

## Collecting and keeping *Temnothorax* ants



*You need: Bowl, zip lock bag, marker, brush, three chamber-nest, Vaseline, filter paper, spray bottle with water, spray bottle with honey, house crickets, food bowl, metal plate, inlay nest, red foil*

1. Search for hollow acorns in the foliage and open them above the bowl using your fingernails.
2. As soon as you have found an ant colony inside an acorn, transfer the acorn with all its ants from the bowl into the bag (using the brush).
3. Close the bag carefully.
4. Mark the bag with your name.
5. Prepare a new nest site for your ant colony:

 **Attention!**

Put only one ant colony (one acorn) into a bag at a time!



### **1<sup>st</sup> step: Preparing the three chamber-nest**

Brush all the inner walls sparingly with Vaseline. Place filter paper on the floors of the three chambers and moisten the chamber on the right (using the spray bottle).

### **2<sup>nd</sup> step: Provide nutrition**

Place the food bowl in the center of the three chamber-nest and the metal plate (=water point) in the chamber on the right. Put a little drop of honey and a little piece of house cricket in the food bowl. Place a drop of water on the metal plate.

### **3<sup>rd</sup> step: Provide a substitute for the acorn**

Remove all the remaining huge acorn pieces. For this purpose, use the brush to push the ants and their offspring (!) out of the acorn into the bag. Place an inlay nest with the transparent cover down inside the bag, close the bag carefully, and leave it in a horizontal position from now on.

 **Attention!**

Have a close look at acorn pieces!  
Ants and their offspring often stay between the acorn layers.

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### **Next lesson:**

6. Take the inlay nest carefully out of the bag and place it with the transparent cover up inside the three chamber-nest in the chamber on the left. The entrance must be in the direction of the conjunction between the chamber on the left and the middle chamber.
7. Cover the inlay nest with red foil.
8. Use the brush to transfer free ants from the bag to the three chamber-nest and lock up the nest with the cover.
9. Mark the three chamber-nest with your name.



## How strong are ants?

You need: Three chamber-nest including *Temnothorax* ants, tissue, spring steel tweezers, brush, weights (fir needles), tweezers, stereo microscope

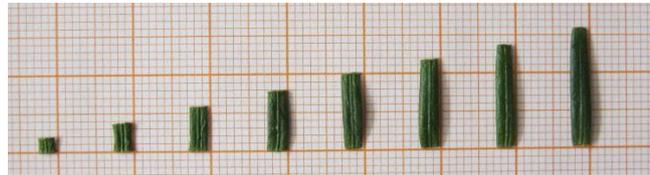
**Attention:** Lay out all the materials you need (weights!) and create your table before opening the nest!

1. Identify the (average) masses of different fir needle pieces and document the results in a table (M1).
2. Prepare different fir needle weights. If you do not have an accuracy weighing machine or enough time at your disposal, M2 will help.
3. Close the inlay nest's entrance using a piece of tissue.
4. Remove the red foil out of the three chamber-nest.
5. Open the inlay nest by shifting the transparent cover for max. 1.5 cm.
6. Spread your fir needles on the transparent cover.

**Attention:** Do not place any needles inside the inlay nest!

7. Observe the ants' behavior every 15 minutes under stereo microscopes (lights on!).
8. Document the number of needles which have been carried into the inlay nest every 15 minutes.
9. Close the three chamber-nest and leave the inlay nest open overnight. In the next lesson, document which needles have been carried into the nest.

### M2: Determining the masses of fir needle pieces



Fir needle length (mm)	Fir needle mass (mg)
2	0,9
4	1,9
6	3,2
8	5,8
10	7,6
12	9,3
14	10,2
16	13,6

These data refer to fir needle pieces of 3 mm width. The tips have been cut generously on both sides. These data are only references since single fir needles differ in their humidity, percentage of wood and stored nutrients.

Fir needle length (mm)	Fir needle mass (mg)	Number of needles carried into nest after 15 minutes	Number after 30 minutes	Number after 45 minutes	Number the next day
...	...	...	...	...	...

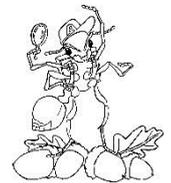
### M1: Structure of your table



**Next lesson:**



1. Remove the fir needles using tweezers and carefully close the inlay nest. Remove ants which might be bruised otherwise using the brush.
2. It is often said that ants may carry 30 times their own weight. A *Temnothorax* worker weighs approximately 0.4 mg. On the basis of your results, check the accuracy of this statement.
3. Estimate the mass a man with a body weight of 80 kg would be able to carry if he was as strong as an ant.
4. Try to find out why ants are much stronger than humans.



## Development of castes within a colony

All insects have basic physical structures in common. Nevertheless, every species looks differently. In the case of ants, even the members within a colony look differently. We speak of **castes** whose morphology and behavior are adapted to certain tasks.

1. Compare the morphology of worker, queen, and – if available – male ants with the aid of the table. Make guesses before observing the ants in your nest closely using stereo microscopes.
2. Explain the different appearances with the function of worker, queen, and male ants (final column in your table).

<b>Body part / appearance</b>	<b>Worker</b>	<b>Queen</b>	<b>Male (if available)</b>	<b>Possible reasons for differences</b>
Body size (in comparison)	...	...	...	The queen is larger because it lays eggs and therefore has larger ovaries.
Head-thorax-ratio	...	...	...	...
Thorax-gaster-ratio	...	...	...	...
Mouthparts	...	...	...	...
Size of compound eyes	...	...	...	...
Simple eyes on the forehead	...	...	...	...
Wing (roots)	...	...	...	...
Color	...	...	...	...
Other	...	...	...	...



## What do ants like to smell, taste, or walk on?

*You need: Three chamber-nest including *Temnothorax* ants, spring steel tweezers, brush, Vaseline, arena, different substrate material, different spices and herbs, different foods, magnifying lens / stereo microscope*

1. Take off the upper slice of the arena.
2. Decide between a) substrate material, b) smells, or c) tastes.
  - a) **Substrate material:** Put one substrate material (e.g., soil, sand, sandpaper, or Vaseline) in each of the four corridors. Avoid cavities between the slices of the arena!
  - b) **Smells:** Put the same amount of spice / herb (e.g., rosemary, cinnamon, thyme, lavender) in each of the four corridors. Avoid cavities between the slices of the arena! Clean carefully after each experiment!
  - c) **Tastes:** Put the same amount of foods (e.g., chicken, tuna, peanut butter, lemon) in each of the four corridors. Avoid cavities between the slices of the arena! Clean carefully after each experiment!
3. Transfer ants into the arena:
  - Take one or two worker ants out of the three chamber-nest (or the inlay nest) and place them in the middle of the arena.
  - Lock up the arena immediately (upper slice). If there are ants on top of the middle slice, use the brush to place them in the middle of the arena.
4. Set up a time, e.g. every two minutes, to document the number of ants in different places of the arena. Document your experimental design in a drawing. Document your results in a table (M1). If the result is unclear, extend the time and continue counting.
5. Document your results with the aid of bar graphs.

### M1: Structure of your table

<b>Number of ants</b>	<i>Corridor A</i>	<i>Corridor B</i>	<i>Corridor C</i>	<i>Corridor D</i>
<i>After 2 minutes</i>	...	...	...	...
<i>After 4 minutes</i>	...	...	...	...
...	...	...	...	...



## Blue ants: Division of labor in an ant colony



*You need: Three chamber-nest including hungry *Temnothorax* ants (food bowl has been taken out at least four days in advance), spring steel tweezers, brush, metal plate, beaker, honey, blue food coloring, spoon, stereo microscope*

1. Place a drop of colored honey on a metal plate and place it directly in front of the inlay nest.
2. Observe and describe
  - the behavior and number of workers who exit the inlay nest and start feeding on the blue honey,
  - the body of feeding ants with the aid of stereo microscopes with lights on,
  - the behavior of single workers after having fed on the blue honey and returning to the nest,
  - the behavior and appearance of those colony members (different castes and offspring!) who have not left the inlay nest.
3. Explain the circulation of nutrition in an ant colony (trigger and transfer!) with the aid of your observations and M1.
4. Explain the advantages of the ants' nutrition from the evolutionary perspective.

 **Attention:** Leave the blue honey inside the three chamber-nest until the next lesson. Observe the ants' appearance in the inlay nest once again.

### M1: Two worker ants transferring nutrition

