



# The Effects of Glass Cleaner on Worms

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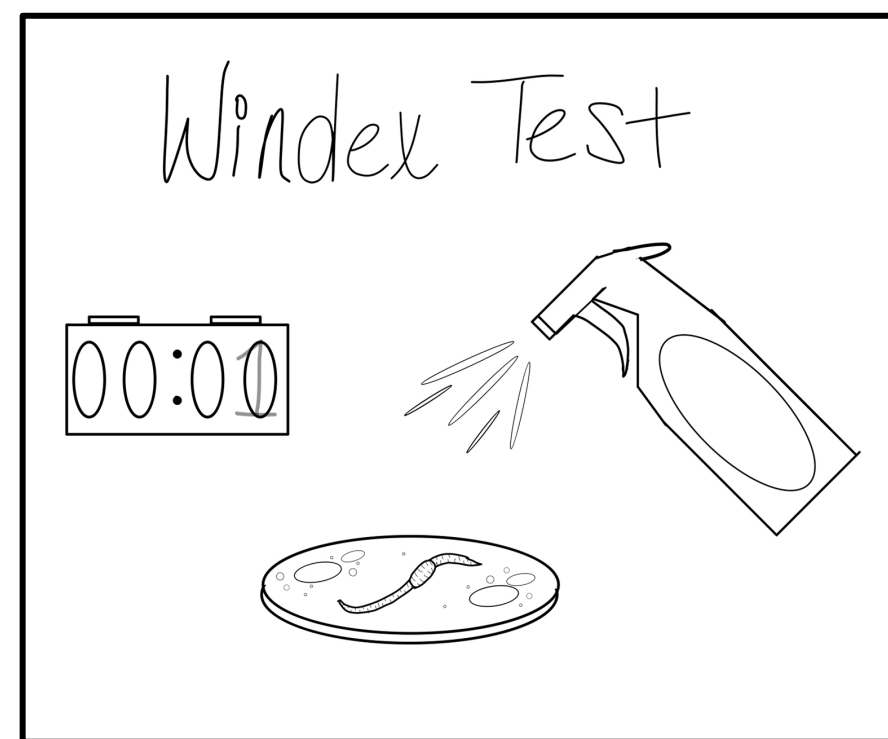


## Introduction

Toxicology is the study of adverse effects of chemical, physical, or biological agents on living organisms and the ecosystem, including the prevention and amelioration of such adverse side effects.<sup>4</sup> For our project we decided to test the safety of commonly used glass cleaners specifically: Windex and another off brand window cleaner. We are doing two tests: a direct spray of 10% cleaner solution, and a residual chemical test of 100% solution. We chose these ways because we believe that these are the ways we are exposed to glass cleaners. We think that windex and other glass cleaners are unsafe at full concentration for sensitive skin and eyes.

## Materials and Methods

We started by doing a residual chemical test. We sprayed the cleaner directly onto a Petri dish and wiped most of the chemical off, to mimic how a person would clean with the chemical. We then placed the worm for three minutes and recorded how long (in seconds) there was no, mild, or a strong reaction. We then did a spray test. We placed a worm onto a Petri dish and sprayed a 10% solution onto the worm and recorded how long (in seconds) there was no, mild, or a strong reaction. We recorded our information on the following digital sheet.



Water Spray				Windex Spray (1 container)				Windex Residue (1 container)			
Mild	Strong	No Reaction		Mild	Strong	No Reaction		Mild	Strong	No Reaction	
Worm 1	0	0	180	Worm 1 (100%, standard wipe)	180	0	0	Worm 1 (100%, standard wipe)	118	7	63
Worm 2	0	0	180	Worm 2 (100%, standard wipe)	0	0	180	Worm 2 (100%, standard wipe)	0	0	180
Worm 3	0	0	180	Worm 3 (100%, standard wipe)	0	0	180	Worm 3 (100%, standard wipe)	0	0	180
Worm 4	0	0	180	Worm 4 (100%, standard wipe)	0	0	180	Worm 4 (100%, standard wipe)	0	0	180
Water Residual				Off Brand Spray (1 container)				Off Brand Residue (1 container)			
Mild	Strong	No Reaction		Mild	Strong	No Reaction		Mild	Strong	No Reaction	
Worm 1	0	0	180	Worm 1 (100%, standard wipe)	0	0	180	Worm 1 (100%, standard wipe)	0	0	180
Worm 2	0	0	180	Worm 2 (100%, standard wipe)	0	0	180	Worm 2 (100%, standard wipe)	0	0	180
Worm 3	0	0	180	Worm 3 (100%, standard wipe)	0	0	180	Worm 3 (100%, standard wipe)	0	0	180
Worm 4	0	0	180	Worm 4 (100%, standard wipe)	0	0	180	Worm 4 (100%, standard wipe)	0	0	180

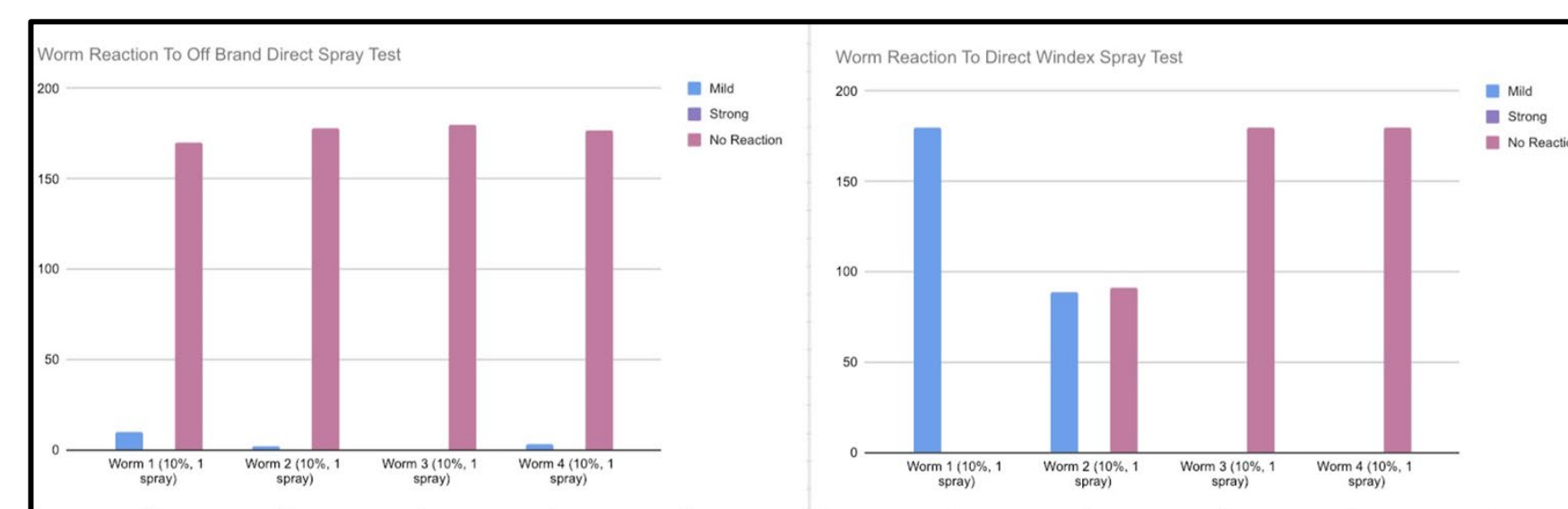
## Results

We determined that worms react strongly to pure chemical, mildly to residual chemical, and have little reaction to 10% chemical. The best way to utilize this information is to wear goggles or gloves when using chemicals and potentially dilute your cleaner to make it safer.

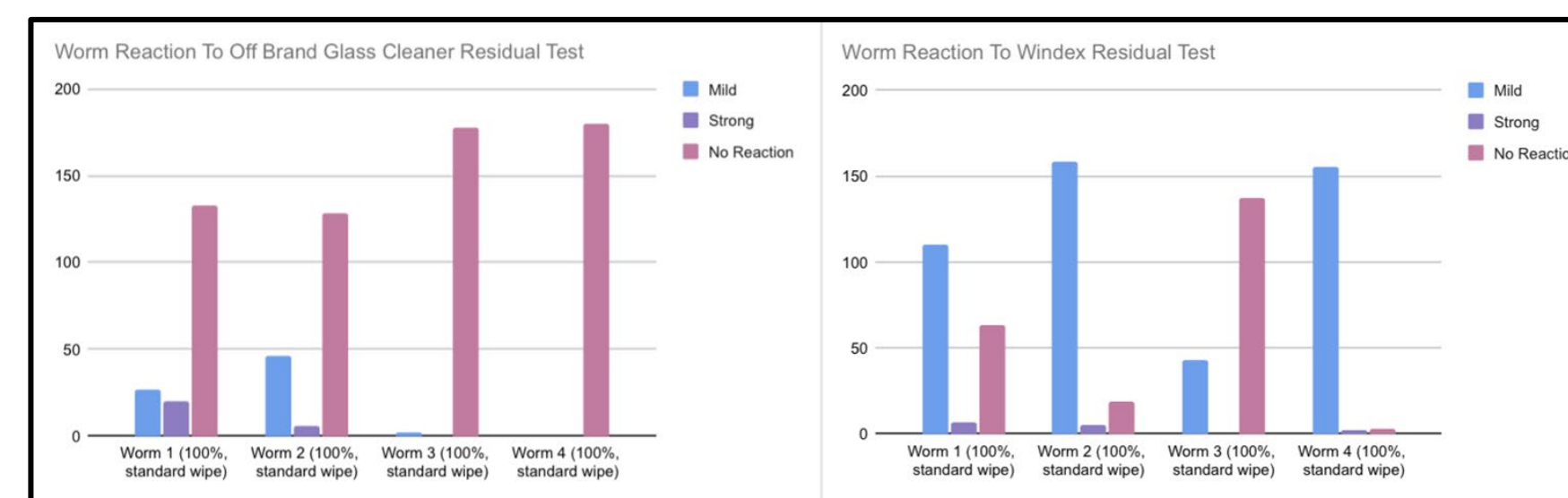
## Abstract

For our project we decided to test different glass cleaners to see if they are safe for human exposure. We discovered that worms react strongly to the pure chemical, signifying that glass cleaners should not be put in your eyes or mouth, and we also discovered that diluting the chemical makes it much safer. This is important because glass cleaners are commonly used.

## Data Presentation



These are our results for the direct spray test. Because we diluted the chemical to 10%, there were no strong reactions. However, the mild reactions signify that even a little chemical can cause damage to sensitive skin or eyes/mouth.



These are our results for the residual chemical test. Because we wiped the majority of the chemical off, there were little strong reactions. However, the reactions signify that sensitive parts of a human should not be exposed to chemicals.

## Data Analysis

We used ANOVA (Analysis of Variances) and pairwise testing to analyze our results, and found that, in the residual test, water and off brand windex are the same while windex is different. In the spray tests, which were all at 10% dilution, both Windex and the off brand cleaner were the same as water. According to the data tables, off-brand glass cleaner is safer because it has a similar reaction to water, so those with sensitivities to chemicals should use an off-brand cleaner.

Spray Testing		Residue Testing	
p-values for ANOVA and Pairwise Testing		p-values for ANOVA and Pairwise Testing	
ANOVA	0.44	ANOVA	0.01
Water v Windex	-	Water v Windex	0.03
Water v Off-brand	-	Water v Off-brand	0.17
Windex v Off-brand	-	Windex v Off-brand	0.04

According to the data tables, at 10%, all chemicals are the same safety as water. You could test to see if the diluted version cleans properly, and if it does, we recommend diluting your chemical to make it safer.

## Discussion

Windex was introduced in 1936 and according to [yourbestdigs.com](https://www.yourbestdigs.com) and other product ranking sites, “Windex is the best window cleaner available.”<sup>2</sup> It was essential that this chemical was safe. We learned that through the years, glass cleaners have gotten safer, as less ammonia has been used. In 1989, 5% of Windex solution was ammonia. The [New York state department of health](https://www.health.ny.gov/diseases/communicable/ammonia/) states that “ammonia is a widely produced chemical” and “When ammonia enters the body as a result of breathing, swallowing or skin contact, it reacts with water to produce ammonium hydroxide. This chemical is very corrosive and damages cells in the body on contact.”<sup>5</sup> Since then, windex has been reevaluated.<sup>3</sup> We wanted to test another glass cleaner as a comparison to see which was safer as well, and we discovered important information.

These results have made us determine that our hypothesis was correct. The worms represent sensitive skin, eyes, and mouth on a human. When placed in a Petri dish with residual glass cleaner on it, the worms sometimes reacted mildly, and sometimes reacted strongly. When the worms had no reaction we saw them unbothered but when they reacted mildly we found the worms thrashed and squirmed away from the chemical but when the worms reacted strongly the worms would have severe spasms, mucus and we believe that if we hadn’t taken the worms out of the petri dish as soon as these severe reactions had happened that they would’ve died.

These tests show that when cleaning your windows or a mirror, you should wear eye protection to keep chemicals out of your eyes and take time to properly wipe down the freshly sprayed surface. We also strongly suggest that after handling the chemical you wash your hands as the [CDC](https://www.cdc.gov) states that Scientific studies show that you need to scrub for 20 seconds to remove harmful germs and chemicals from your hands,<sup>1</sup> and [top class actions](https://www.consumerreports.org) says that Windex contains many harmful chemicals including butylphenyl methylpropional, linalool, 2-hexoxyethanol and isopropanolamine.<sup>6</sup>

## Works Cited

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