc). The number for each question of a category corresponds to the number of points the team that correctly answers the question would win.
- Read the chosen question aloud. All teams can participate. The first team to raise their hands gets to answer the question first. If the first team answers incorrectly, another team can try to answer (again, the first team to raise their hands). The team that answers the question correctly gets the points and picks the next question. We suggest you erase the box each time a question is answered.
- Keep track of points for each team on the board. We suggest to only add points when answering a question correctly, not to deduct points when answering a question incorrectly.
- After all questions have been answered, students answer the final jeopardy question. Write this question on the board, and all groups have 2 minutes to write down the answer on a piece of paper. All groups that answer correctly receive an additional 700 points.

Have fun!

Category: Figure It Out

100. An educated guess that answers your question and is testable.  
Q: What is a hypothesis?
200. The process scientists use to try to answer questions about the world around them.  
Q: What is the scientific method?
300. The step of the scientific method that involves your sense of sight.  
Q: What is observation?
400. This is when scientists work together on a problem.  
Q: What is collaboration?
500. The part of an experiment that remains constant and is used when comparing experimental results.  
Q: What is a control?

Category: Termite Behavior

100. The type of food that termites ingest.  
Q: What is wood?
200. The main role of this termite caste is to defend the colony.  
Q: What are soldiers?
300. The predators that attack termite colonies.  
Q: (any/all are acceptable) What are ants/anteaters/aardvarks/armadillos?
400. Termites use these chemicals to communicate with each other.  
Q: What are pheromones?
500. Termites, ants and bees form this type of social structure, in which there is one queen and many workers.  
Q: What is eusociality?

Category: Cool Facts

100. In tropical species, it can be as tall as 30 feet!  
Q: What is a termite mound?
200. One of the functions of termites in Africa because of their high fat and protein content!  
Q: What is a source of food for humans?
300. Termites have five senses like humans. This sense is highly undeveloped in termites.  
Q: What is sight?
400. This is caused by termites, which leads to 50 billion dollars spent each year worldwide!  
Q: What is damage?
500. A termite queen produces 3,000-30,000 of these a day, holding the record among insects.  
Q: What are eggs?

Category: Termite Social Life

100. The termite caste member that can be 30 times larger than the workers.

Q: Who is the queen?

200. The part of a soldier termite that accounts for half of its length.

Q: What is the head?

300. A member of this caste will replace the queen once she is dead.

Q: What are the winged (or alate) caste?

400. The damage done to homes and buildings are done by this termite caste.

Q: What are the workers?

500. Soldier termites cannot do this activity because of their large jaws, so they require help from the workers.

Q: What is feeding?

Category: Science In Action

100. This kind of scientist studies insects.

Q: What is an entomologist?

200. The number of species of termites!

Q: What is 2600? (Students don't have to be exact)

300. The area of the world where most termites live.

Q: What are the tropics?

400. Termites have 400-500 species of microorganisms in their guts that help them with this process.

Q: What is digestion?

500. Their tongues, specially designed for eating termites and ants, can be as long as two feet!

Q: What is an anteater?

Final Jeopardy Question

We developed two final jeopardy questions: one short, straightforward question coming straight from the termite activity, and one longer, more conceptual question that requires students to apply what they learned in the termite activity. We encourage you to ask students both questions if you have time.

1. Short final jeopardy question:

In our termite presentation, we found that termites follow shapes drawn in ball point pen. Why were they following it and what did they think they were going to find?

Answer: They were following it because the chemical in the pens smelled like the pheromones (or chemicals) termites use when leaving a scent trail. The termites were expecting to find food!

2. Long final jeopardy question:

You are a scientist studying a population of moths that vary from white to dark brown in color. The environment that the moths live in is very polluted and has turned the bark on the trees a darker color. You want to know whether the trees being darker has any effect on the survival of different colored moths. Which colored moths do you think would survive best? What experiment would you do to find out the answer?

Answer: The scientist can observe and record which colored moths are eaten by predators and see if there is a significant difference between the light and dark colored moths. The darker colored moths survive best because they are camouflaged with the dark tree bark.

This game was designed by the LADDERS team

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