

## So many Earthworms?



Many deep burrowing earthworms are found in meadows (Wikimedia commons)

### List of Materials

- Spade, garden shovel, and possibly grass shears
- One or two 10-liter containers filled with 9 liters of water. If a water connection exists at the study site, only an empty container is needed.
- 2 liters of mustard solution (or more, depending on the number of areas)
- A field or kitchen scale
- 6 sealable, transparent plastic containers or sealable glas jars
- A wooden or metal frame or 4 individual boards/sheets each measuring 50cm x 20cm
- Plastic gloves
- Waterproof marker for labeling the containers/jars
- Measuring tape and a plastic sheet as a base (e.g., 1m x 2m)
- Bamboo or wooden sticks to mark investigation areas
- Research sheet
- Research notebook

### Research Steps

#### Preparation for Field Investigation

1. With the help of your teacher you should prepare all materials to ensure a smooth field investigation. It is important to understand what each item is used for.
2. After consulting with the teacher, your group chooses two investigation areas from ecosystems that are as different as possible, e.g., meadow and acre, cornfield and wheat field, meadow and garden bed, etc.

### Question and Presumption/Hypotheses

- Every research experiment starts with formulating a research question and a hypothesis about the course of the research process and its results. What questions do you consider meaningful? What hypotheses would you make in this regard? Record your thoughts on the research sheet and in your research notebook.

### Field Investigation

- Measure and mark out the investigation area. The area must be precisely 50cm x 50cm = 0.25m<sup>2</sup>. If the vegetation is tall, use the grass shears to cut it as close to the ground as possible.
- Lay out all materials on the plastic sheet. Then, weigh the plastic containers/jars (=tare weight) and label 2 containers each for „surface dwellers,“ „shallow burrowers,“ and „deep burrowers.“
- Carefully dig the outline of the area using the spade. Then, set up the frame.

### Expelling Earthworms

- Put on gloves! Mustard solution burns in the eyes.
- Add 1 liter of mustard solution into the 10-liter container filled with 9 liters of water and shake well. Pour the 10-liter mustard solution all at once onto the marked-out area; the frame prevents the solution from flowing away superficially.
- Immediately collect earthworms, sort them into ecological groups, and place them in the labeled containers/jars. CAUTION: With large earthworms, wait until they have completely emerged from their burrows before touching them – otherwise, they might retract.
- Once no more earthworms come to the surface, use the spade and garden shovel to dig the soil 25cm deep (measure with a measuring tape). Search the excavated soil for earthworms and collect them separately by group.
- Note the quantity and weight (total weight - tare weight) on the research sheet for each earthworm group.
- Return the soil material to the hole, lightly tamp it down, and then release the earthworms.
- Repeat the entire process for the second investigation area.

### Data and Analysis

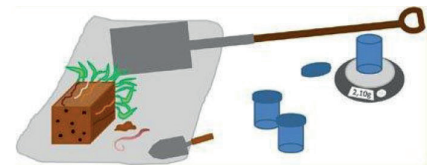
- In class you will combine the results from all groups, allowing you to calculate the average (quantity and weight per m<sup>2</sup>, NOTE: You must convert the results from 1/4m<sup>2</sup> to 1m<sup>2</sup>) for each area and each earthworm group.
- Advanced students can also calculate the standard deviation.
- You can present the results in a table and a graph.

### Presentation of Your Results

- Present your results to the class, compare your findings with the results of other groups. Showcase your research question and hypothesis. Discuss whether it has been confirmed or not. What are the reasons for differences (or similarities) in the investigated areas? What measures could be taken to promote earthworms? Where do you see a connection to climate change and biodiversity?



The investigation site should be set up like this before starting.



Instead of expelling the earthworms with the dry mustard solution, you can also use the spade test. The teacher will tell you how it works.

## Further Research

### Additional Investigations

Comparisons of further ecosystems or even different farms can also be fascinating. However, it is important that you conduct these investigations roughly within the same time frame (1-2 weeks) because earthworms respond to seasons and weather extremes. Earthworm extractions are not very meaningful in winter and summer because they survive these periods in deeper layers of the soil.