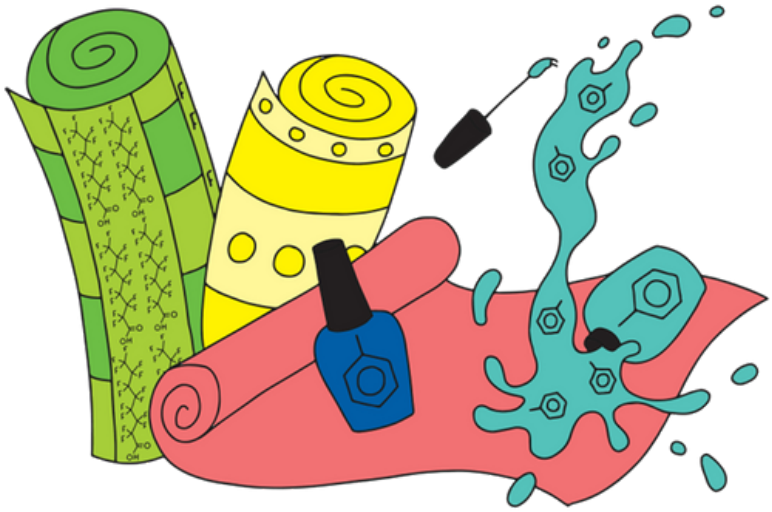
Department of Toxic Substances Control

Toxic Crusaders

Are your products safe?



2023

Summary Report

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Introduction

Toxic Crusaders is a 6-week laboratory exposure program developed and presented by the Department of Toxic Substances Control (DTSC). The department strives to protect California's communities and environment from toxic chemicals, to restore contaminated land, and to compel manufacturers to make safer products. Toxic Crusaders is aligned with the mission of DTSC with the following program specific goals:

- To expose students to an applied science in a professional laboratory;
- To develop critical thinking skills with respect to toxic chemicals in consumer products and the environment;
- To learn about the DTSC and government careers.

ECL scientist Arely demonstrating the process for separating carpet fibers from backing.

Introduction

The Toxic Crusaders program is offered to high school students as a unique opportunity for exposure to the inner workings of a real, professional government laboratory. The curriculum provides five weekly onboarding workshops developed, delivered and presented by the Department of Toxic Substances Control(DTSC). The virtual curriculum introduces the chemicals of concern in priority consumer products and contextualizes their analysis in the laboratory. The goal is to prepare the students for the on-site event where they can apply that knowledge as they work alongside DTSC scientists in the laboratory.

Students have the opportunity to talk to the staff in detail about their career experiences and trajectories. Most students are unfamiliar with the stable and meaningful careers offered by DTSC and other public sectors. Students additionally have the opportunity to connect with professionals of other skill sets such as volunteers from the Office of Environmental Management (OEIM) and Agilent, a manufacturer of analytical instrumentation tools.

ECL Scientist Mui guiding students through preparation of solutions for a calibration curve.

Curriculum

Virtual Workshops

Toxic Crusaders begins with a series of virtual workshops to prepare students for the in-laboratory event. Over the first three weeks, the workshop curriculum introduces why DTSC decided to regulate and phase-out per- and polyfluoroalkyl substances (PFASs) in carpets and toluene in nail products. The fourth week and fifth week focus on the analytical testing of these chemicals in the products. Topics include the quality control requirements and the instruments that are used to measure the concentration of chemicals in these products. The full curriculum is listed below:

Table 1. Virtual workshop curriculum and event schedule.

Week	Provider	Activity
1	DTSC (Virtual)	Topic 1: Are Your Products Safe?
2	DTSC (Virtual)	Topic 2: PFASs in Carpets and Rugs
3	DTSC (Virtual)	Topic 3: Toluene in Nail Polish
4	DTSC (Virtual)	Topic 4: Quality Control and Calibration
5	DTSC (Virtual)	Topic 5: Analysis of PFASs by LC-MS/MS and Toluene by PT-GC/MS
6	DTSC (On-site)	HPIAM Visit - Tuesday / Wednesday Ortho Visit - Thursday Friday Community Visit - Saturday

Curriculum

On-site Event Day

Each day, the Pasadena Environmental Chemistry Lab (ECL) hosted a different class of students who were divided into 6 groups. Three stations were set-up in duplicate to accommodate smaller group sizes. The stations are summarized below:

Station 1: Preparation of carpet and rug samples.

Station 2: Extraction and analysis of PFASs in carpets and rugs using LC-MS/MS*

Station 3: Preparation, extraction and analysis of toluene in nail products using PT-GC-MS**

*Liquid Chromatography-Tandem Mass Spectrometry

**Purge and Trap Gas Chromatography-Mass Spectrometry

Table 2. On-site event schedule.

Event	Time	Description	
Introduction	8:45 – 9:00 am	• Overview of today's event	
Migration to first rotation and restroom if needed – 5 min.			
First Rotation	9:00 – 10:10 am	• Group 1: Station 1a • Group 2: Station 2a • Group 3: Station 3a	• Group 4: Station 1b • Group 5: Station 2b • Group 6: Station 3b
Migration to second rotation and restroom if needed – 5 min.			
Second Rotation	10:15 – 11:30 am	• Group 1: Station 2a • Group 2: Station 3a • Group 3: Station 1a	• Group 4: Station 2b • Group 5: Station 3b • Group 6: Station 1b
Lunch and then migration to third rotation – 50 min. - Lunch will be in Large Break Room			
Third Rotation	12:30 – 1:45 pm	• Group 1: Station 3a • Group 2: Station 1a • Group 3: Station 2a	• Group 4: Station 3b • Group 5: Station 1b • Group 6: Station 2b
Migration to Large Break Room or Sample Receiving Room and restroom if needed – 5 min.			
Reporting Out and Q&A	1:50 – 2:30 pm	Group 1-3: Large Break Room	Group 4-6: Sample Receiving Room

HPIAM

Huntington Park Institute of Applied Medicine

HPIAM is a small pilot high school available as an option to the local community of Huntington Park, Los Angeles. The school is known for its health-based science, technology, engineering and mathematics (STEM) curriculum in addition to expected class subjects. The goal of HPIAM is to prepare students with knowledge necessary to help students compete in college enrollment and succeed in their professional aspirations.

Table 3. HPIAM student career aspirations.

Career Subject	Number of Students
Biology	10
Medicine	10
Social/Psychology	3
Law	2
Engineering	4
Business	6
Creative	4
Comp Sci	6
Other STEM	4
Unsure	13
Total	62

Students preparing carpet samples at Station 1.

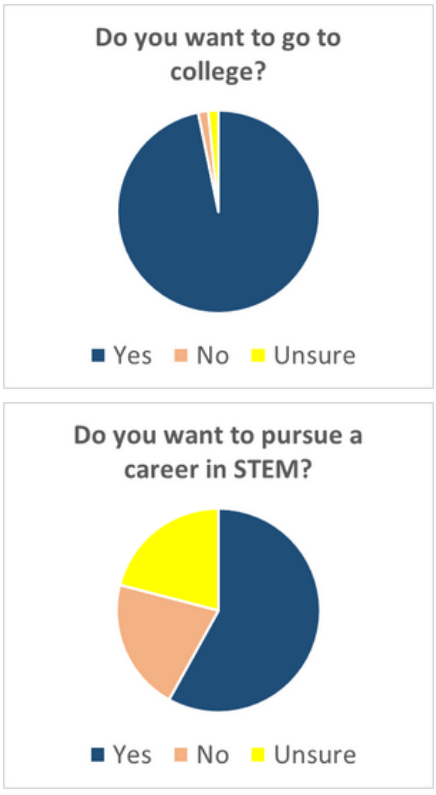


Figure 1. HPIAM students' self-reported career aspirations.

The 11th grade students from HPIAM joined DTSC ECL in two groups on October 24th and October 25th 2023. Pre-event surveys were distributed before the virtual workshops, and students were asked if they wanted to attend college, to which the overwhelming majority, 60/62 students, responded "yes" to college. HPIAM junior year students completed chemistry in 10th grade and may not be aware of the full scope of available professions in chemistry. Early career exposure to real, professional laboratory-based work is beneficial for students affirming or deciding on their major.

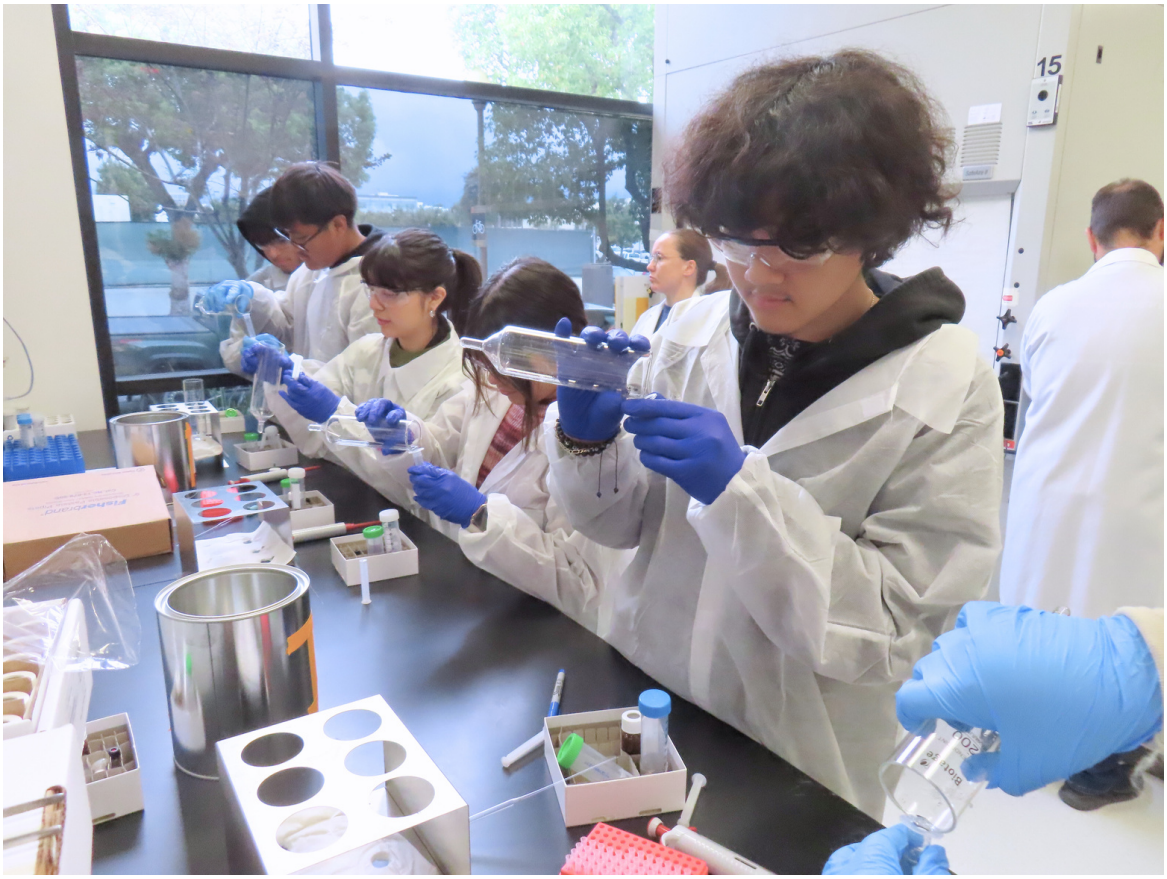
Another question asked students to report their career aspirations. The majority was composed of 36/62 students who responded with interest in a STEM-related field. Students received direct exposure to instrumentation and information helpful for their professional development during the on-site event. DTSC's information technology (IT) program, OEIM, also attended the event and offered continued conversation about computer science careers(6). Unsure students (13) had the opportunity to experiment mentally with the idea of working in a laboratory or aligning with a public endeavor like the mission of DTSC: to protect the people and environment from toxic chemicals.

HPIAM

On-site Event Day

> I expect to learn more about how toxic chemicals are/should be handled. I also expect to learn more about the laws/processes the products on the market have to go through to be able to be approved.
>
> -J. Jimenez

Student preparing a nail polish sample to test for toluene (left). Students pouring carpet sample extracts into centrifuge tubes. (bottom)



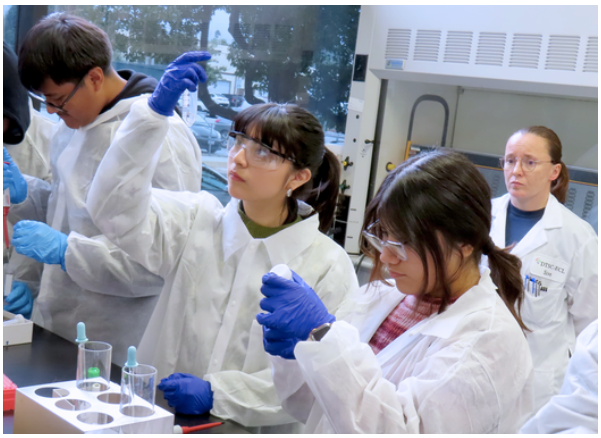
HPIAM

Survey Results

Student engagement and program outcomes were assessed through self-reported pre- and post-event surveys.

HPIAM students' self-reported scores increased across all questions asked in the survey. The top three differentials between pre- and post- survey align directly with the goals of Toxic Crusaders. The greatest score increase was 1.32 points in response to "I'm familiar with the work of DTSC", and the third greatest increase of 0.85 points was "I'm familiar with the different professions at DTSC,". Toxic Crusaders aims to equip students with knowledge about DTSC's mission and the careers within the government, and these qualitative data suggest improvement.

Student preparing to extract PFASs from a carpet sample.



The second greatest score differential aligns with the goal of educating students on the contaminants in their home environments; a 0.96 point increase was observed in response to the question concerning knowledge of toxic chemicals in consumer products.

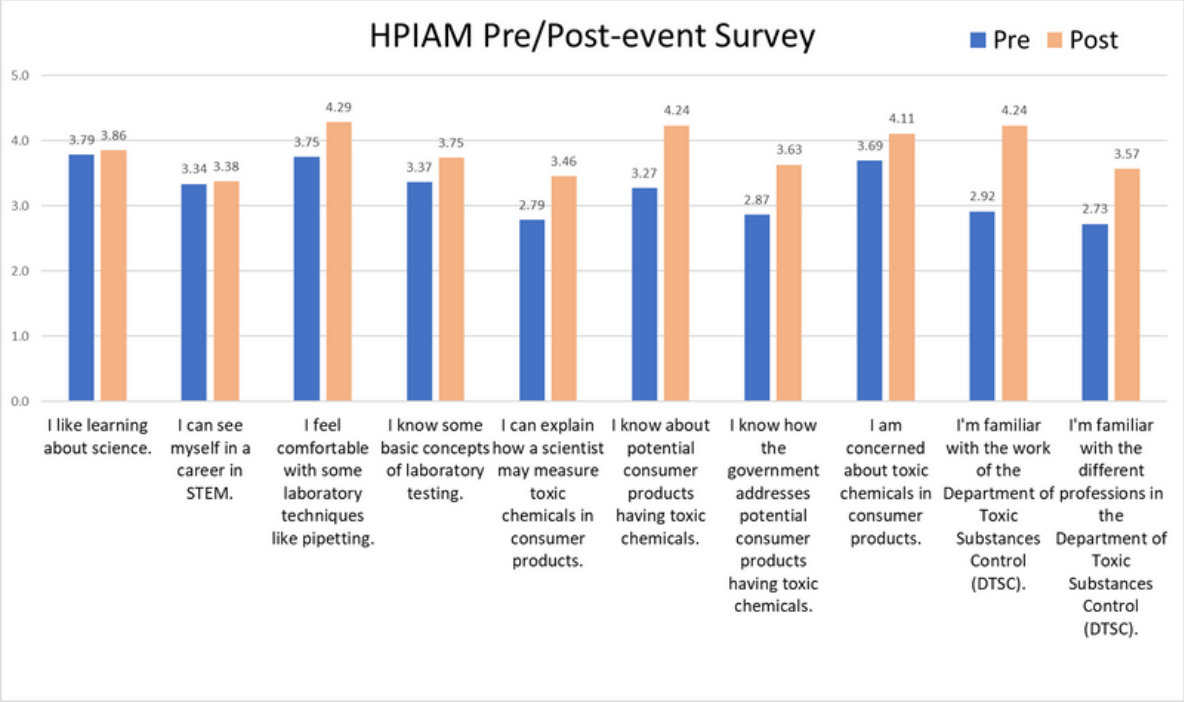


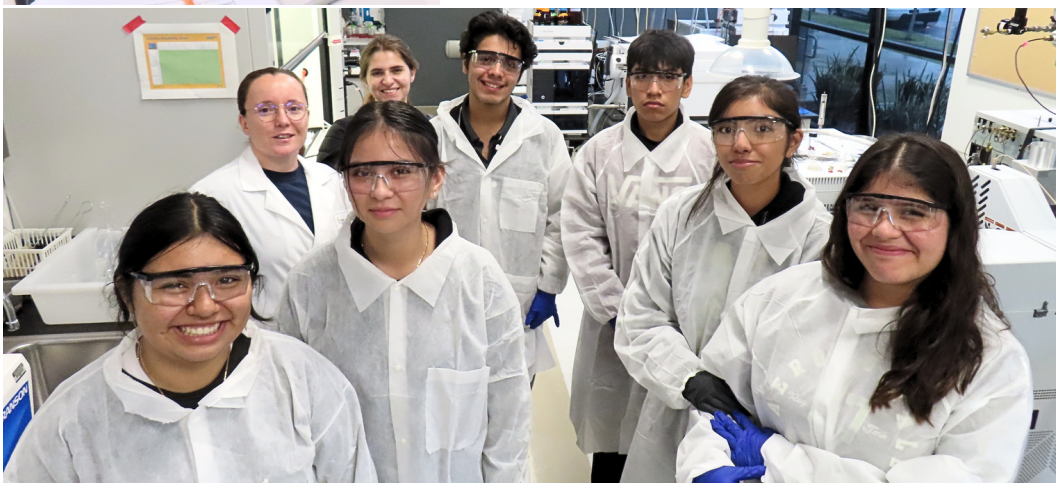
Figure 2. Students were asked to rate the following statements from 1-5 ranging from 1 = disagree to 5 = agree.

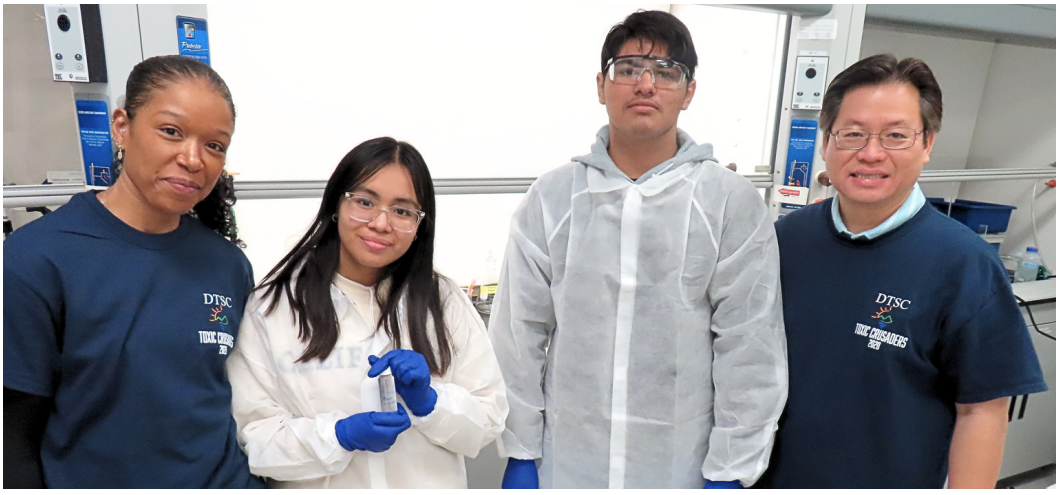
HPIAM

Huntington Park Institute of Applied Medicine

> I learned how to use C1V1=C2V2 in order to see the calibration concentration.
>
> -Z. Xie

Student separating carpet fibers from the backing to prepare for analysis (left). Group photo in the organics lab after extracting PFASs from carpet samples (middle).





Students pose with a nail polish extract ready for analysis next to OEE Volunteer Jamie and ECL Scientist Eddie (bottom).

HPIAM

Huntington Park Institute of Applied Medicine

ECL Scientist Sive teaching a student how the centrifuge works (top left). ECL Scientist Anna with a student working on preparing carpet samples (middle left). A student preparing a sample in the fume hood (middle right). HPIAM students, teachers and volunteers pose for a group photo after completing the on-site visit (bottom).

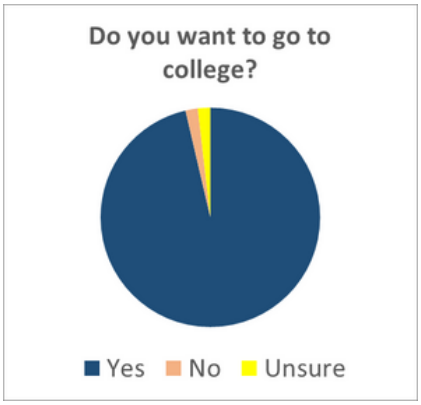
ORTHO

Orthopaedic Hospital Medical Magnet High School

Ortho is a magnet high school located in the concrete jungle of downtown Los Angeles. The curriculum exposes students to pre-med specialized coursework with the goal "to produce well-educated and responsible young adults ready for the responsibilities of further education, careers and citizenship".

Table 4. Ortho students' career aspirations.

Career Subject	Number of Students
Bio/Chem	13
Medicine	8
Social/Psychology	4
Engineering	5
Business	7
Comp Sci	3
Other STEM	4
Other (non-STEM)	3
Unsure	8
Total	55



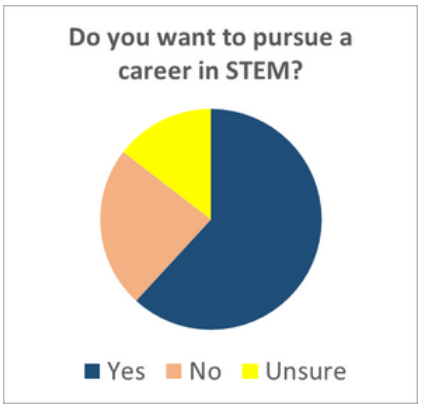


Figure 3. Ortho students' self-reported career aspirations.

The 12th grade students from Ortho joined DTSC at the ECL in two groups on October 26th and October 27th, 2023. Pre-event surveys were distributed before the start of virtual workshops, and students were asked if they wanted to attend college. The overwhelming majority, 53/55 students responded "yes" and eight of these "yes" students were unsure of what major to pursue.

Toxic Crusaders serves as an opportunity for students to find assurance in their STEM career aspirations, or for students to explore the work of DTSC to see if they resonate with the work and/or the mission. Laboratory bench skills, like pipetting and measuring with analytical tools, provide experience for the 21 bio/chem/medicine-oriented students, and it may help them be more competitive in attaining a laboratory position during their undergraduate education. The students go through the process of chemical analysis by LC-MS/MS and PT-GC-MS, complicated sets of instruments that take months to years for scientists to become proficient.

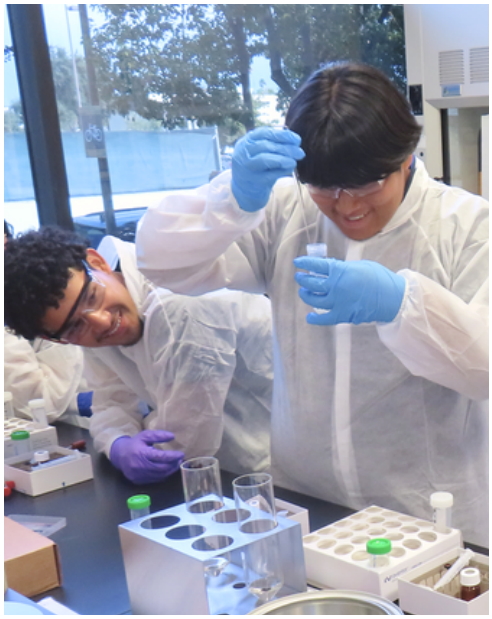
Students interpret and present their results from the workshop.

ORTHO

On-site Event

Students using volumetric flasks to prepare quality control samples (top).

> I want to learn more about the different chemicals in consumer products and better extend my knowledge on what they are so I can take precaution and also spread more awareness.
>
> -H. Mateo



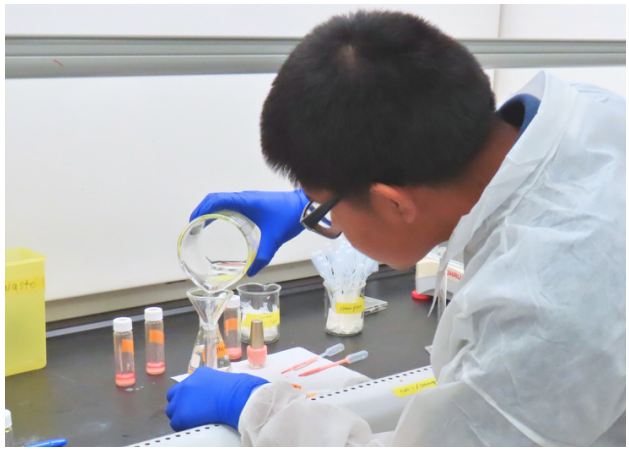
Student pipetting PFASs extracted from his carpet samples (bottom right).

ORTHO

Survey Results

Student engagement and program outcomes were assessed through self-reported pre- and post-event surveys.

The largest gains were observed in the responses to questions pertaining to the work of DTSC and the careers within the department. This was reflected by many questions received from students throughout the day regarding personal career trajectories, paygrades, benefits and skills needed for various positions.



Student pouring methanol into an erlenmeyer flask.

Students were asked to reflect on what they learned from the Toxic Crusaders program following the day's activities. Scores increased for most responses, the exceptions being "I like learning about science." and "I can see myself in a career in STEM", which decreased slightly. Working in a laboratory differs from learning about scientific theories in classroom settings, and learning about day-to-day work environment is an important part of developing a career trajectory.

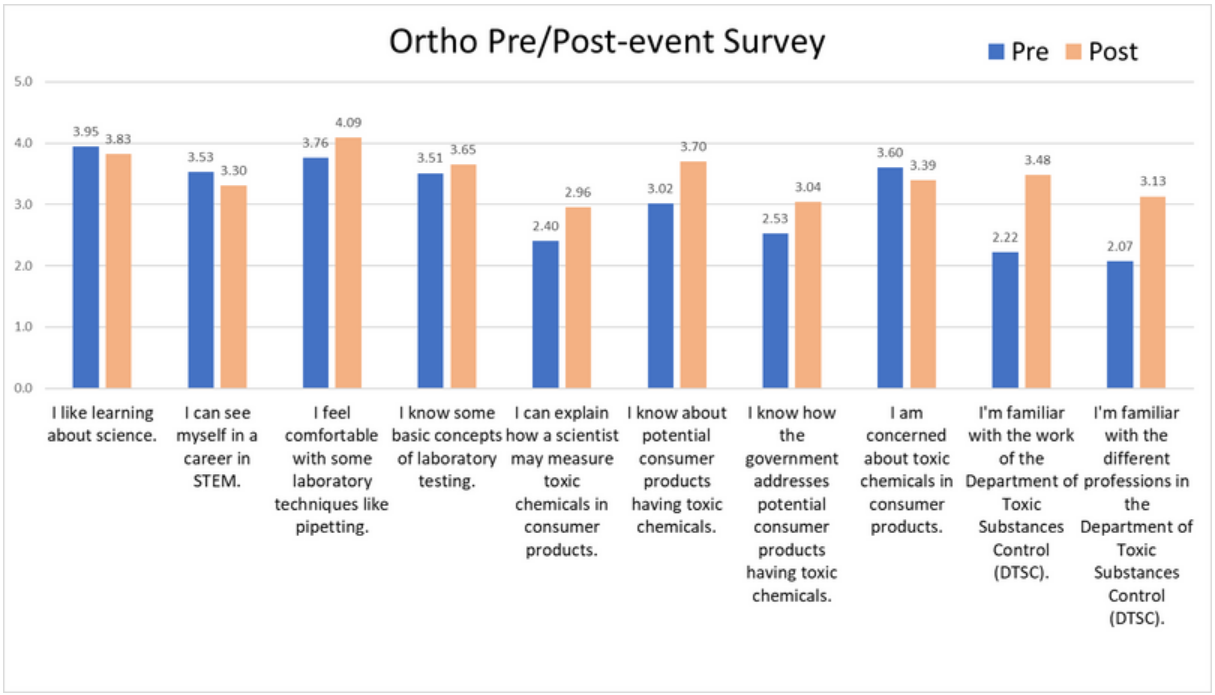


Figure 4. Students were asked to rate the following statements from 1-5 ranging from 1 = disagree to 5 = agree.

ORTHO

Orthopaedic Hospital Medical Magnet High School

> I learned information about what some of the machines do here like the MS, LC and GC as well as pipetting and measuring.
>
> -J. Calon

Ortho students peppered the staff with questions during the on-site event, many of which were focused on the practical aspects of entering the workforce. Some questions included: “What is the pace of your day usually?”, “How is the work/life balance?”, “Do I need a masters degree to work in [DTSC’s] lab?”

A student preparing a quality control sample (top). ECL Scientist Sive demonstrating the centrifuge (bottom).

ORTHO

Orthopaedic Hospital Medical Magnet High School

Student preparing a nail polish sample to test for toluene (top left). Student preparing a quality control sample (top right). Ortho students pose for a group photo after completing the on-site visit (bottom).

COMMUNITY DAY

The in-lab event was held on Saturday and open to all

The day hosted 42 high school students from all across the Los Angeles County area who began to trickle in an hour before the event. The majority of the students were in their sophomore year and currently enrolled in chemistry. A group of students attended from the same class for which the teacher had incentivized attending the on-site event with extra credit. Those who attended the community day event did not receive prior onboarding content, and so the day opened with a brief lecture introducing the topics and concepts.

Recruitment

Fliers designed by DTSC were posted in local areas:

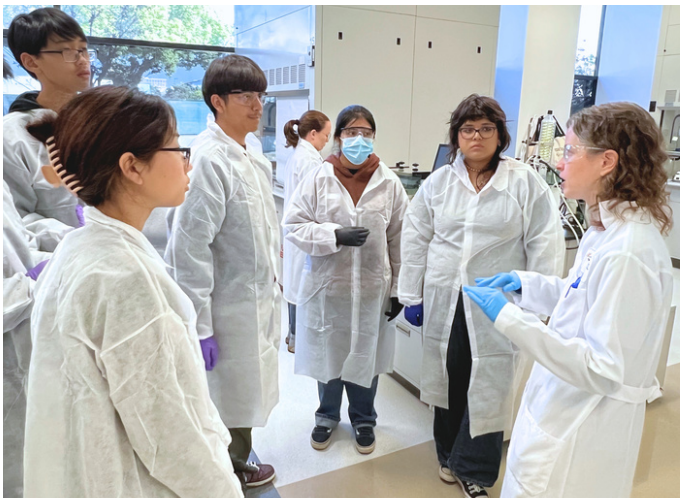
- Permission was received from school districts to post fliers
- A QR code on the fliers directed interested students to an Eventbrite registration

Response

42 students from **9 high schools** attended the event.

Table 5. Number of students per high school attending the open-invite event.

High School	Number of Students	Grade Level
Alhambra HS	27	19 of 10th 3 of 11th 5 of 12th
Cathedral HS	1	11th
Grant Union HS	2	11th
Marshall HS	1	11th
Rosemead HS	4	10th
San Gabriel HS	2	1 of 11th 1 of 12th
Simi Valley HS	1	11th
Temple City HS	2	11th
Valencia HS	2	9th
Total	42	



ECL Scientist Jess teaching students how to prepare PFASs extracts for analysis using LC-MS/MS.

COMMUNITY DAY

Student career aspirations

Saturday's students were highly engaged despite not having the virtual workshops to prepare for the event. The survey results described the group as highly motivated in the pursuit of university with 49/50 students responding with "yes". The open-community group showed the highest interest in a STEM career at 72% compared with the two high schools HPIAM and Ortho at 58% and 61%, respectively.

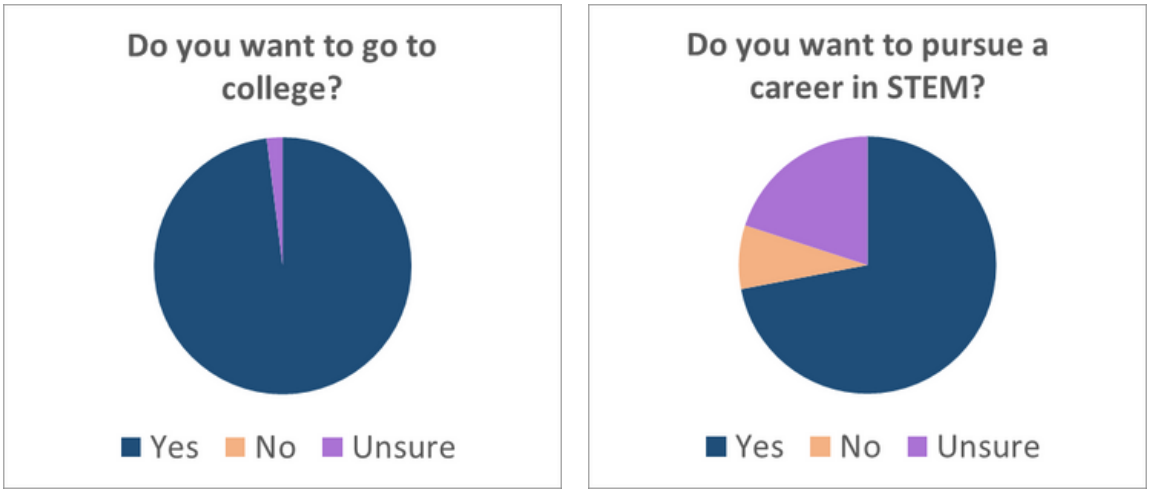


Figure 5. Community day students' self-reported career aspirations.

ECL Scientist Nan demonstrating the proper use of glassware.

COMMUNITY DAY

Students received certificates of completion following the event

Community students of Group 1 proudly displaying their certificates with sponsor Robina, ECL Scientist Mui, OEE* Volunteer Jamie (top) and Group 6 with Mui, Robina and SCP** Volunteer Hannah (bottom).

*Office of Environmental Equity
**Safer Consumer Products

COMMUNITY DAY

Students received certificates of completion following the event

Community students of Group 3 received their certificates with Robina, Mui and OEE Volunteer Teresa (top) and Group 4 with Mui, Robina and ECL Scientist Ori (bottom).

CONCLUSION

Teacher Feedback

HPIAM and Ortho teachers who participated in Toxic Crusaders were asked to fill out surveys following the event to report their observations. The eight teachers, four from each school, overwhelmingly reported ratings near 5/5 across all questions. The four questions with perfect scores echo the fine-tuned organization and robustness of the Toxic Crusaders program. Teachers of both schools felt the curriculum was valuable in engaging and facilitating curiosity within students. They felt supported by DTSC and unanimously reported "I would recommend Toxic Crusaders to a fellow teacher."

The Toxic Crusaders program provides the unique opportunity to serve as the first bridge between high school classroom education and professional exposure to STEM and government related careers. The response of the teachers speaks for the need to supplement the conceptual education students receive in high school with the practicality of working in a real laboratory.

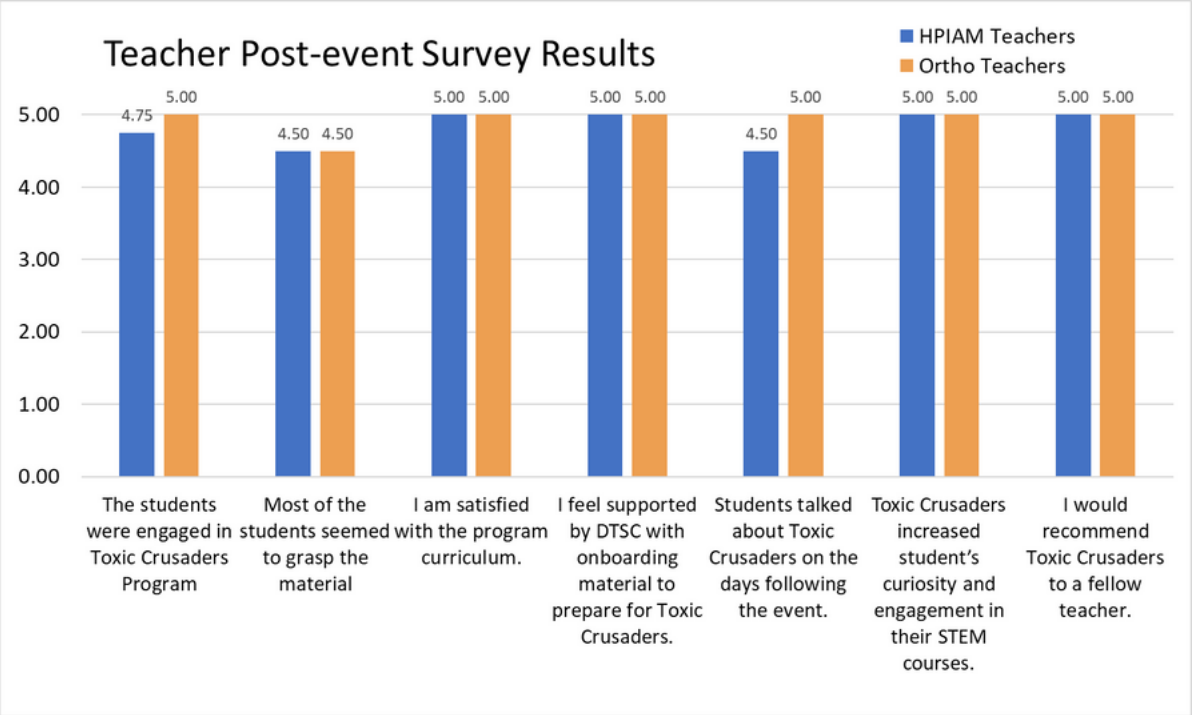


Figure 6. Teachers of HPIAM and Ortho (n=8) were asked to rate their agreement with each statement.

This year's program welcomed HPIAM again for the third time, and the teachers and school faculty who have been working with DTSC on Toxic Crusaders have expressed interest in continuing the program's government-community partnership.

CONCLUSION

Meeting and Exceeding Goals

To evaluate the success of Toxic Crusaders 2023: Are Your Products Safe?, responses reported by students can be evaluated and extrapolated to the program's goals. The first goal, exposure to a professional laboratory, was met with a reported 13%(0.48 points) increase in feeling more comfortable in the laboratory. There is no data on the community students pre- survey; however, their scores matched the averaged HPIAM/Ortho scores at 4.24 and 4.28, respectively. The high self-report for the community students on lab comfortability is significant in that they did not receive the five weeks of onboarding workshops, signaling the value of the on-site visit to any high school student.

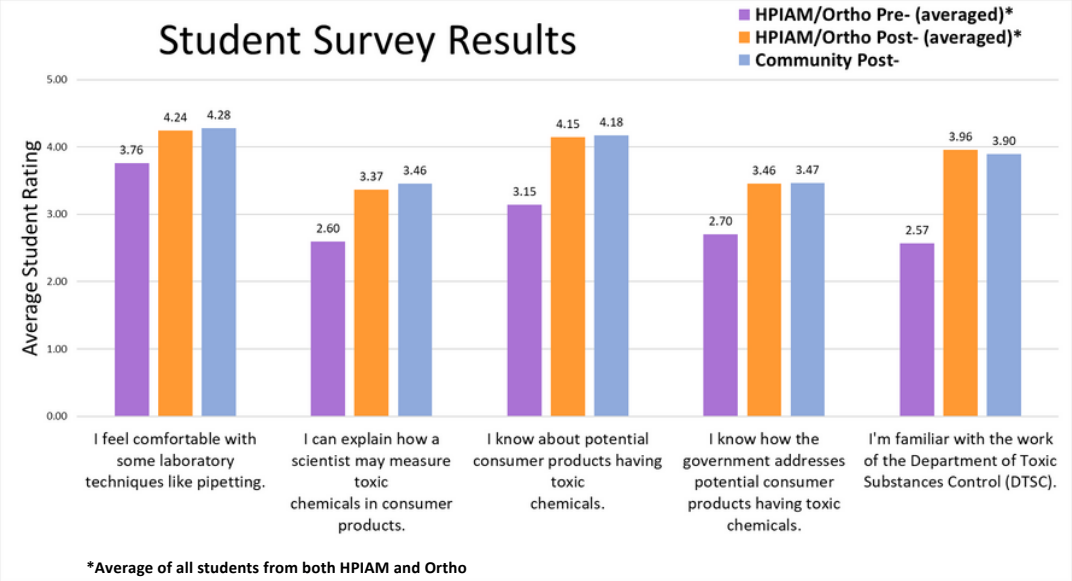


Figure 7. Pre- and post- survey averaged responses of HPIAM and Ortho students and post- survey responses of community day students.

The second goal of Toxic Crusaders was to facilitate the development of critical thinking skills, and indications of the success may lie in two response scores. HPIAM/Ortho students reported a 29%(0.77 points) increase in self-reported ability to describe the scientific process of chemical analysis. These students also report themselves as more informed about toxic chemicals in consumer products with an increase of 32% (1 point).

The third goal of the program was to educate students on careers within DTSC and the government as a whole. Most of DTSC professionals involved in the event represent positions not normally circulated in casual conversation. The 54% (1.39 points) increase for the familiarity of DTSC's work checks the final box.

Goals of Toxic Crusaders

- To expose students to an applied science in a professional laboratory;
- To develop critical thinking skills with respect to toxic chemicals in consumer products and the environment;
- To learn about DTSC and government careers.

HPIAM/Ortho post-event survey scores matched community student scores with the greatest difference between the two at 0.09 points. These data suggest that the unique, wholistic on-site event of Toxic Crusaders can benefit students who have not received onboarding material. All indicators point to the success of Toxic Crusaders meeting its goals by imbuing students with skills as a byproduct of the interactive, immersive event.

Toxic Crusaders would like to acknowledge the teachers and coordinators from HPIAM and Ortho who worked to support their students throughout the weeks leading up to and during the events.

Brian Boyle
Daniel Delgado
Estela Donluca
Karen Lohnes

We thank you for your continued collaboration to support students in a hands-on experience in a professional, public laboratory.

CALEPA | DTSC

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