How Does Gasoline Affect an Earthworm's Ability to Learn and Relearn Different Behaviors?

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Abstract

In this study, the effects of gasoline were tested on earthworms. The purpose was to determine how gasoline effects earthworms' nervous systems and then to relate that information to humans. Earthworms were tested by exposure to gasoline.The study found that the gasoline severely impacted the earthworms' nervous system. A method used was to test an earthworm's ability to learn and relearn behaviors after being contaminated with gasoline. The scientists dropped three drops of gasoline on the earthworm, about 0.15 mL, and tapped the earthworm's posterior end every fifteen seconds. The contaminated earthworms, compared to the control earthworms, had severely different results. The gasoline can be seen dampening the earthworm's ability to react to stimuli, The study, along with others, show that humans react the same way to gasoline, as it depresses their nervous system. This test is different than others as testing gasoline on earthworm has never been done before. This study found that gasoline does affect an earthworm's nervous system, and with assumably similar results, drastically affects a human's as well.

Introduction

According to www.healthline.com, there are many symptoms that come with gasoline poisoning, which is caused by contact with or inhalation of gasoline. Exposure to gasoline can cause many health problems such as "difficulty breathing, throat pain or burning, burning in the esophagus, abdominal pain, vision loss, vomiting with or without blood, bloody stools, dizziness, severe headaches, extreme fatigue, convulsions, body weakness, and loss of consciousness." However, perhaps the worst problem that

comes with long-term gasoline inhalation is lung damage. Inhaling these types of fumes can also cause carbon monoxide poisoning, which is why it is dangerous to run a vehicle in an enclosed space. Gasoline is extremely common among vehicles and industrial machines; this is why humans are exposed to it on a daily basis even though this can cause serious risks to health. There are components in gasoline, hydrocarbons, that make it dangerous to inhale or come into contact with. Hydrocarbons are generally found in common fluids such as, “motor oil, lamp oil, kerosene, paint, rubber cement, and lighter fluid.” With hydrocarbons found in all of these substances, the risks to our health are not just limited to gasoline. Although pumping gasoline into a vehicle is not too dangerous on its own, the gasoline coming into contact with skin can cause harm to the contacted area, especially if an allergic reaction is caused. Although most symptoms of gasoline poisoning is treatable without serious injury, gasoline poisoning can cause permanent lung, mouth, and stomach problems. This is a study of anatomy as the scientists are using the information to relate back to how gasoline could harm humans.

An earthworm can learn and relearn certain behaviors. Earthworms learn to react a certain way to a specific stimulus and they learn which stimuli they need to be afraid of. By becoming habituated with a stimulus, an earthworm can temporarily learn a behavior. It will eventually forget but the earthworm can also relearn a behavior. Though the earthworm may forget what it learns, when faced with the same stimulus, it knows what to do, and relearns quicker than when it learned the first time. This is useful in the wild for an earthworm for it to recognize danger, such as the vibrations that a mole, a worm's natural predator, creates when it digs. But it also is dangerous as birds simulate these vibrations when they peck at the ground to draw worms to the surface, right into

the bird's mouth. While both useful and dangerous, the ability to learn behaviors is important to survival. An earthworm can learn and relearn how to react to a certain stimuli. Another important fact that the scientists figured out is that about, 30 mL of gasoline are leaked from a single gas station each day. That may not seem like much but that is enough to fill a small like, about 7,000 acres in volume, in just 24 days from a single gas station.

As this study is to be related to how gasoline exposure could affect humans, without using humans as that is inhumane and illegal with the health risks, earthworms were used to test. However, between the two species, there are many different variables that come into play. Such as size, strength, tolerance, and a very different anatomy. Due to the size difference between a human and an earthworm, of course the exact same measurement of gasoline cannot be used to achieve the same effect with a human. While a different measurement could be calculated it strays from the study which focuses on general effects. Another difference is the strength and tolerance levels that each animal possesses. Despite a possible calculable amount to test on a human, using the amount tested on the earthworm and the size difference, the human may be more tolerant to that calculated amount, as size is not the only factor. Even if not immediately, a human would most likely become tolerant to the amount of gasoline much more quickly than an earthworm would. Another very important difference between a human and an earthworm, is our anatomy. Despite countless similarities between our bodies, there are even more differences. While an earthworm breathes through its skin, humans can only breathe through their mouth and nose. So, an earthworm can come into contact with the gasoline and inhale it at the same time as it

does both through its skin; while a human would do these separately. An earthworm is then experiencing two forms of contact at once, both internally and externally. This would only cause the earthworms to receive gasoline poisoning more quickly through two types of contact at once. Despite what is known about the study, there are countless variables between the subjected earthworm and the humans that would presumably have the same effect. However, with presumably similar effects to a human's, contact with gasoline will have devastating effects on the earthworm's nervous system

Materials and Methods

The experiment was conducted to test the effects of gasoline on earthworms and to find how gasoline would affect humans. The first test that the scientists conducted was a preference study, to see if earthworms prefered untouched soil, or gasoline saturated soil. There are a few things needed to conduct this experiment.

- A small metal tray (2)
- Small amount of soil, about a ziploc bag's worth (2)
- Earthworm (3) (Carolina Biological)
- 45 mL of gasoline in a 100 mL glass beaker
- A stop watch (optional)
- A spray bottle of dechlorinated tap water

To conduct this experiment, first you will need two metal trays. Take one of the trays and empty a ziploc bag of dirt into each end of the tray, making sure to leave soil-free space in the middle for the earthworm to move. Next, take the 45 mL of gasoline in the 100 mL glass beaker, and dump the gasoline in one of the piles of soil, to completely 100% saturate that pile of soil. Leave the other pile untouched. Place one of the three

earthworms in the middle of the two piles of soil. Watch which pile of dirt that the earthworms chose and record it. Then observe the earthworms and write down any observations that you find important. You can also time the earthworms to see how long it takes them to chose a pile of dirt and burrow into it. Then spray the earthworms with the water to wash off any gasoline that might still be on them.

The next experiment that the scientists conducted was to test the startle response on earthworms that had been contaminated with gasoline. This test was used to find how gasoline would affect the human nervous system, judging by how it affected the earthworm nervous system. What is needed is

- A small metal tray (2)
- Earthworm (2) (Carolina Biological)
- 10 mL of gasoline in a 100 mL glass beaker
- A glass eye dropper
- Spray bottle of dechlorinated tap water.

For this experiment, lay out the metal trays. Place one earthworm in each tray. Take the 10 mL of gasoline and draw out as much as you can with the eyedropper. Next, take only one of the earthworms and drop three drops of gasoline on its posterior (head) end. Then, wait 15 seconds and after that tap the posterior end every 15 seconds until the earthworm doesn't react. Record the intensity of its reaction and then do the same for the other earthworm, without dropping any gasoline on that worm. Finally, spray down both of the earthworms for safe measures.

The results were measured based on the intensity of the earthworms reaction on a scale from strong, to mild, and no reaction.

Results

The preference experiment is set up by using to piles of soil, one 100% saturated with gasoline and one left alone, and placing the earthworm in the middle. The earthworm is then to be observed as to which soil it chooses, and possibly how long it takes them to chose that soil. To test if the earthworms can learn and relearn while affected by gasoline, drop three drops of gasoline on the posterior end of an earthworm, and quickly touch its head every fifteen seconds. It is important to test on earthworms instead of humans as there are many negative effects that gasoline has on humans. Gasoline also has many of the same negative effects on earthworms as well, but it is inhumane, and also illegal, to test on humans. Earthworms are an exceptional candidate as the have similar DNA to ours. This means that they will presumably have the same reactions as a human would. However, with presumably similar effects to a human's, contact with gasoline will have devastating effects on the earthworm's nervous system. What is being tested here is how gasoline, the independent variable, affects an earthworm's ability to learn and relearn, the dependent variable. Within the experiment, the scientists also had a control, an earthworm who was not contaminated with gasoline, to compare the contaminated earthworm's results to. As shown, the results from the control earthworm is severely different from the contaminated earthworm.

Ability to Learn	1	2	3	4	5	6
Contaminated Earthworm Reaction	Mild Reaction	No Reaction				
Control Earthworm Reaction	Strong Reaction	Strong Reaction	Strong Reaction	Mild Reaction	Mild Reaction	No Reaction

Ability To Relearn	1	2	3	4	5	6
Contaminated Earthworm Reaction	Mild Reaction	No Reaction				
Control Earthworm Reaction	Strong Reaction	Mild Reaction	Mild Reaction	No Reaction		

These tables show the results of the test and how the earthworms reacted to the gasoline and stimuli.

Besides the obvious reaction change, another difference between the two earthworms' reaction is the time between the two tests. It took the control earthworm five minutes to relearn this behavior after learning it. It took the contaminated earthworm twenty three minutes to relearn the behavior. "Gasoline depresses the central nervous system", similar to alcohol intoxication. While it seems that these worms are reaction faster to the stimuli, the gasoline actually prevents them from reacting. This shows that the scientists' hypothesis is alternate as the test clearly shows that the earthworms were affected and the tests are statistically significant.

Discussion

Exposure to gasoline can cause a wide variety of health problems such as functions like breathing and vision; pain in the abdomen or headaches; and poisoning causing possible permanent lung, mouth, and stomach problems. Since humans are dependent on the use of gasoline in their daily lives, they are exposed to it often. Those who work in certain jobs or industries may be more at risk to related health problems since hydrocarbons can often be found in common fluids such as, “motor oil, lamp oil, kerosene, paint, rubber cement, and lighter fluid.” The study on earthworms showed that gasoline is harmful to their nervous system and presumably it would be harmful to humans’ nervous systems as well. A significant result in the experiment is that the earthworm reacted to only one stimuli when affected by gasoline. An error in a previous test with earthworms found that it took the earthworm 13 stimuli to become habituated with the behavior that was being tested. It took three stimuli to relearn the behavior.

Even with the errored experiment, there was a trend in the learning; it took less stimuli to relearn a behavior than it did to learn it the first time. The most recent test took the earthworm six stimuli. The challenges in comparing earthworms to humans include the size difference as well as the fact that earthworms breathe through their skin making contact to gasoline even more dangerous for them. To get more concrete and accurate results on the effects that gasoline has on humans, further studies would need to occur. Perhaps a solution could be invented to offset the harmful chemicals in gasoline. This could be further tested to check its accuracy as well as its effect. The data supported the hypothesis which stated that gasoline would negatively impact an earthworm’s ability to learn and to relearn behaviors. The data shows that gasoline dampened an

earthworm's ability to react to stimuli. The results are relevant because they show that exposure to gasoline can cause many health problems such as "difficulty breathing, throat pain or burning, burning in the esophagus, abdominal pain, vision loss, vomiting with or without blood, bloody stools, dizziness, severe headaches, extreme fatigue, convulsions, body weakness, and loss of consciousness."

Conclusion

With presumably similar effects to a human's, contact with gasoline will have devastating effects on the earthworm's nervous system. Gasoline has many studied and confirmed negative effects on humans, and this study clearly shows that gasoline affects earthworms as well. Gasoline prevents earthworms from reacting to stimuli by depressing their central nervous system. This study not only helps us find how gasoline affects earthworms as an environmental contaminant, but also helps find how gasoline affects humans, without testing on them.

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