

# **The Effects of Zinc on Earthworm Burrowing**

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## **Abstract**

The purpose of this lab is to test the ability of the worm to detect high and low levels of zinc when placed in the environment. The worm was placed in the center of the dissecting tray with four different quadrants of soil surrounding it. Each quadrant had different amounts of zinc, ranging from 1000 ppm to 10 ppm and one quadrant had distilled water. Over the course of four days, each observation session lasting twenty minutes, we analyzed the worm, its motions and the quadrants it chooses to burrow into. Each day we observed the varying behavior and locations that the worm decided to go. Overall, we infer that the worms could not detect high levels of zinc in their environment as they spent the majority of their time in the 1000 ppm contaminated quadrant.

## **Introduction**

Earthworms aid the environment by changing the structure of their environment. Earthworms have the ability to improve water infiltration, soil aeration, and available nutrients to plants. Earthworms burrowing proves of importance through the beneficial effect it has on soil and crop production. Burrows form pores in the soil where oxygen and water can enter and carbon dioxide can leave. The focal point of our lab is to determine how the presence of zinc in soil affects the Earthworm's burrowing? Zinc is a naturally occurring metal that can also be released into the environment during mining, smelting, steel production and the burning of coal. If zinc-containing wastes from metal manufacturing industries and electric utilities are improperly disposed, high concentrations of zinc can be found in soil. Consuming large quantities of zinc for an extended period of time may result in anemia, nervous system disorders, damage to the

pancreas and lowered levels of “good” cholesterol. In order to test the effects of zinc, the worms will be placed in an environment containing distilled water, 10 ppm, 100 ppm, and 1000 ppm of zinc. The prediction is that if the earthworm is placed in a tray with varying amounts of zinc, then the earthworm will be unable to initially detect the amount of zinc in the soil which will compromise their health, but after but after coming in physical contact with zinc contaminated soil the earthworm will move to soil containing distilled water.

## **Materials and Methods**

### *Materials*

- Distilled Water
- Pipets
- Potting Soil
- Dissecting Tray
- Red Worms
- Latex Gloves
- Stopwatch
- Tweezer
- Zinc Solutions (1000 ppm, 100 ppm, 10 ppm)

### *Methods:*

1. Put the potting soil, about three cups, into the dissecting tray until the tray is fully covered, and divided the soil into four different quadrants.
2. Label the quadrants with the amount of zinc concentration or distilled water

*Figure 1: Shows how the tray and quadrants were divided.*

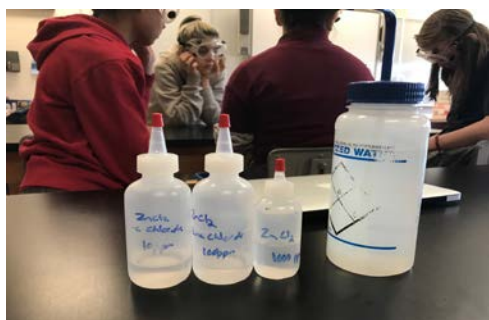
Quadrant One (1000 ppm)	Quadrant Two (100 ppm)
Quadrant Three (10 ppm)	Quadrant Four (Distilled Water)

3. Saturate quadrant one with 1000 ppm of zinc
4. Saturate quadrant two with 100 ppm of zinc
5. Saturate quadrant three with 10 ppm of zinc
6. Saturate quadrant four with distilled water
7. Put the chemicals into the soil until the soil was completely saturated in zinc and water.

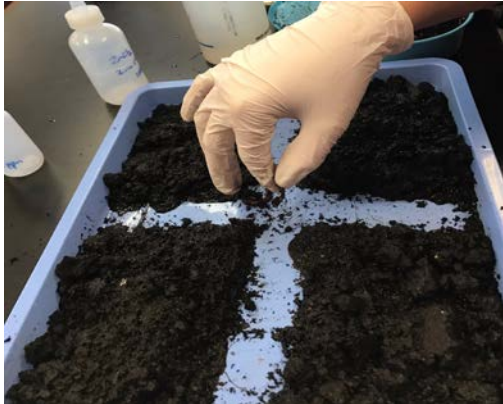
We made sure to moisten the edges of the quadrants to have the most accurate response.

8. Place the three worms into the center of the tray
9. Start the timer for twenty minutes and record the initial quadrant the worm went into and how much time the worm spent in each quadrant (see data table)
10. When the twenty minutes are over, remove each worm from the tray, rinse the worm off with distilled water, and place the worm back into the container.

**Visuals:**



*Figure 2- This picture shows the varying quantities of zinc.*



*Figure 3-This picture shows the different quadrants as well as where the Earthworm is placed.*

**Data Table 2:**

How Zinc Affects the Location of Earthworms (time table)

Day	Quadrant One (1000 ppm)	Quadrant Two (100 ppm)	Quadrant Three (10 ppm)	Quadrant Four (distilled water)
1	<ul style="list-style-type: none"> <li>➤ Worm One 0 min</li> <li>➤ Worm Two 0 min</li> <li>➤ Worm Three 20 min</li> </ul>	<ul style="list-style-type: none"> <li>0 min</li> <li>0 min</li> <li>0 min</li> </ul>	<ul style="list-style-type: none"> <li>0 min</li> <li>0 min</li> <li>0 min</li> </ul>	<ul style="list-style-type: none"> <li>20 min</li> <li>19 min</li> <li>0 min</li> </ul>
2	<ul style="list-style-type: none"> <li>➤ Worm One 0 min</li> <li>➤ Worm Two 20 min</li> <li>➤ Worm Three 5 min</li> </ul>	<ul style="list-style-type: none"> <li>20 min</li> <li>0 min</li> <li>15 min</li> </ul>	<ul style="list-style-type: none"> <li>0 min</li> <li>0 min</li> <li>0 min</li> </ul>	<ul style="list-style-type: none"> <li>0 min</li> <li>0 min</li> <li>0 min</li> </ul>
3	<ul style="list-style-type: none"> <li>➤ Worm One 20 min</li> <li>➤ Worm Two 20 min</li> <li>➤ Worm Three 0 min</li> </ul>	<ul style="list-style-type: none"> <li>0 min</li> <li>0 min</li> <li>0 min</li> </ul>	<ul style="list-style-type: none"> <li>0 min</li> <li>0 min</li> <li>16 min</li> </ul>	<ul style="list-style-type: none"> <li>0 min</li> <li>0 min</li> <li>0 min</li> </ul>
4	<ul style="list-style-type: none"> <li>➤ Worm One 1 min</li> <li>➤ Worm Two 20 min</li> <li>➤ Worm Three 15 min</li> </ul>	<ul style="list-style-type: none"> <li>2 min</li> <li>0 min</li> <li>0 min</li> </ul>	<ul style="list-style-type: none"> <li>17 min</li> <li>0 min</li> <li>0 min</li> </ul>	<ul style="list-style-type: none"> <li>0 min</li> <li>0 min</li> <li>0 min</li> </ul>

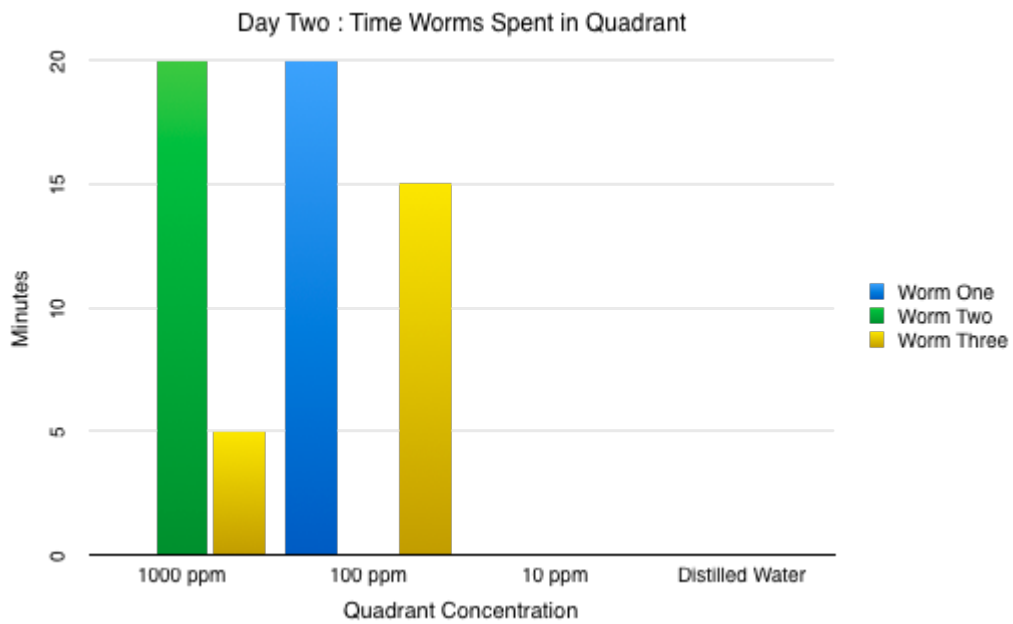
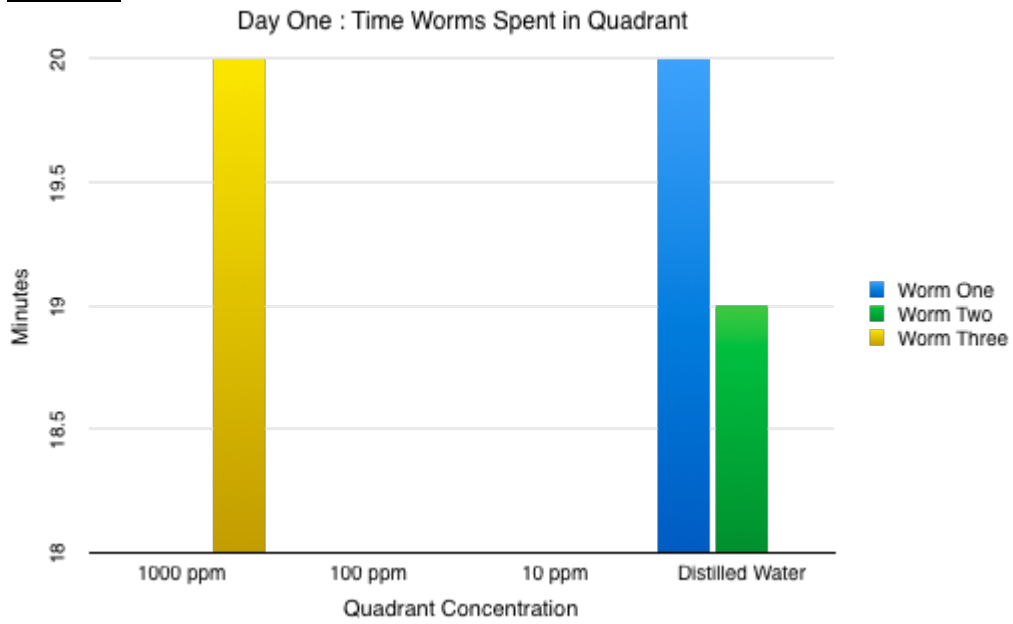
\* Quadrant times started when worms moved into a quadrant

**Data Table 1:**

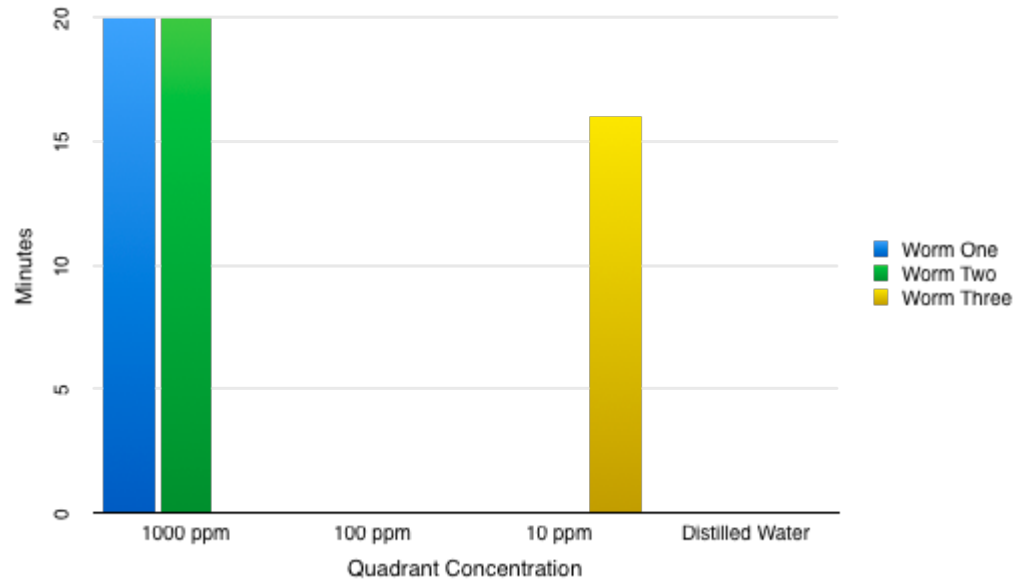
## How Zinc Affects the Location of Earthworms (observations)

Days	Worm 1	Worm 2	Worm 3
One	<ul style="list-style-type: none"> <li>Was placed into the tray and automatically went into the distilled water (fourth quadrant)</li> <li>Lost sight of worms as they went into the soil (3 min)</li> </ul>	<ul style="list-style-type: none"> <li>Was placed into the tray and did not move for one minute then started moving toward the distilled water (fourth quadrant)</li> <li>Lost sight of worm as it went into soil (3 min)</li> </ul>	<ul style="list-style-type: none"> <li>Was placed into the tray and automatically started moving around the 1000 ppm (first quadrant) and went into the soil</li> <li>Lost sight of worm as it went into the soil (3 min)</li> </ul>
Two	<ul style="list-style-type: none"> <li>Burrowed into quadrant 2 with 100 ppm of zinc</li> <li>Lost sight of the worm at 4 minutes</li> </ul>	<ul style="list-style-type: none"> <li>Burrowed into quadrant 1 with 1000 ppm of zinc</li> <li>Lost sight of the worm at 5 mins</li> </ul>	<ul style="list-style-type: none"> <li>Burrowed into quadrant 1 with 1000 ppm of zinc</li> <li>At 3 minutes, stopped burrowing halfway into the 1000 ppm (stopped moving)</li> <li>At 5 minutes, he moved all the way into the 100 ppm</li> </ul>
Three	<ul style="list-style-type: none"> <li>Followed worm two into quadrant one</li> <li>Burrowed right away</li> </ul>	<ul style="list-style-type: none"> <li>Automatically went into quadrant one</li> <li>Sat ontop of the soil and did not burrow until two minutes</li> </ul>	<ul style="list-style-type: none"> <li>Stayed in the middle, had to touch it and spray water on it to get it to move</li> <li>At four minutes moved into quadrant three and burrowed</li> </ul>
Four	<ul style="list-style-type: none"> <li>Went into quadrant two and two minutes passed then, automatically turned away and went into quadrant one for one minute</li> <li>Went over quadrant one and started to burrow in quadrant three for the duration of the time</li> </ul>	<ul style="list-style-type: none"> <li>Automatically started burrowing in quadrant one</li> </ul>	<ul style="list-style-type: none"> <li>Stayed in the middle for five minutes and then went into quadrant one and burrowed</li> </ul>

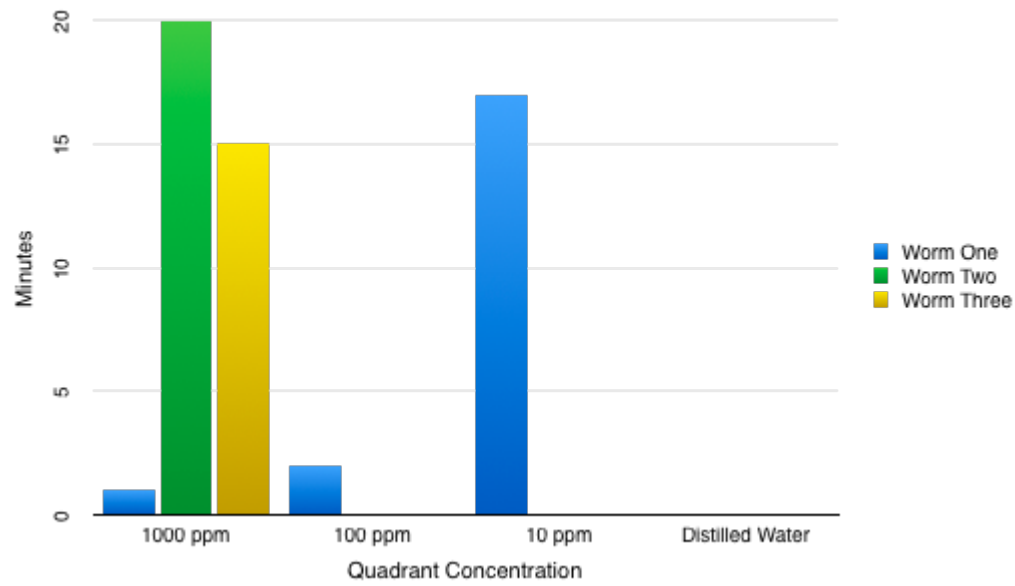
**Graphs:**



Day Three : Time Worms Spent in Quadrant

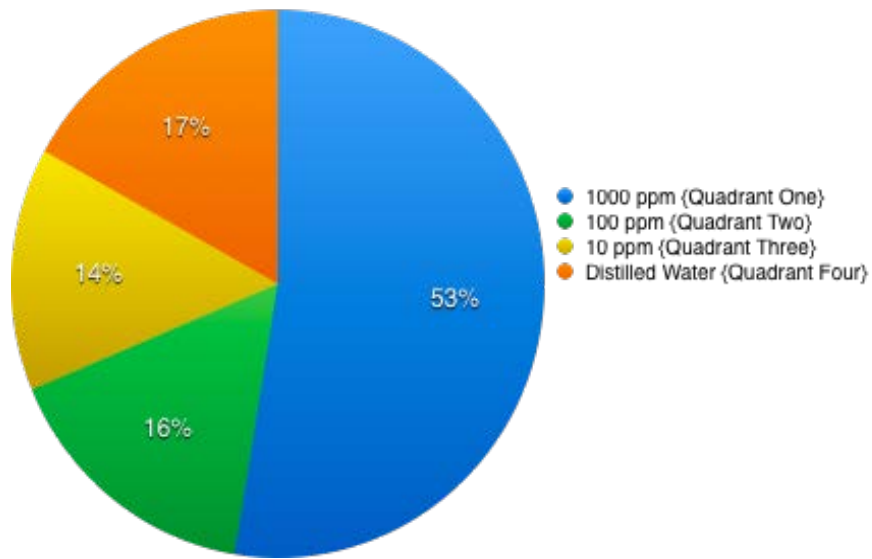


Day Four : Time Worms Spent in Quadrant





Percent of Time Worms Spent in Each Quadrant  
{ Day 1 - 4 }



*Figure four and Figure five show the movement of Earthworms.*

*Figure Four-the worms are still yet to fully commit to a quadrant yet.*



*Figure Five-This shows one of the earthworms moving into quadrant one (1000ppm), a different worm entering quadrant 3 (10ppm), while the other worm remains in the center.*



## **Results**

In the experiment, the independent variable is the concentration of zinc placed in each quadrant. The dependent variable is the amount of time each earthworm spent in each quadrant. The control variable is the amount of soil and zinc placed in each quadrant. The worms were placed in the center of the tray and had the ability to choose the quadrant in which it wanted to enter. Spending 53% of the time there, the most common location for earthworms to burrow in was quadrant one(1000ppm). The Earthworm's spent about equal time in quadrants two, three and four. Only two worms moved from their initial quadrant. On day two, worm three spent its first five minutes in the highest concentration of 1000 ppm, but then moved to quadrant two which contained 100 ppm. On day four, worm one went to quadrant one (1000 ppm of zinc) for one minute, then moved to quadrant two (100 ppm) for two minutes, then ended in quadrant three (10 ppm) for the remaining seventeen minutes. In both cases the worms that changed quadrants started in the high concentration and migrated to lower concentrations.

## **Discussion:**

Our original hypothesis was that, if the earthworm is placed in a tray with varying amounts of zinc, then the earthworm will be unable to detect the amount of zinc in the soil, but after spending 20 minutes or less time in the soil with zinc, the earthworm will move to the soil containing distilled water. We were correct that the earthworms lacked the ability to sense the pollution in the soil; however, we were partially wrong in predicting that if the earthworm chose a quadrant with a high concentration of zinc it would move to a quadrant with a lower concentration. As shown in our data on six different occasions the first quadrant the worms went into was the quadrant with the highest concentration of zinc. Furthermore, of those six worms, two of them moved out of the quadrant. This data proves the Earthworm's inability to detect the

concentrations of zinc and that they failed to avoid the quadrants with higher concentrations of zinc. Time was a limitation on this lab, if we had more time to observe the earthworms movement, we would have the possibility to determine if more time causes them to recognize the pollutant. An error our group had was not exactly measuring the amount of zinc we placed into each quadrant and just fully saturating the soil in the solution, this could have affected the which quadrant the worm decided to enter.. Likewise, in society humans are susceptible to pollutants they are unaware of. Many pollutants can be detrimental to humans health. Luckily, zinc, in small amounts, is not harmful to humans health. High exposure to zinc can be toxic; causes of exposure can be from the ground water found in hazardous waste sites as well as in your pipelines. Consumption of zinc from small organisms can affect their metabolism as well as disrupt food chain layers. The passing of pollutants throughout the food chain among consumers potentially could increase the concentrations, which could ultimately affect humans.

### **Further Questions:**

After completing this lab, a question our lab group was curious about is that if the worms were allotted more time in the tray, would it affect where they burrow? A solution to this could be observing the worms for a longer period of time.

### **Works Cited**

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