

**YEAR: 2022-2023**

**Project Title:** Are ants similar to humans in reacting to As

**School:** MMHS

**Grade Level:** 11

**Your Name:** Jim Lenke

**Project Partners:**

I worked with Tora Johnson from UMaine at Machias

**Teacher/Scientist Partner Profile:**

Finishing seventh year of teaching after roughly 35 years work in industry as a chemist/engineer. Studied Chemistry with minor in Mathematics at College, but with a keen interest in engineering( all types). Fun fact, I was given the first and only Chemistry Factotum award from my school. Having worked in several University research laboratories, I really like making the impossible possible by designing new equipment or techniques that ultimately are useful for other researchers or humankind. Upon entering the secondary teaching profession I quickly realized there are not many research opportunities available, so when AAA fell into my lap I jumped at the opportunity.

**Summary:**

I remember vividly as a young boy walking around with my Grandfather sprinkling white arsenic powder on ant hills to kill carpenter ants. Previous bioassays have presented many difficulties in both operation and successful. Handling small organisms has traditionally been tedious for students, so this year switched to ants as the colonies are easier to observe and dispense arsenic to.

Students had to calculate amount of As per weight of ant and relate to human weight, as well as discuss how much As can be absorbed by food. This was coordinated with normal curriculum on periodic table and organization of elements. Discussion of what to graph and how to collect data lead to a lengthy discussion on data, types of data and graphing of data. In addition, this lead to a discussion on ethics as it was determined that the ants might need to be dissected in order to see the effects. LD50 was needed to discuss results, which were not immediately conclusive. Additionally samples were collected from each student, from those that chose to participate (10), and then Washington County results were looked at to determine a series of questions: Which city is the most dangerous to live in? How does Washington county compare to Maine for As danger? Is As a problem across the state? Further, Maine CDC data was looked at for cancer rates by county and by city, followed by a discussion of how As effects the body and then the geology of where and how it occurs.

**Project Details:**

- Overall there were 10 students who participated in water sample collection, but 12 chemistry students.
- The maths/Stats teacher was involved regarding statistics and likely hood of cancer.
- During the bioassay of ants not optimum outcome brought out the discussion of ethics, and ethics vs. morality, and death. Further, not 100% death of subjects brought out how to deal with graphing.
- From the discussions it was learned that a "Wednesday" course on debates would be enjoyed by many students.
- TUVAs were used to analyze ant results and attempt to make graphs. TUVAs are used, as always during chemistry and physics course throughout the year to explain graphs, conduct data literacy and analyze existing TUVAs files.
- Kits purchased this year were pipettes, four ant farms, digital sensors, containers, disposal equipment and safety goggles. All of this equipment was used to monitor and conduct the bioassay as well as prepare special environments for the ants. Despite all this, it was learned that fermentation can happen very quickly and probably have a detrimental effect.
- Community outreach ended with discussion about how to improve the laws, discussions with the Social Studies teacher on Maine legal process, as well as why some laws currently exist while others don't. Perhaps a growing time for the older students who think they know everything but then learn there is much more information needed.
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**Discussion:**

- Students learned that science, and data, take actually quite a lot of planning and are very slow, unlike say TikTok or ordering from Amazon or an app.
- It was learned that is extremely hard to explain the complexity of a scientific peer reviewed article and what's required and why to HS students.
- It was learned that ants are much harder to keep than it seems.
- I would really seek out a variety of bioassays and ask the students which they want to do, plan everything and execute. Although this sounds amazing and fun, the moving pieces complexity is very hard to accomplish in a spring semester course, as well as collect water samples.

**Conclusion:** This was a low success year for MMHS. This is the first time I have had a spring course and the timing makes success and operation tedious. The ants weren't great but it brought out many more discussions that I think would not have happened if student couldn't visibly see and take care of subject.

**References:**

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Google slides on TUVA results

<https://docs.google.com/presentation/d/1U3CkmB4I-dVb-R-6CFRdq9hOHPBnWJi7jCDxAkNNsaU/edit?usp=sharing>

[https://docs.google.com/presentation/d/1gkuqj1-ONwI2TyYPHjLwi6hJl\\_OEndPU2LaHvM059A4/edit?usp=sharing](https://docs.google.com/presentation/d/1gkuqj1-ONwI2TyYPHjLwi6hJl_OEndPU2LaHvM059A4/edit?usp=sharing)

**Experimental**

It was observed that the arsenic group of ants would often gather together in groups, which was seemingly unusual.

Both groups of ants would bring their dead to a specific part of the farm, which was often referred to as the "ant graveyard".

Side note: Both groups of ants originally had 16 in each vial when they were first separated, but the next day, when they were put in the farms, the control group experienced a diminishing loss and were down to 9 ants left. This left us with an uneven amount of ants at the start of the experiment

**Control**

Both groups were fed bananas, apples, and corn, along with a small pad soaked in water. The arsenic group first had their food freeze dried, then soaked in the arsenic, which was handled by Mr. Lenke.

Check out some real live ants!

Control start: 9

Arsenic start: 15

**Ar**  
Arsenic  
74.921595

**Ar**  
Arsenic  
74.921595

Works cited:  
<https://azielharper.co.uk/2022/06/ant-anatomy-for-beginners/>  
<https://www.who.int/news-room/fact-sheets/detail/arsenic---text---arsenic>  
<https://www.dreamstime.com/arsenic-periodic-table-elements-vector-ii-image-image62220893>

Group	Beginning	Dead	% left	Time (days)	Death rate
Arsenic	15	5	66	4	16.6%/day
Control	9	0	90	11	7.3%/day

Control (ants) and Arsenic (ants)

Ants (Survival)

Time (days)

The control group at 12 days had about 9 inches of tunneling in their farms by day 12, while the arsenic ants only had about 10 inches