The effects of Lead Nitrate on the reproductive behaviors and secondary sex characteristics of Fathead Minnows

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Abstract
In order to determine the effects of lead on human reproduction, fathead minnows were exposed to the element and then studied and observed over the course of two weeks. A total of six different mating pairs of fish, three of which have been previously exposed to lead and three from a controlled lead-free environment, had the male in each pair’s reproductive patterns and traits observation and recorded. It was observed that male fish previously exposed to 1 ppm lead nitrate were much smaller in size, took longer to enter their secondary sex characteristic cycle, and performed fewer reproductive behaviors than the control fish not previously exposed to lead.

Introduction
Lead (Pb) is a naturally occurring element found within the Earth’s crust (2). Trace amounts of this element can be found in minerals, water, plants, animals, and air. A high degree of lead exposure can be very dangerous to human health, specifically with reproduction (involving reproductive habits and patterns as well as and how a child development can be affected during a mother’s pregnancy). Primarily, the offspring of these mothers who experience lead exposure often have problems in learning and motor skills, such as a delay in speech, inability to remember information, and psychiatric disturbances (3). The importance of this experiment was to see how a minnow’s reproduction under the influence of lead relates back to human reproduction. It was hypothesized that minnows exposed to lead would have suppressed reproductive behaviors (i.e. nest prep, chase, and hover), and suppressed secondary sex characteristics whereas minnows not exposed to lead nitrate solution.

Purpose
This experiment was conducted in order to observe the lasting effects of lead exposure on the reproduction patterns of a fathead minnow. By doing this, one can better understand the negative risks lead exposure could have on other organisms as well, especially for human beings, specifically during pregnancy. By recording the harm done to a minnow’s body and reproductive performance helped to further support the existence some of the risks involved with unsafe environments of high lead exposure, on human individuals.

Procedure
I. Gather Materials
   a. Fish tanks
   b. Fathead minnows (male and female)
   c. Filter
   d. Breeding chambers

II. Two large fish tanks were each separated into 3 subsections (A, B, C)

III. Each subsection had a single breeding chamber inside.

IV. One male and one female fathead minnow were placed in each of the 6 section.

V. The first large tank filled with only non-lead exposed minnows, while the second tank was inhabited by minnows previously exposed to lead nitrate at a concentration of 1 ppm.

VI. Every other day (eventually a total of 7), the minnows behaviors and appearances were observed and recorded.

VII. The appearances observed were a dorsal fin spot, side bars, tubercles, and a head pad.

VIII. The behaviors observed were patrolling, hovering, chasing, nest prepping, and spawning.

Results
The most notable difference between the lead nitrate exposed and control fathead minnow males was their size. Minnows previously exposed to lead were much smaller in size than those between those who had been raised in the control environment. The smaller minnows exposed to the lead were approximately the same size as the average female fathead minnow, exhibiting the detrimental effects lead has on the growth rate of minnows. The rate at which the lead exposed minnows developed secondary sex characteristics was much slower than the rate at which the unexposed minnows developed the same characteristics. The prevalence of secondary sex characteristics in the control minnows was higher and not as varied as the prevalence of the same characteristics in the minnows exposed to the lead nitrate solution. The frequency at which each male performed the specified reproductive behavior varied significantly between the lead exposed minnows and the control minnows. For example the minnows in the lead exposed tank had less frequent hover behaviors than the minnows in the control tank. Overall the control minnows were able to exhibit the reproductive behaviors much more frequently and with more vigor than the minnows exposed to the lead nitrate solution. In addition the control minnows developed secondary sex characteristics faster than the lead nitrate exposed minnows, and the control minnows had the characteristics longer than the lead nitrate exposed minnows.

Discussion
It was hypothesized stated that minnows exposed to lead would have suppressed reproductive behaviors like nest prep, chase, hover, and patrol. The data recorded from the seven days of observing the minnows supported this hypothesis. The control tank showed a much higher prevalence of hovers and nest preps than the lead tank. The results were the same results Dr. Weber found when he conducted his fathead minnow experiment. These results were expected, but one behavior that was unexpected was tank 2b(lead exposed tank) spawned and was the only tank to spawn over the course of all the observations. Because tank 2 was exposed to lead it was unexpected to see an increase in reproductive behaviors. Despite the hypothesis being supported there were some limitations. Some limitations were that there was limited sample size, meaning it may not have been a representative of the whole fathead minnow population so results could have been skewed. Another limitation encountered was that the fish were viewed over the course of 14 days but only recorded observations 7 of the 14 days for 5 minutes each day. This limited the results to the same time period everyday and only 7 days out of the minnows’ entire lives. If the fish were able to observed for longer periods of time at different times of the day, more behaviors may have been seen.

Work Cited