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# BASIS Lesson Plan

**Lesson Name:** Smell me if you can! A lesson about insect communication

**Grade Level Connection(s)**

NGSS Standards: Grade 4, Life Science (4-LS1-1)
FOSS CA Edition: Grade 5, Life Science (Living Systems)

**Note to teachers: Detailed standards connections can be found at the end of this lesson plan.*

## Teaser/Overview

Sniff, sniff, sniff! What do you smell? Is it a member of your family or foe? This hands-on lesson guides students to investigate and explore the world of insect communication. Students will discover how ants communicate through smell instead of sight!

## Lesson Objectives

- Students will learn that insects communicate through pheromones/scents and that ants live together in a family unit known as a colony
- Students will discover that different animals communicate with one another in different ways (e.g. humans generally rely on vision whereas insects depend on smells/pheromones)
- Students will explore the way insects communicate that they found food, and be able to identify this behavior in nature
- Students will understand why we cannot all detect the pheromones that ants use because we do not have the same receptors

## Vocabulary Words

**Antennae**: structures that allow the insect to detect odors and communicate
**Insect**: small arthropod that has six legs and generally one or two pairs of wings and three body part (head, thorax, abdomen).
**Communication**: The exchange of information.
**Pheromone**: a chemical substance produced and released into the environment by an animal, especially a mammal or an insect, affecting the behavior or physiology of others of its species.

**Colony**: a community of animals or plants of one kind living close together or forming a physically connected structure.
**Mimicry:** when an animal or plant (or part of one) resembles or imitates another plant or animal – this can be visual, chemical, or behavioral.

## Materials

**Scientist Volunteers will bring:**

- Laminated small color cards (34 – 4 different colors)
- Film canisters with lids (34)
- Color stickers/stars for lids (34 – at least 4 different to correspond to extracts)
- Cotton balls (at least 34, one for each film canister)
- Extracts (at least 4 different – lemon, cinnamon, peppermint, vanilla)
- Small plastic ants (28)
- Small plastic spiders (6)
- String or yarn, each 4-5 feet long, with small magnet attached to one end (34)
- Laminated images/signs for the four different extracts (lemon, cinnamon, peppermint, vanilla) with magnets on back so they can stick on white board in classroom
- Laminated images of cool ants!

**Materials teachers should provide:**

## Classroom Set-Up

Please have students sitting in table groups of four students, if possible. We will need access to a whiteboard and markers. Nametags for calling on students are always very helpful!

## Classroom Visit

### 1. Introduction (10 minutes)

**Role Model Introduction:**
Being a role model for students is an important part of being a BASIS volunteer. Begin your lesson by introducing yourselves! Every team member should take a moment to explain who they are and what they study/do as a scientist. A bonus will be to tell your "story," as if giving an elevator pitch to 10-year-olds: Why did you become a scientist? What made you interested in your topic? Why

should students relate to you, or be interested in you? Feel free to draft a script of what you will say, here. And remember, you can also weave your story throughout your lesson through examples from your own life, and/or return to it with Q&A at the end.

My name is Jenna Florio and I am a scientist who studies insects. They call me an entomologist. I have studied everything from spiders, to mosquitos, to beetles and now I am currently studying ants. I got interested in studying insects when I was your age by going outside and watching the ants in my backyard. I thought about how there are these mini cities of ants all around us that no one pays attention to. I decided then that I wanted to study insects and show the rest of the world about the world of insects that exists around us that many people never think about. Most importantly I am passionate about science education and teaching everyone who is interested that they can become a scientist. You don't have a to be a rocket genius or even be great with numbers the only thing that matters to being a successful scientist is **curiosity** about the natural world.

**Topic Introduction:**
After you introduce yourselves as role models, take some time to introduce the topic of this lesson: pheromones & insect communication. It may be helpful to keep the suggested take-away in the back of your mind throughout the lesson: **Insects communicate primarily through chemicals called pheromones. They receive chemical signals through their antennae, process the signal in their brains, and react in different ways depending on the type of chemical.**

Your topic introduction should cover, at a minimum, the following information. As much as possible, try to frame this information as questions posed to the class, rather than as a lecture. This helps activate students' prior knowledge and facilitate student-guided conversation.

- Ask each student to think about their favorite food. Turning to the person next to them, discuss what this food is and how you would get it – which cabinet is it in their kitchen? If it's at a restaurant, how do they walk or drive to the restaurant from their home?
- Gather some ideas from the class regarding their favorite foods and how they locate those foods.
- Now instruct all the students to close their eyes and imagine if they couldn't see. They can only use their sense of smell to find their favorite food. How could they do this? What if it's not smelly?
- It would be a lot harder to find your favorite foods! This is how ants communicate! Ants lay down a path that smells a certain way to tell their other colony members where their food is [Define **pheromone**, write on board]
- Insects "smell" with their antennae. The chemicals (which produce an odor) attach to special receptors on the antennae. Insects use these chemical receptors to find food, a mate, a place to lay eggs. For example, worker ants leave a scent trail when they find food, but if the trail is disturbed, they become confused.
- What else do you know about ants? [Gather student responses, draw an ant on the board – don't forget the antennae!]

- Do they live alone? [No, ants are social animals and live in large groups called colonies. Define **colony**, write on board. Colonies are basically like ant families.]
- How do ants recognize which other ants are part of their own colony? [Ants recognize others from their colony by their scent.]
- Today we're going to do some activities to explore ant communication and pheromones!

## 2. Learning Experience (30 minutes)

Students will be getting up and moving around the room for these activities. Remember that all of these activities are designed to address the take-away in a particular way: **Insects communicate primarily through chemicals called pheromones. They receive chemical signals through their antennae, process the signal in their brains, and react in different ways depending on the type of chemical.**

**Activity 1: Visual Communication**

1. Engage students in a conversation about how humans use their eyes and vision to understand the world around them.
    a. Today we're going to learn about ant communication, but let's first think about how humans communicate. What is communication? [Define **communication**, write on board] How do we communicate with each other? [Verbal, visual]
2. Do the visual communication activity.
    a. Today we are going to pretend to be ants! An ant family is called a **colony** [Define].
    b. Instruct students that they will each be getting a color card in a moment. When I say the magic word for today "pheromone", you will try to find the other people who belong to your colony. But the rule of the game is that <u>you cannot talk</u>. You can only use your eyes to figure it out!
    c. Pass out one color card to each student.
    d. Say the magic word and make sure that students are following the rules of the game. [No talking!]
    e. Time the students to see how long it takes for them to all find their colony.
    f. Have students return to their seats. Recollect the color cards.
3. Connect the activity to the big picture
    a. Invite students to reflect on the difficulty of the activity. Was this easy? Hard? Why or why not? Before having students return to their seats, engage them in a conversation about what they would do if they wanted to sneak into an ant colony. What would be your disguise?
    b. Emphasize the overall takeaway of the lesson: **Insects communicate primarily through chemicals called pheromones. They receive chemical signals through their antennae, process the signal in their brains, and react in different ways depending on the type of chemical.**

**Activity 2: Pheromone Communication**

1. Engage students in a conversation about how ants communicate and how this is similar and different to the way humans communicate.
    a. We talked earlier about how insects and other ants communicate. How do they do this again? [smelling, pheromones]
2. Do the pheromone communication activity.
    a. Today we are going to pretend to be ants! An ant family is called a **colony** [Define].
    b. Instruct students that they will each be getting a canister in a moment. Each of the canisters has a cotton ball that has a specific scent. When I say the magic word for today "pheromone", you will try to find the other people who belong to your colony. But the rule of the game is that <u>you cannot talk</u>. You can only use your nose to figure it out! Let's make a hypothesis – do you think you will be able to find your colony members more quickly or more slowly than the previous activity? Why or why not?
    c. Pass out one canister without the lid and with a cotton ball soaked in extract to each student.
    d. Say the magic word and make sure that students are following the rules of the game. [No talking!]
    e. Time the students to see how long it takes for them to all find their colony.
3. Connect the activity to the big picture
    a. Invite students to reflect on the difficulty of the activity. Was this easy? Harder than the color card activity? Why or why not?
    b. Emphasize the overall takeaway of the lesson: **Insects communicate primarily through chemicals called pheromones. They receive chemical signals through their antennae, process the signal in their brains, and react in different ways depending on the type of chemical.**

**Activity 3: Friend or Foe?**

1. Before having students return to their seats, engage them in a conversation about what they would do if they wanted to sneak into an ant colony. What would be your disguise? [If students struggle with thinking about this, first have them think about how they would disguise themselves to sneak someplace as a human. What would be their disguise?]
2. There are animals that mimic [Define **mimic** on board] the pheromones of an ant.
3. They smell just like an ant, but they are not actually ants, and sometimes don't even look a lot like an ant.
4. Do you think you have any mimics in your colony? Let's find out!
5. Remove the cotton from your container and look inside. If you find a plastic ant, you're an ant, but if you see something else, you are an ant mimic!
6. Once students reveal their true identities, have students put plastic toys back in container, place cotton back in container. Students should return to their seats. Recollect the containers.
7. Show students some images of actual ant mimics inside colonies.

**Activity 4: Food Preferences and Pheromone Trails**

1. Now we've done some activities to understand how ants communicate and find their colony members, but how do they tell other ants where food is? When ants are out searching for food and they find something delicious, how do they tell their colony members where that food is?
2. Let's do another activity to understand how they do this! Each person at your table group should have a different scent in your vial. Pass them around to smell each type, decide which one is your favorite smell. [As students do this, put up signs (for corresponding scents) on the whiteboard.]
3. Give a string to each student that has a small magnet attached to it.
4. Call up each group of students, one table at a time (call on the quietest tables first) to come up and place their string underneath their favorite scent. Model what this should look like for the students before having them do it.
5. Once all students in the class have placed their strings on the board, choose a volunteer to count the number of strings placed underneath each of the scent signs. Write it on the board to keep track.
6. Lead a discussion with students about the differences. Is there one scent that is more popular than the others? If there are many strings leading to a scent, is it easier to visualize? When ants find food, they put down a pheromone trail so that other members of their colony can come back and find that food too! Then as more ants follow the trail, take the food, and then return to their ant nest, they lay down another trail on top of that first pheromone trail. So then the pheromone gets stronger and stronger so that soon all the ants in the colony are out gathering food from the one point. This is why when you see ant trails leading to your food when you picnic outside or when they eat your pumpkins you leave out for Halloween, or when they find something delicious to eat in your kitchen at home!
7. So now you know how one tiny ant in your home can lead to an ant infestation!
8. Why can't we smell these trails? Elicit student responses. Brief discussion about scent receptors and how we can detect certain scents, but not others!

## 3. Wrap Up: Review and Discuss the Learning Experience (5 minutes)

Now as a wrap up ask them how ants smell pheromones? [antenna]
Ask them how ants tell who is part of their colony and who is not? [pheromones]
Ask them how ants tell their family/colony members they found food? [by laying down pheromone trails]
Now ask if they have other questions about ants!

## 4. Connections & Close (5 minutes)

**Connections to the real world around students:**

Emphasize that pheromone communication and understanding the language of ants is a question ant scientists are studying and very curious about. Understanding how different organisms communicate is key to understanding their behavior. And more importantly understanding how ants swarm food sources helps you to know how to prevent them from happening. There are many ways to break pheromone trails such as cinnamon, pepper, vinegar, lemon juice and next time you see ants in your kitchen help your parents out by using what you learned today to break their communication!

**Close:**
Wrap up as a role model by leaving a few minutes for students to ask questions about science, about being a scientist, and about becoming a scientist. Then, thanks and goodbye!

## Follow Up: After the Presentation

Teachers who wish to extend the impact of this lesson may find the following CRS web pages useful:

- http://www.crscience.org/educators/helpfulreports
- http://www.crscience.org/educators/treasuretrove

## Standards Connections

**NGSS:**

- Connections by topic
  - Life Science: 4. Structure and Function
- Connections by disciplinary core ideas
  - Life Science: 4-LS1 From Molecules to Organisms: Structures and Processes
- Connections by scientific & engineering practices
  - 4. Analyzing and interpreting data
  - 6. Constructing explanations (for science)
- Connections by crosscutting concepts
  - 4. Systems and system models
  - 6. Structure and function
- Connections by performance expectation
  - 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction
  - 4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to information in different ways.

**FOSS CA Edition:**

Grade 5 Life Science: Living Systems