Mission Folder: View Mission for 'Code Red'

State	Texas
Grade	7th
Mission Challenge	Food, Health and Fitness
Method	Scientific Inquiry using Scientific Practices
Students	Alexa Tindall (GlitterKittyXYZ) Josiah Morales (JAM_Da_Doggo) Ethan Djajadi (Toxapex)

Team Collaboration

(1) How was your team formed? Was your team assigned or did you choose to work with each other?

The team members of Code Red attend school together and work on eCYBERMISSION during our science class and after school. Everyone in our grade level is on a team and we are able to choose our topics and team members ourselves. Our team chose to work with each other in sixth grade and decided to work together again this year. The team was originally formed because we had attributes in common like a love for math and science. We have two members who have won the Math Olympics, and having them on our team helps with the calculations, analyzing data, and logical comprehension. We like doing experiments, so we all agreed on a scientific project this year, as opposed to an engineering project which we did as sixth graders. Because of last year's project, teamwork has become strong, and coordination and communication between us have been good. We all have different skills and interests and this means valuable assets to the team. For example, Ethan has the ability to easily figure out and use computer programs, Josiah has knowledge of firefighters and their jobs because his father is a firefighter, and Alexa is able to write clearly and design experiments well.

(2) Provide a detailed description of each team member's responsibilities and jobs during your work on the Mission Folder.

How We Worked:

Our team would meet twice a week during school. Every team member contributed greatly to the team. Each member would contribute something to the project, be it educational, data analysis and collection, scientific, or artistic. Everyone also assisted or participated in every lab experiment. Almost all of our work was done in school because we all lead very busy lives outside of school. Most of our team meetings were during science class on Thursdays, where we were able to work on group activities.

We would go to Texas Tech University (TTU) to use scientific equipment that our school did not have and work with mentors there whose expertise was in chemical analysis. We met a lot of contacts that were willing to help our team gather data, learn more about our topic, and analyze data. Local firefighters would share their knowledge and helped us network with many agencies and individuals who also had an interest in the topic. One of our moms is a pediatrician, so she knew many oncologists who worked at University Medical Center, and another's dad is a firefighter and provided us with access to many experts in various fields.

Our Team:

Ethan (Toxapex) is the main computer expert, and is good at coding, typing, and performing internet searches for the team. He is very logic-oriented and therefore perfect for generating all the graphs that we as a team used, and was the main technical expert of the group. Ethan is responsible for organizing and analyzing all the data. In terms of personality, he is the enthusiast, keeping everyone interested in every facet of the project.

Alexa (GlitterKittyXYZ) is responsible, punctual and organized. She is our artist/graphic designer. She designed the brochure and helped design the survey. She was a big help in organizing the Mission Folder and assigning parts to the team members.

Josiah (JAM_Da_Doggo) is the moderator of the team. He is patient, kind, a good listener, a timekeeper, and an organizer. He is the calmest of us three and helps keep situations under control. He is the person who has personal experience with this topic and is the driving force on our team. He also has a lot of stage experience as a singer and actor, so he was also a strong presenter. He hosted most of the team meetings outside of school, and he can come up with conclusions based on data.

Research and Experiments:

Our team did many experiments and did a lot of research on our topic. Each of us did a full research paper on different aspects of this community problem. We researched the general health concerns of firefighters, the contaminants in fire today, and the harmful carcinogens that may actually get absorbed through the skin.

There were five different investigations performed this year. Each experiment built on our knowledge and pushed us forward to our main experiment. Our main experiment was the following: we gave strips of decommissioned, cut up firefighter bunker gear to firefighters. Then, the firefighters went to fires, came back, and gave us back the strips. Lastly, we tested the strips using two different instruments, a portable XRF Spectrometer (X-ray fluorescence), and an inductively coupled plasma mass spectrometer (ICP-MS). Both are sensitive and accurate testing devices, and can be used to test our strips and water samples.

Time Management:

Our team had to manage the time we had to work on eCYBERMISSION to finish all experiments, research, and the Mission Folder questions. All of us have after school activities and homework we need to complete as well as doing this project.

Ethan has multiple instrument lessons, such as drums and guitar, performs with School of Rock, attends STEM Club weekly, and he competes in the spelling bee and math olympics.

Josiah is in a theater and musical group outside of school and rehearsals take multiple hours. His activities have been acting with the Lubbock Moonlight Musicals Junior and adult programs developing his acting and dance skills. He has also played basketball and run cross country for his school. He started taking voice lessons to help with a stronger, more confident voice for his acting activities.

Alexa works on improving her artistic talent with art classes and learning new techniques and skills, like animating, which takes quite a bit of time. Her interests outside of school include theater and drawing. She recently won a Silver Key and an Honorable Mention in the Scholastic Art and Writing national competition. One award was for graphic design, and the other for an architectural-type drawing. She also is currently working on her other art skills, such as animation and digital media.

(3) Did your team face any problems working together? If so, how did you solve them? If not, why do you think you were able to work together so well?

Our team has faced the problem of time management. Finding time to work on Ecybermission while having homework and after school activities has been hard to juggle effectively. Other than working on Thursdays during science class, we gave up study hall last period every Wednesday and Thursday to work in the high school science lab on the research project. Our team advisor would also pull us out of school to do labs and to visit professors who helped us understand our topic more, find data, or analyze data in the Texas Tech science laboratories. This helped us get work done during the school day, while saving our afternoons and evenings. for other activities.

Our team did not face many problems during the time that we worked together. This is mainly because we have been together on a team already, we have known each other since 4th grade, and know each other's limits. We have different skills, and together we can accomplish many things. Our team can have a laugh with each other. We can be humorous, but when we need to get things done, we can be diligent and work fast and efficiently. If we had disagreements about the direction of the project or how to work on an experiment, we learned to talk it over calmly and compromise, because that is how teams work in the real world.

(4) What were some possible advantages to working together as a team on this project? How would working as individuals have made this project more difficult?

Being on a team for a project that requires this much work and input is crucial. Some of the advantages we had was that we had already been on a team together. We are able to know how to work together quite well. We know each other's weaknesses and strengths and we are able to fill in each other's weaknesses with our strengths. We also already have knowledge of some community issues and our knowledge put together can be combined to create a larger span of information.

If we each were working individually, our knowledge and strengths would be limited to what only we could do. Our work might have some flaws when working alone. We might miss some tiny details or results might make sense to us but not others. Our research might not be as extensive alone as it is together as a team.

This project would be quite different if only individuals worked on it. If only Ethan worked on the project, there would be fewer reports, no hand-drawn pictures, and more numeric data points. If only Alexa was on the project, there would be fewer interactions with firefighters and more pictures. If only Josiah was on the project, the whole project would focus on firefighter interviews with fewer medical professionals being consulted. The reason for this is because Ethan is very good with deciphering raw data and numbers, while Alexa is good at drawing and more artistic things, and then Josiah is better at public speech and already had a lot of connections with the firefighters in our area. Both individual projects and group projects have pros and cons, but group projects are superior in terms of this type of project.

Uploaded Files:

- [View] **Selecting a Community Problem** (By: JAM_Da_Doggo, 02/12/2020, .pdf)
  Evidence shows the increased risk of cancer to firefighters. During the early research phase of eCYBERMISSION, these are two pieces of evidence used in combination with many PubMed and Google Scholar sources, which led to our team choosing this topic for scientific research in our 7th-grade year.
- [View] **Scientific Research Ideas 2019-2020** (By: JAM_Da_Doggo, 02/12/2020, .pdf)
  The team compiled a list of all the topics we were considering for scientific/engineering research in our 7th-grade year. We ultimately selected the increased risk of cancer to firefighters as our topic. Our teammate's dad is a firefighter and we knew this was a very critical issue for many heroes in our hometown, and across the country as well. The project had the potential to impact countless lives and families, which is our ultimate goal.
- [View] **Action Plan for the Team** (By: JAM_Da_Doggo, 02/12/2020, .pdf)
  The Code Red Action Plan is included to show the flow of the project through a graphic organizer or infographic. This traces the project from Community Problem to three hypotheses leading to three experiments, and finally leading to three solutions connected to three major community benefits. We hope it shows the big picture of the Code Red project and its potential to help many firefighters and their families.
- [View] **Timeline of the Project** (By: JAM_Da_Doggo, 02/23/2020, .pdf)
  A timeline of the project is uploaded to show the major work completed (and future work scheduled for completion) from August 2019 to May 2020.
- [View] **Roles and Responsibilities** (By: JAM_Da_Doggo, 02/23/2020, .pdf)
  A graphic organizer is used to show the strengths of the team members and the roles and responsibilities we took on this year. Throughout the Mission, we relied on each other for encouragement, help when we needed it, and problem-solving in innovative ways.
- [View] **Experiment Schedule** (By: JAM_Da_Doggo, 02/26/2020, .pdf)
  The experiment schedule showing some of our accomplishments in the classroom meetings from August - February

Scientific Inquiry

Problem Statement

(1) What problem in your community will your team be investigating through scientific inquiry using scientific practices? Specifically, based on this problem, what question will you be trying to answer?

Even with state-of-the-art apparatuses and protective clothing, there is still an invisible killer lurking among many of our firefighter heroes. According to the International Association of Firefighters, 61% of the line of duty firefighter deaths were caused by occupational cancer.

Cancer risks to firefighters have been a greater issue since people started using artificial veneer and synthetics in our homes instead of wood and other natural materials.

When these artificial materials burn, they produce toxic carcinogens (cancer-causers) that stick to the firefighter bunker gear (firefighter suit). These then can be out-gassed into any place where the bunker gear goes. There is a culture among firefighters when it comes to dirty bunker gear and helmets: the dirtier, the braver; the dirtier, the better. With the new knowledge of carcinogens found in the contamination, that ages-old belief is a deadly one.

Currently, there is not a standardized way that firefighter bunker gear is cleaned or how frequently this occurs. Practices vary among fire stations, as there is an extreme number of factors involved. Some of these factors include being a professional firefighter versus a volunteer firefighter, the cost for extra gear or for cleaning supplies, and time itself.

The question we are trying to answer is the following:

How can we reduce the risk of cancer among our firefighter heroes?

(2) Research your problem. You must learn more about the problem you are trying to solve and also what testing has already been done. Find AT LEAST 10 different resources and list them here. They should include books, periodicals (magazines, journals, etc.), websites, experts, and any other resources you can think of. Be specific when listing them, and do not list your search engine (Google, etc.) as a resource.

*** Please see uploaded files “Works Cited,” “Research Paper,” "Video Clips" and “Interview Questions & Notes” for a detailed look at the information sources.

The main research phase of this project began in August and continued into November, although we are continuing to gather information from sources as the project goes on. Research papers were completed in English class because our science teacher and the English teacher collaborate and work together for the sake of the larger projects. We used resources including websites, TEDTalks, seminars, videos, books, professional journals, periodicals, and interviews with experts. In addition, regional and national conferences were attended by us and many contacts and information was gathered through those events. Our resources are listed below:

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(3) What did you find out about your problem that you didn’t know before? What kinds of experiments have been done by other people before you? Be sure to put this in your OWN words, do not just copy And paste information. Also, be sure to cite your sources.

Through the use of PubMed, TED Talks, websites, periodicals, personal interviews with cancer survivors, doctors, Google Scholar, and medical journals, research was summarized and includes many studies conducted on risks to firefighters. Some of the major information is included below and a research paper was also uploaded to the Mission Folder as well. Parenthetical citations are included here to cite the sources and they were required by our junior high English teacher in whose classroom we conducted the research.

We included answers to two different questions:

1)What did we find out that we didn’t know before?
2)What kinds of experiments have been done by other people?

Did you know that there are many chemicals causing cancers in a single fire? These chemicals can be known as carcinogens, which means it is a substance known to cause cancer. These carcinogens can highly increase the risk for firefighters to develop cancer if they are exposed to them. Our team wants to make sure more awareness is provided to career firefighters and volunteer firefighters when coming back from a fire. We believe that through investigations and education, we can make firefighters more aware of these carcinogens and encourage them to clean their suits in such a way as to decrease their risk of exposure, thus decreasing their risk of cancer.

The development of cancer among firefighters can be seen for many years. Their job has exposed them to this threat through combustion of chemicals or also known as carcinogens. Many of these carcinogens can be scary and it’s alarming to find out what our firefighters are running into without knowing.

Many studies have shown that the development of cancer, amongst firefighters, is indeed very high. Other studies have also shown that in many of the fires our firefighters are exposed to many dangerous carcinogens such as polycyclic aromatic hydrocarbons (PAH), benzene, and many other chemicals. Studies have shown that even with a self-contained breathing apparatus (SCBA), firefighter’s SCBA can still get contaminated. Many of these carcinogens will build up on suits of firefighters. Many studies on PAH find that there may be a connection to many certain cancers. Many PAHs are not just carcinogens but can also be found as genotoxins and mutagenics. (“Occupational Exposure to Polycyclic Aromatic Hydrocarbons and Elevated Cancer Incidence in Firefighters.”)

Firefighters occupancy have increased the risk of lung disease. Even though SCBAs are supposed to keep firefighters from the risk of inhalation of chemicals, exposures to these chemicals are still happening today. Combustion exposure for has been identified as one of the potentially dangerous situations to firefighters. Although studies have shown that CO, CO2, HCN, and many others have been found in a fire. The findings of tests for this have been proven with mice. One of the mice was in the overhaul environment while the other was in the firegrounds. The results were dramatically different. These chemicals can sometimes be related to cardiac deaths among firefighters. There have been links from cancer or lung disease to exposures during the overhaul period among fires. Little evidence has given us the answer to why many firefighters have higher risks of developing these things. Although we have found that the impact of overhaul, it creates exposure to great lung disease and cancer. (“Exposure to a Firefighting Overhaul Environment without Respiratory Protection Increases Immune Dysregulation and Lung Disease Risk.” Gainey)

Minimizing risks to exposure to carcinogens is of great importance to a firefighter at this time. Research shows that flame retardants, when burned, are the cause of these carcinogens. Flame retardants have been manufactured onto many consumer products such as computers, furniture, wiring, and many others. When firefighters enter a fire they are surrounded by a haze of hazardous toxins that can potentially cause cancer. The carcinogens go through firefighters gear risking the firefighter and anyone at the station. Products such as flame retardants are infused with a product believing they are safer from a fire when in fact they are not. Big manufacturers have prohibited the use of flame retardants but some out there still use flame retardants in their products(“Firefighter Calls for Action on Toxic Flame Retardant Chemicals.”)

Many people believe that a firefighter getting cancer had to be exposed to asbestos or jet fuel on 9/11 to get cancer but that is not the case. Meta-analysis shows that firefighters have higher risks of catching Multiple myeloma. Multiple myeloma is a cancer that is created in a white blood cell called a plasma cell. Since then research shows that risk of getting lung, digestive, respiratory, and urinary cancers increased in every fire firefighters have fought. The problem is our possessions. When caught on fire they can release great toxic chemicals, researchers believe the chemicals lace the smoke there for causing fires to be more toxic than normal. Some chemicals believed to be toxic are benzene, formaldehyde, hydrogen cyanide, and other flame retardants added to foams of furniture. In 2012, paramedics drew the blood of 12 firefighters. It contained three times as much flame retardant than the regular population. Their perfluorinated chemical blood levels were twice as high as the World Trade Center first responders. All people are at some point in their life exposed to these chemicals, except fire enlarges this exposure. When a compound and flame retardant burns, it can create toxins that bind to a person’s DNA and creates a mutation that could one day lead to possible cancer. A firefighter’s suit soaks up toxins and off-gasses them sometime later. (Kirk)

The extremity of the heat allows the chemicals to enter the skin. Every 5 degrees, body temperature rises, increasing the absorption of chemicals by four hundred percent. The gasses make it through the mouth and nose. So when a firefighter enters a house fire, he must wear a mask connected to a canister that is worn on the back full of compressed air. The mask, although needed, is very uncomfortable and is extremely hot. The worst period of a fire is called the “overhaul.” It is the highest level of toxicity of a fire. To reduce a firefighters' cancer risk, they must remove their gear instantly after a fire and shower until clean. Normally gear should be cleaned immediately, but it requires specialized cleansing from washing machines that are extremely expensive. To reduce more risks, firefighters always need to have a second set of gear if there ever was to be another fire. Kathy Crosby-Bell, the mother of a fallen firefighter, raised $500,000 dollars to give the fire station a washer and dryer. In that sense, firefighters everywhere need to educate each other on ways to prevent cancer. Some take two to three showers after fighting a fire to prevent risks of cancer. (“How Your Furniture

Endangers Firefighters." Khazan)

Firefighter Captain David Matchke is aware of the dangers he has faced for 32 years such as house fires, car crashes, and breaking through windows and doors. Researchers from the University of Ottawa worked with the University of Toronto and Health Canada to study the exposed chemicals from their firefighters in Ottawa. They collected samples of skin from the firefighters to see if they had been exposed to polycyclic aromatic hydrocarbons or otherwise known as PAHs. It has been known to cause mutations of the DNA and cancer and can have many harmful chemicals that can be found in smoke. They found that firefighters have 3 to 5 times more metabolites than normal humans. Other studies of this have shown that firefighters have increased the risk of potential cancer and many other serious illnesses. This is typically due to exposed hazardous chemicals that are found in the smoke of fires. This study examined the exposure of chemicals during a fire. According to researchers urine is an excellent way of finding toxic components in firefighters' blood. Since urine is waste and toxins filtered through the kidneys, it has been known for its mutagenic potency as a good suggestion for the chemicals. The mutagenic potency of urine reveals potential genetic mutations four times more hazardous after a fire. Unexpected research shows that PAH metabolites, found on skin, leads to firefighters exposed to these harmful chemicals through contact with skin rather than the inhalation of chemicals. Ottawa's study has shown that the best way of reducing exposure to chemicals, that have been combusted, is to reduce the contact of skin with these chemicals (Smith).

Airborne contaminants during controlled residential fires:
During a structure fire, many chemicals are released, including some that are carcinogenic (Fent). These are known as carcinogens (Fent). This study tested and analyzed firefighter's personal air concentrations of carcinogens like polycyclic aromatic hydrocarbons, volatile organic compounds, hydrogen cyanide, and particulate matter (Fent). The exposure to most of these substances exceeded short-term occupational limits and immediately dangerous to health and life levels (Fent). These show the importance of wearing a self-contained breathing apparatus, and if not, some form of respiratory protection, even when in the overhaul period (Fent).

Structural Fire Fighting Ensembles: Accumulation and Off-gassing of combustion products.
Structural firefighting is dangerous, as firefighters get contaminated turnout gear after the fire (Kirk). This can lead to cancer or even worse, cancer can lead to a line of duty death (Kirk). "This study characterized the deposition of polycyclic aromatic hydrocarbons (PAHs) onto structural fire fighting ensembles and off-gassing of combustion products from ensembles after multiple exposures to hostile structural attack fire environments." The findings of this study suggest that contamination of firefighter's PPE increases with use, and that an unventilated storage room of PPE may result in future exposure to these contaminants, whether possible carcinogens or known carcinogens (Kirk). This study shares a glimpse of what firefighters are exposed to whenever they respond to a call (Kirk).

It's in the smoke: cancer-causing compounds and [contaminants]
Smoke is dangerous (Avsec). Smoke is not just unburnt fuel that could re-ignite, but also carcinogens, or cancer-causing substances (Avsec). There are many possible carcinogens that can be present in smoke such as acrolein, carbon monoxide, formaldehyde, and glutaraldehyde, all which are known or possible carcinogens (Avsec). The problem with this is that our skin is highly absorptive (Avsec). Since it has so much surface area, it absorbs chemicals like a sponge, and a sponge is exactly what we don't want it to be, as it gives us cancer (Avsec). Firefighters need to be aware of this problem, and adjust to it (Avsec).

Structural Fires Are Hazardous Materials Incidents
Nowadays, since there are so many synthetic materials in homes, fires aren't just heat, fire and smoke (Stull). The smoke part is also contaminants, some of them being carcinogens (Stull). This amounts to a very hazardous structure fire, and firefighters need to be aware of these toxins (Stull). Firefighters need to make sure that before the fire, their gear is clean, as dirty gear gets even more dirty than clean gear, they need to make sure that during the fire PPE is always equipped, and after the fire, they need to make sure that their gear is separate from other equipment, clean the gear, and clean themselves, as contaminants can still get from the suit onto them (Stull).

Addressing Toxic Smoke Particulates in Fire Restoration
Many contaminants can be found in houses that have been through the fire, not just during the fire, but also the residual matter that can be found after the fire (Scott). This can contaminate humans, giving us a chance of getting cancer, even worse for the elderly who can't fight it as easily and who might not survive cancer (Scott). We need to address this problem before it gets worse, but for now, stay away from the burnt house and let trained professionals take care of the situation (Scott).

Cancer incidence and mortality among firefighters
According to this study, firefighters have an increased risk of getting and dying from cancer (Jalilian et al.). This study researched articles posted on PubMed, Web of Science, and Embase to find articles to find out if firefighters face a greater risk of getting cancers or not (Jalilian et al.). This study took in each factor very carefully, and has come out with the result confirming their hypothesis (Jalilian et al.). They found an increased risk for firefighters to get certain cancers and die from their cancers (Jalilian et al.). They suggest that we should improve technologies and educate firefighters to drastically reduce their carcinogen exposure, therefore reducing the risk that the firefighter gets cancer (Jalilian et al.).

If firefighters can be more aware of these risks of cancer, then they will be more careful and acknowledge the cleaning of bunker gear. The evidence of this is that many firefighters have died from occupational cancer deaths. Many of these deaths have been proven to be caused by a lack of education and not cleaning the suits or cleaning them well. This has been seen to be related among volunteer fire departments, small town/city fire departments, and urban fire departments. Therefore this is why we believe if we educate the firefighters, there will be less rates of cancer among them.

Experimental Design

(4) Based on the question you are trying to answer, and your research, what is your team's hypothesis for this investigation? Be sure to include the independent and dependent variables and how they are related along with evidence of your research.

The team's hypothesis was formed based on the problem which asks, "How can we reduce the risk of cancer among our firefighter heroes?"

The hypothesis is testable, repeatable, and measurable:

If bunker gear is cleaned with water during gross decontamination and washed two or more times in a commercially-designed machine, there will be far fewer contaminants present with each wash cycle. The risk of cancer will be reduced when bunker gear is cleaned in this way.

Our team used research-based information to form a series of hypotheses for the investigations conducted this year. Each separate experiment built on the knowledge we gained from original research plus the kinds of experiments done by researchers before us. Please see the uploaded attachment called "Hypotheses and Evidence" for a detailed explanation for the rationale behind each investigation listed below:

Investigation I: The Use of a Spectrophotometer to Evaluate Contaminants in Fire Engines as a Health Risk to Firefighters

Hypothesis I: If rinse water from cleaning seats inside the fire engine is found to contain contaminants by the use of a spectrophotometer, then firefighters will be considered at greater risk for exposure when bunker gear is placed inside engine trucks or vehicles after being in a fire.

Investigation II: The Effect of Contaminants in Rinse Water on Living Organisms

Hypothesis II: If contaminants found in the rinse water are used in a bioassay experiment on the invertebrate Daphnia magna, then the risk of harm to the living organism will increase with the concentration of contaminated water.

Investigation III: Engineering a Strap to Collect Contaminants from Firefighters during Exposure to a Structure Fire

Hypothesis III: If a strap can be designed for attachment to a firefighter's gear and be used to collect contaminants in a structure fire, then those firefighters will learn whether or not the fire poses a health risk.

Investigation IV: Evaluation of Straps - Exposure to Elements in a Structure Fire

Hypothesis IV: If contaminants are collected on straps and identified as elements posing a possible health risk, then firefighters would be aware of these dangers and could be alerted to the need for lessening their risk.

Investigation V: Evaluation of Bunker Gear: Contaminants Found During the Washing Process

Hypothesis V: If contaminants are found in water coming off the bunker gear after: a)gross decontamination, b)one wash, c)two washes, and then d) three washes, then the amount of contaminants will decrease at each stage. We will then be able to determine cleaning procedures needed to decrease the risk of exposure to contaminants.

(5) Identify the independent and dependent variables in your investigation.

The independent and dependent variables for each investigation are listed and follows the specific Investigation I, II, III, IV, and V as described in the hypotheses above. This is organized so readers can distinguish between the five investigations conducted for the overall project.

Investigation I: The Use of a Spectrophotometer to Evaluate Contaminants in Fire Engines as a Health Risk to Firefighters

Independent Variable I: The number of times the fire engine seat was rinsed during clean-up

Dependent Variable I: The number of photons in each wavelength measured with a spectrometer

Investigation II: The Effect of Contaminants in Rinse Water on Living Organisms

Independent Variable II: The Concentration of Contaminated Water collected when seats in the fire truck were cleaned after a fire

Dependent Variable II: Our observations of the behavior seen in Daphnia magna exposed to contaminated water - qualitative data was collected.

Investigation III: Engineering a Strap to Collect Contaminants from Firefighters during Exposure to a Structure Fire

Independent Variables III: The type of fire straps to which straps are exposed and whether a veteran or rookie was wearing it - tested separately.

Dependent Variable III: The presence of contaminants on the straps in parts per million (ppm)

Investigation IV: Evaluation of Straps - Exposure to Elements in a Structure Fire

Independent Variable IV: The exposure of the strap to structure fires

Dependent Variable IV: The number of elements on the straps measured in parts per million

Investigation V: Evaluation of Bunker Gear: Contaminants Found During the Washing Process at each Rinse Stage

Independent Variable V:
The stage of wash-water being used during the investigation: water-only, one wash, two washes, three washes, four washes.

Dependent Variable V:
The amount of contaminants or elements (ppm) in the water samples

(6) What are the constants in your investigation?

The constants for each investigation are listed and follow the specific Investigations I, II, III, IV, and V as described in the hypotheses above. This is organized so readers can distinguish between the five investigations conducted for the overall project.

Investigation I: The Use of a Spectrophotometer to Evaluate Contaminants in Fire Engines as a Health Risk to Firefighters

Constants I:
-The spectrophotometer used
-The time of evaluation
-The jars in which the water samples were used
-The method used to evaluate contaminants

Investigation II: The Effect of Contaminants in Rinse Water on Living Organisms

Constants II:
-The species used (Daphnia Magna)
-The method used to count heart rate (bpm)
-The way observations were recorded
-The amount of water to which the Daphna magna were exposed
-The container used
-The microscope used

Investigation III: Engineering a Strap to Collect Contaminants from Firefighters during Exposure to a Structure Fire

Constants III:
-Buttons used
-Thread(s)used
-Decommissioned bunker gear used
-Sewing machines used
-Needles used
-Where the strap is to be placed on the gear
-Size of the strap sewn

Investigation IV: Evaluation of Straps - Exposure to Elements in a Structure Fire

Constants IV:
-The XRF used to perform the analysis
-The placement of the strap in the instrument
-The time the beams were shone on the strap (45 seconds)
-The number of beams used for the analysis (3)
-The method used to conduct the experiment

Investigation V: Evaluation of Bunker Gear: Contaminants Found During the Washing Process

Constants V:
-Firefighter bunker being used
-The amount of water used in testing
-The washing machines being used
-The amount of gear per load
-The containers being used
-The handling of the water
-The way we test the water using an ICP-MS

(7) Will your investigation have a control group? If so, describe the control group. If not, why not?

The control group for each investigation is listed and follows the specific investigations I, II, III, IV, and V as described in the hypotheses above. This is organized so readers can distinguish between the five investigations conducted for the overall project.

Investigation I: The Use of a Spectrophotometer to Evaluate Contaminants in Fire Engines as a Health Risk to Firefighters

Control Group I: Distilled water was the control

Investigation II: The Effect of Contaminants in Rinse Water on Living Organisms

Control Group II: Spring water where the Daphnia magna live

Investigation III: Engineering a Strap to Collect Contaminants from Firefighters during Exposure to a Structure Fire

Control Group III: Straps not exposed to a structure fire were the control

Investigation IV: Evaluation of Straps - Exposure to Elements in a Structure Fire

Control Group IV:
-The straps not exposed to a structure fire were the control

Investigation V: Evaluation of Bunker Gear: Contaminants Found During the Washing Process

Control Group V:
Distilled water was the first control and tap water before it was added to the machine was the second control.

Experimental Process

(8) List all of the materials you used in your experiment. Be sure to include all physical materials as well as any technology or website used to collect data (not websites you used in your research).

The physical materials and technology used for each investigation are listed and follow the specific investigations I, II, III, IV, and V as described in the hypotheses above. This is organized so readers can distinguish between the five investigations conducted for the overall project.

Investigation I: The Use of a Spectrophotometer to Evaluate Contaminants in Fire Engines as a Health Risk to Firefighters

Materials I:
-Gloves
-Goggles
-Aprons
-Spectrophotometer
-Jars to hold contaminated water
-Contaminated water from the washing of the fire engine seats
-Pipettes
-Cuvettes
-Adult supervision
-Distilled water

-Laptop for recording data
-Microsoft ExCel for data tables and graphs
-Journal for observations and qualitative data

Investigation II: The Effect of Contaminants in Rinse Water on Living Organisms

Materials II:
-Daphnia Magna, invertebrates used to test water quality
-Spring water
-Small, four-compartment container
-Compound Light Microscope
-Timer

Investigation III: Engineering a Strap to Collect Contaminants from Firefighters during Exposure to a Structure Fire

Materials III:
-Donated bunker gear
-Sewing machines
-Thread
-Buttons
-Snaps
-Seam rippers
-Snap installer Kit
-Scissors
-Rulers
-Ziploc bags
-Sharpie markers
-Instructions for firemen
-Many firefighter departments
-Firefighter Chief Permission for testing

Investigation IV: Evaluation of Straps - Exposure to Elements in a Structure Fire

Materials IV:

-Olympus DELTA Professional (X-Ray Fluorescence XRF Instrument)
-Gloves
-Safety goggles
-Laptop for collecting data during the experiment
-GeoChem software

Investigation V: Evaluation of Bunker Gear: Contaminants Found During the Washing Process

Materials V:
-Test tubes
-Test tube rack
-Pipettes
-Micropipettes
-Distilled water
-Water Samples from rinse water off washing machines
-Gloves
-Safety goggles
-Samples of pure elements to calibrate the ICP-MS
-Inductively Coupled Plasma Mass Spectrometer (ICP-MS)
-Computer with ICP software downloaded
-Commercial washing machines for bunker gear

Technology Used:

-Computers (receiving data, taking notes, recording data)
-Firefighter-Class Washing Machines
-Google Docs (notes)
-Google Sheets (data)
-X-ray Fluoresence Instrument
-Olympus Software (to Receive Raw Data From XRF Instrument)
-Computers (for notes and graphs)
-Inductively Coupled Plasma Mass Spectrometer (ICP-MS)
-Google Slides
-Microsoft ExCel
-Smallpdf compressor online

(9) Explain your experimental process. Be sure to list all of the steps and ALL SAFETY PRECAUTIONS for your experiment. Remember to write it so someone else could follow the steps and recreate your experiment.

The safety precautions and experimental processes used for each investigation are listed and follow the specific investigations I, II, III, IV, and V as described in the hypotheses above. This is organized so readers can distinguish between the five investigations conducted for the overall project.

Investigation I: The Use of a Spectrophotometer to Evaluate Contaminants in Fire Engines as a Health Risk to Firefighters

Experimental Process I:

SAFETY PRECAUTIONS: Use gloves and goggles when handling rinse water with contaminants from fires. Be careful with glass cuvettes to avoid breakage. Carefully use pipettes to avoid getting contaminated water on the countertop.
Select a blank cuvette and place it in the spectrophotometer. Close the lid.
Click on 0 ABS 100%T button, the instrument now reads 0.00000 A.
Choose a solution of rinse water from the fire station seat that is being cleaned and add it to a cuvette.
Place it in the spectrometer and measure the absorbance between the wavelengths 350 nm and 700 nm.
Compare with the known concentration.
Record the wavelength at the maximum absorbance value.
Continue recording the wavelengths for the concentrations of rinse water, repeating the tests multiple times for accuracy.

** After collecting data from the spectrometer, we learned the known concentrations would not be accurate because we could not determine the exact elements present in the rinse water or the amount of detergent that was added in the water. Due to this measurement source of uncertainty, we determined a different way of measuring contaminants was needed and we began contacting a university to find a mentor in chemical analysis with a commercial-grade spectrometer

Investigation II: The Effect of Contaminants in Rinse Water on Living Organisms

Experimental Process II:

SAFETY PRECAUTIONS: use gloves and goggles when handling the rinse water from the fire engines. Adult supervision is required. Take care to be respectful of the Daphnia magna organisms. Keep water away from the microscope which is plugged into electricity.
Obtain jars of the invertebrate Daphnia magna from Carolina Scientific online. Use invertebrates only to avoid IRB with unnecessary vertebrate testing.
Loosen jar lids upon receiving them and keep Daphnia in spring water until ready for testing.
Prepare concentrations of contaminants by adding distilled water to the water collected from the seats being washed in the fire engines with the help of the chemistry teacher. 1%, 2.5%, 5%, 10% solutions.
Place the different concentrations into labeled cuvettes.
Using a concave microscope slide, place one Daphnia in the opening, observe its behavior and heart rate (bpm) in spring water.
When the daphnia is still, count the number of heart beats you see in a 20 second interval. Multiply by 3 to get beats per minute.
Repeat #6 for each of the concentrations, multiple times, to lessen the source of error in the measurements.
Record observations and note when a lethal dose occurs.

Investigation III: Engineering a Strap to Collect Contaminants from Firefighters during Exposure to a Structure Fire

Experimental Process III:

SAFETY PRECAUTIONS: Use care when cutting and sewing on a machine
First, you need to receive firefighter gear. We did this by going to a firefighter station, and finding that they have a firefighter suit that was not in commission, and they let us have it.
Next, get permission to pull out the experiment, as the Fire Chiefs need to all agree to let you do this.
Be ready for the preparation of the suit. You need to cut it into 5 inch x 2 inch strips, and sew those strips.
Put a snap in each of those strips to attach it.
You'll need about 60 strips to have valid data, and you might not get all of them back so plan ahead.
Distribute strips to the firefighters, have them attach some of them to their gear.
If a firemen enters a structure fire with this strap, ask them to remove it when they come out of the fire and place it in a ziploc bag labeled so we know where the strap comes from.
Collect the straps when the fire station notifies the team.
Observe the appearance of the strap compared to the straps that were not exposed to the structure fire and record qualitative data.
Take the straps to the GeoSciences lab at Texas Tech for quantitative analysis using XRF technology.

Investigation IV: Evaluation of Straps - Exposure to Elements in a Structure Fire

Experimental Process IV:

SAFETY PRECAUTIONS: wear goggles and gloves when handling straps with contaminants. Use adult supervision with this expensive XRF equipment. Be sure the lead lid is on tightly before activating the XRF to avoid exposure to x-rays.
Prepare straps that were exposed to fire and smoke in a structure fire by labeling the type on the computer and in the journal.
Turn on the handheld X-ray fluorescence instrument (XRF).
One at a time, place the strap sample on the instrument and cover with the lid.
Activate the XRF.
After the 45 second beams have finished, carefully remove the strap and place back in the bag from where it came.
The elements found in the strap will then be listed in the GeoChem software program on the laptop.
Use this lengthy list called a concordance to highlight those elements of greatest interest.
Create data tables and graphs from the concordance.
Conduct data analysis by looking carefully at the data collected and forming results and conclusions.

Investigation V: Evaluation of Bunker Gear: Contaminants Found During the Washing Process

Experimental Process V:

ICP-MS Instrument Startup Check
1. Turn on gas (Argon).
2. Check gas pressure in tank and be sure it is 600 psi
3. Place sample in beaker with water and place tubing on the pump.
4. On the computer, open the ELAN icon.

5. File - Open Workspace - Daily Performance Instrument tab - start.
Check that water is being drawn up the tube. When the ignition sequence is complete, the diagram of the instrument in the window should be green.
6. The Ready and Plasma lights on the instrument (by the beakers) should be green.
7. Wait 10-15 minutes for the plasma to warm up.
8. Fill the beaker labeled daily performance check solution.
9. When the run is complete, a report will print.

Preparing the standards
1. Standards should be prepared for a range of concentrations encompassing expected sample concentrations.
2. A minimum of 5mL of standard or sample should be used for each run.
3. 2% volume of nitric acid (HNO3) should be added to samples and standards.
4. The standards run for this test included manganese, zinc, potassium, calcium, titanium, antimony, nickel, iron, chromium, arsenic, aluminum, magnesium, strontium, selenium, barium, and tin.

Running Samples
1.Place samples in auto-sampler tray and create sample list.
2. Select samples to run on the periodic chart - manganese, zinc, potassium, calcium, titanium, antimony, nickel, iron, chromium, arsenic, aluminum, magnesium, strontium, selenium, barium, and tin.
3. Click Summary.
4. Use a micropipette to add solutions of rinse water from machines with bunker gear into test tubes.
5. Label the tubes with number and concentration.
6. Place the tray of tubes in the container so the ICP can pull a liquid sample from each test tube in turn.
7. Check that Sample info is correct. Select Analyze Batch.
8. Start sample run.
9. Remove your samples from the tray after test run.
10. Analyze the data collected from the computer software and make tables and graphs of the elements of greatest interest.

Data Collection and Analysis

(10) Present the data you collected from your experiment. Be sure to include all of the data you collected from your observations and measurements. Use of graphs and charts is HIGHLY encouraged. Explain how your data supports or refutes your hypothesis.

*** Please see uploaded files of lab reports and data tables and graphs for all these investigations. The answers are given in those uploads in full detail and with clear graphs.

Investigation I: The Use of a Spectrophotometer to Evaluate Contaminants in Fire Engines as a Health Risk to Firefighters

Data Analysis I:
According to the hypothesis, “If rinse water from cleaning seats inside the fire engine is found to contain contaminants by the use of a spectrophotometer, then firefighters will be considered at greater risk for exposure when bunker gear is placed inside engine trucks or vehicles after being in a fire.” The data showed wavelengths that indicate contamination but it was inconclusive data, as we did not have a standard that told us what element correlates to what wavelengths of light we were seeing. All we learned was that the elements were in the water. This was helpful as it taught us how to use a spectrophotometer, and told us that there are elements present, but we needed to find a university-level instrument to find out exactly what those elements were. The hypothesis was refuted because although we know elements are present that could be classified as contaminants, we cannot positively identify them.

Investigation II: The Effect of Contaminants in Rinse Water on Living Organisms

Data Analysis II:
The hypothesis is stated like this, “If contaminants found in the rinse water are used in a bioassay experiment on the invertebrate Daphnia magna, then the risk of harm to the living organism will increase with the concentration of contaminated water.” A bioassay experiment was conducted in which several concentrations of pollutants from rinse water were used in place of the spring water habitat of the Daphnia magna. The daphnia’s heart rate could be determined and used as a quantitative measure of harm to the invertebrate. During qualitative data, harm happened very quickly and qualitative data became as important as the beats per minute. At lower concentrations, the daphnia died, but took longer to die by several seconds, showing that the contaminants are still lethal, just a bit slower than when it has a concentration that is higher. The hypothesis was supported because through both qualitative and quantitative data, it was shown that a lethal dose was correlated with higher concentrations of contaminants. This experiment shows us that even though the carcinogens may not immediately be lethal at the concentrations of PPM for the daphnia, possible exposure over long periods of time could still be cancerous and dangerous to their health and possibly human health as well. This proves our hypothesis that this is lethal, even at lower concentrations, and that it is still dangerous to life.

Investigation III: Engineering a Strap to Collect Contaminants from Firefighters during Exposure to a Structure Fire

Data Analysis III:
Our hypothesis states, “If a strap can be designed for attachment to a firefighter’s gear and be used to collect contaminants in a structure fire, then those firefighters will learn whether or not the fire poses a health risk.”

The straps were designed using the engineering process. Our criteria included straps that could attach easily, ones that could also come off if need be by simply a movement from the firefighter to get free, and straps made of the same material as the actual bunker gear. The constraints were a size that would not get in the way of the firemen, snaps only on the ends of the material, and the ability to last through a fire. Code Red ended up with straps that met our criteria and constraints, and this experiment was a success, as we did find the optimal design for the straps. A snap on the end allowed it to be hooked around the breather hose yet could be pulled off if needed. Qualitative observations include the look of the strap after coming from a fire. It was obviously darker in color, contained a strong odor even inside a plastic Ziploc bag, and showed contaminants. We would not know if any of those contaminants were risky, however, until they were tested with an XRF spectrometer. Firefighters were alerted to the findings after they turned in their straps to us for analysis.

Investigation IV: Evaluation of Straps - Exposure to Elements in a Structure Fire

Data Analysis IV:
Referring to the hypothesis which states, “If contaminants are collected on straps and identified as elements posing a possible health risk, then firefighters would be aware of these dangers and could be alerted to the need for lessening their risk,” data analysis focused on looking for contaminants on the straps that returned from the structure fires. The straps were tested with the Portable X-ray Fluorescence Spectrometer to determine the elements present. The results supported the hypothesis. The straps contained elements of silicon and calcium where are not dangerous but contained levels of chromium, iron, and aluminum that could be problematic. It was troubling to find these levels

of metals on a strap that was only in ONE structure fire and for a short amount of time. The levels on the strap would also be the levels on the bunker gear. What might the levels be if firemen wore bunker gear for six months before washing it? The out-gassing from that gear would be contaminating the storage area where it was hung or the seats in the car where it is placed for volunteer firemen. As a result of this analysis, information was included in an informational brochure to firefighters to alert them to the risks right on their gear.

Investigation V: Evaluation of Bunker Gear: Contaminants Found During the Washing Process

Data Analysis V:
The hypothesis says, “If contaminants are found in water coming off the bunker gear after: a)gross decontamination, b)one wash, c)two washes, and then d) three washes, then the amount of contaminants will decrease at each stage in the wash/rinse cycle.Our data supports our hypothesis, as the data correlates. We originally thought that rinse one would have been different in concentration than rinse 2, and so forth. This data proves the correlation is correct. This gives us a solid ground to show that we should even wash bunker gear twice, as one wash on the outside shell of the gear is not as effective, and two times is much more effective, as proven by the data.

Results of Survey:
Most career firefighters know about the cancer risks, are reminded about them, and take measures to avoid them, but not to the degree they should. On the other hand, those in a volunteer fire department are not aware, and therefore, more vulnerable to cancer by exposure.

(11) What are your potential sources of error? Remember, this doesn’t mean "Did everything work?", all tests have potential sources of error, so make sure you understand what that means. Explain how these sources of error could have affected your results.

To be sure we understood what this question means, we used the Team Resource Guide on the eCYBERMISSION website where there was a worksheet explaining “potential sources of error.” At first, we thought it meant to describe when we made errors during the investigations but that is not what this means scientifically. “Sources of Error” is divided into two types. One type is systematic errors, and these cannot be removed by multiple testing, as these will always be there, such as a person not being able to read the instrument exactly, poorly maintained instruments, and bad calibration of instruments. Random errors are different, as their effects can be removed by repetitive testing. These can be reading a measurement between lines, or if the instruments’ reading fluctuates.

Systematic errors or uncertainty in measurements happened in our project during the spectrometer experiments in the high school lab. Using the water collected from the seats of engines being cleaned, there was uncertainty in the levels of detergent added to the wash water that could cause the photons to record higher than they should.

We also had the problem of potential random errors, as we had the team reading the wavelengths on a spectrometer for the first time and some of the readings fluctuated. By repeating the tests, it can lower the uncertainty. The way random errors affect data is by giving less precise measurements.

Drawing Conclusions

(12) What conclusions can you draw based on the data you gathered during your experiment(s)? Be sure to include data and how it relates to the experiment(s) and the original question. Your conclusion should be related to your original problem and your experiment, include the data you collected, and discuss if your hypothesis was supported or refuted by your experiment.

The goal of decreasing the risk of exposure to contaminants to firefighters, thus decreasing the risk for cancer, took seven months of research, investigations, and data analysis. Moving the project through phases of observing effects on living organisms to identifying contaminants in wash water to devising a method of collecting contaminants in real time to the use of XRF and ICP-MS spectrometers to see how washing bunker gear removes elements was lengthy but very worthwhile. Results show the more rinse cycles done to the suit does indeed wash off more carcinogens than we had previously thought, potentially decreasing the risk of cancer among firefighters. The most effective and time-efficient way of lowering the risk is to wash the bunker gear two times instead of once, with a third and fourth rinse even more effective, if time and money allows.

The conclusion that we came to based on the data we gathered during our experiments was that there would be a significant reduction of contaminants if we were to wash and rinse the bunker gear at least twice in a designated washing machine with special detergent. This is supported by the significant decrease in the concentration of elements we tested from unwashed straps to straps that were cleaned at least once, then more decreased after the second rinse. The reduction in the concentrations of the elements would support that if less contaminants are on the gear, then the firefighters who wear the gear would not be exposed to as many contaminants, which in turn would reduce their risk of cancer since these contaminants are found to be carcinogenic. The elements that we tested for include Arsenic, Uranium, Lead, Mercury, Antimony, Vanadium, Chromium, Aluminum and many others.

The data we collected did not always show a significant decrease after the first rinse, but there was a significant decrease after the second rinse. Our data shows that the total concentration and individual element concentrations decreased as the number of washes increased. However, the biggest decrease in concentration was between the first and second wash, therefore leading us to the conclusion that we should rinse the bunker gear at least twice.

We also collected one hundred firefighters’ opinions that it typically takes more than one wash or shower to clean off the smell from their clothing and body. The qualitative response from the firefighters supports our hypothesis that cleaning the gear more than once provides a more thorough cleaning.

Our overall hypothesis is the following: If bunker gear is cleaned with water during gross decontamination and goes through a wash and rinse cycle two or more times in a commercially-designed machine, there will be far fewer contaminants present with each cycle. The risk of cancer will be reduced when bunker gear is cleaned in this way.

We broke our experiment up into five different stages or experiments, each of which built on the knowledge we gained from the original experiment plus the kinds of experiments done by researchers before us.

Our first experiment was to use a spectrophotometer to evaluate contaminants in fire engines as a health risk to firefighters. We took the wash water from the fire engine seats and ran it through a spectrophotometer. Our first hypothesis is if the rinse water from cleaning seats inside the fire engine is found to contain contaminants by the use of a spectrophotometer, then firefighters will be considered at greater risk for exposure when bunker gear is placed inside engine trucks or vehicles after being in a fire. We identified multiple peaks on the results, but were not always able to correlate it to specific elements or contaminants. We recorded our findings, but the uncertainty in the results taught us that we needed to find a university with better instruments to help us measure the elements.

Our second experiment looked into the effect of contaminants on living organisms. In this experiment, we placed Daphnia magna into spring water and counted their heartbeats and rate of death. We compared this to placing the Daphnia into contaminated water, and repeated the experiment. We found that the Daphnia died sooner in the contaminated water, and the lower the wash count was (i.e. first wash), the sooner they died. This supported our hypothesis that if contaminants found in the rinse water are used in a bioassay experiment on the invertebrate Daphnia magna, then the risk of harm to the living organism will increase with the concentration of contaminated water.

The third experiment was the engineering portion of our experiment. We got together with firefighter, Abi Morales, and obtained a decommissioned bunker gear, and got permission to cut it up. The thought was that we could make small straps from the bunker gear, so that they could be attached to firefighters’ gear when they went into fires, and we would obtain a sample of the contaminants they were exposed to. Our problem statement for this engineering project was to have straps made which would attach

and detach well to firefighters' gear, would not interfere in their ability to fight fire and be safe, and minimize off-gassing. We made two inch by five inch strips of bunker gear, sewn together with cotton thread, with metal snap buttons to attach. We made sixty straps, distributed them to the different Fire Chiefs who in turn distributed it to their firefighters. These straps were attached to the air canisters of firefighters and exposed to the fire that they were involved in. We were successful in making the straps and distribution was done efficiently by the Fire Chiefs.

Experiment four entailed the exposure of the straps made in Experiment Three to the element in a structure fire. Our hypothesis was that if contaminants are collected on straps, and are identified as toxic elements, then firefighters could be made aware of these dangers and could be alerted to the need for lessening their risk. The straps were collected after a fire, and placed in Ziploc bags then taken to Fire Station 4 to be washed. The wash water after each wash was collected, and then we took it to Texas Tech University, Department of Geosciences and Chemistry to be tested via X-ray Fluorescence (XRF) and Inductively Coupled Plasma Mass Spectrometer (ICP-MS). We identified the contaminants that were on the straps, and found that some elements were indeed carcinogens, such as Arsenic, Lead, Mercury, Chromium, Uranium.
The final experiment was to evaluate the contaminants found during the washing process. Our hypothesis was that if contaminants are found in water coming off the bunker gear after: a) gross decontamination, b) one wash, c) two washes, and then d) three washes, then the amount of contaminants will decrease at each stage. We will then be able to determine cleaning procedures needed to decrease the risk of exposure to contaminants. We identified the concentrations of the contaminants and graphed them. We found that there was a general decrease in total and individual concentrations, with the biggest decrease after two washes. For example, the first wash of the shell was not very effective, as it only removed 0.072 parts per million (PPM) of toxic material, whereas the second wash of the same suits removed 0.655 PPM of toxic material. These numbers may not seem like the washes are doing much, but keep in mind that these chemicals are toxic at parts per billion, not even parts per million.

The summary of all the experiments is that there are carcinogens that are present in the bunker gear, and that at least two washes are recommended in order to decrease the level of contamination significantly. As there are carcinogens on the bunker gear, it would be best to have a designated washing machine, and the use of a specialized detergent that is designed to remove the most carcinogens should be used. Although in the past, it has been a badge of honor for firefighters to have well-used gear, it is now found that there are a lot of contaminants in the dirt, and that continued wear of dirty contaminated gear may be the reason for the increased cancer rate and deaths of firefighters.

As part of our education of firefighters, we made a poster with the increased risk outlined and how they can clean their gear effectively and timely. We also made a brochure which was distributed electronically to firefighters who participated in our survey. We sent out a survey to study the behavior of firefighters when it comes to knowing their risk of cancer, and how often and timely they clean their gear. The results were eye-opening as some still were not aware that they were at increased risk, and did not know that their dirty gear was contributing to the increase. We hope that this project will be able to spread that knowledge and help our heroes be safer in their chosen profession.

Uploaded Files:

- [View] **Works Cited** (By: JAM_Da_Doggo, 02/12/2020, .pdf)
  The complete Works Cited or Bibliography document is uploaded with 45 sources of information listed including websites, TED Talks, Personal Interviews with Experts, Books, Professional Journals, PubMed documents, and extensive research articles from Google Scholar. This document continues to grow and expand with every day as we learn more information and add to our knowledge base.
- [View] **Interview Questions & Notes for Cancer Survivors** (By: JAM_Da_Doggo, 02/23/2020, .pdf)
  Google doc was used to write interview questions for community experts in many fields. Different questions were asked depending on the expertise. These questions and brief notes were taken using a laptop during the interview let us record enough notes to be able to write up the information we learned, yet still give full attention to the person we interviewed.
- [View] **Interview Questions & Notes for Doctors of Oncology** (By: JAM_Da_Doggo, 02/23/2020, .pdf)
  The questions and notes in this document came from our interview with Dr. Fred Hardwicke, an oncologist who worked with firefighters who had line-of-duty cancers.
- [View] **Use of the XRF Spectrometer** (By: JAM_Da_Doggo, 02/25/2020, .pdf)
  XRF (X-ray fluorescence) is one of the analytical techniques we used to determine the elements found in the straps we made & distributed to firemen. It allowed us to analyze them for exposure once they had been exposed to a structure fire. Photos from the lab are included.
- [View] **Notes taken Using Google Docs** (By: JAM_Da_Doggo, 02/25/2020, .pdf)
  A sample of our notes taken using a laptop and Google docs is shown. This was what we learned from visiting Fire Station #19 in October.
- [View] **Video Clips of the Team** (By: JAM_Da_Doggo, 02/25/2020, .pdf)
  A link to six brief video clips of the team working this year can be found in this document. They link to unlisted YouTube videos recorded by Code Red.
- [View] **Combustible Materials - Risks for Firefighters** (By: JAM_Da_Doggo, 02/25/2020, .pdf)
  Using many sources of information from expert interviews and websites they provided, we compiled a list of combustible materials that pose risks to firefighters.
- [View] **Partnership with "Last Line of Cancer Defense"** (By: JAM_Da_Doggo, 02/25/2020, .pdf)
  Our team worked with Joseph Wallace, President of Last Line of Cancer Defense, to develop networks and reach many people with ways to lower a fireman's risk of cancer. His email correspondence and contact information is included here.
- [View] **Summary Photo Essay** (By: JAM_Da_Doggo, 02/25/2020, .pdf)
  Our team made a 15 slide presentation of photos and explanations to show the summary of our major activities this year. It includes interview photos, pictures of us sewing straps, presenting information to fire stations, and conducting our investigations in the university labs at Texas Tech University.
- [View] ***** Investigations LAB REPORT** (By: JAM_Da_Doggo, 02/25/2020, .pdf)
  **** VERY IMPORTANT UPLOAD The entire lab report is uploaded here which includes the steps of the scientific inquiry process, photos, charts, data tables, graphs, results of our experimentation, conclusions, and future plans of Code Red. Thank you for viewing our work this year.*
- [View] **Hypotheses - Evidence from Research** (By: JAM_Da_Doggo, 02/25/2020, .pdf)

Using research from a variety of sources and consulting with many experts in the fields of fire fighting, chemistry, biochemistry, and environmental health, Code Red used the Claims-Evidence-Reasoning technique to develop its hypotheses. This table shows our thinking from the abridged hypothesis to proposed experiments to variables and to research evidence.

- [View] **Accurate Data is Critical** (By: JAM_Da_Doggo, 02/25/2020, .pdf)

  While conducting research, we found many conflicting facts and statistics on cancer + firefighters. It was important for us to realize data can be skewed and misinterpreted so we carefully read studies from PubMed and Google Scholar to find accurate information. This source helped us figure out how to accurately represent research-based FACTS from fiction.

- [View] **Interviews with Experts in the Community** (By: JAM_Da_Doggo, 02/26/2020, .pdf)

  The team interviewed many community experts and the main ideas of each one, with a picture of what happened.

- [View] **Data Table and Graphs** (By: Toxapex, 02/26/2020, .pdf)

  **** VERY IMPORTANT UPLOAD These are the data tables, charts, and graphs from our major investigation of identifying specific contaminants and risks after various cleaning techniques were performed on bunker/turnout gear. Instruments used included: XRF X-ray Fluorescent Spectrometer ICP Inductively Coupled Plasma Spectrometer*

- [View] **Extra Data** (By: Toxapex, 02/26/2020, .JPG)

  This is more data, for the spectrophotometer experiment, and is inconclusive. See mission folder for more information.

Community Benefit

(1) Explain how investigating the problem your team chose will help the community. Be sure to include the impacts your research will have on individuals, businesses, organizations, and the environment in your community (if any). Make it very clear why solving this problem would help your community.

If we investigate this problem and present our results to rural and urban firefighters, they will have a better understanding of what can cause cancer in firefighters and how to prevent it. This will impact all firefighters and will help them be more aware of the hidden long-term exposure danger, not just from smoke, but the carcinogens that come with the smoke. Although this problem has existed for years, it has become exponentially worse with the increase in toxins and carcinogens found when synthetic materials burn.

Cancer survivor and firefighter Brian Gross said, “A dirty helmet was a badge of honor. It proved that a firefighter had been invaluable in a fire.” This shows how clueless many firefighters could be when it comes to the carcinogens in smoke and how times have changed. This information will help save the lives of many firefighters and those whose lives are owed to the firefighters.

The business and organization impact will be huge. Giving firefighters more time to live by educating them about these: carcinogens and how they collect on the firefighter suit, how leaving the bunker gear in the cab of a car exposes others to the carcinogens on the firefighter suit, keep the SCBA on the person at all times so they do not inhale carcinogens, and wash the helmet and other gear with water so that they eliminate more carcinogens. This will help keep the firefighter industry alive by letting firefighters live longer, and help out more people who are struggling with fires. This will also help out oil workers who deal with fires every so often and will help them get carcinogens off their bodies when a fire starts. We helped out many businesses in our area, including most of the firefighter departments in Lubbock, and rural fire departments in our area by showing them the impacts of carcinogens in smoke from homes.

We want to help individuals, organizations, and businesses, so we chose this project, something that Josiah can relate to personally, and something that will impact the world. Our project will save the environment and people from fires, and firefighters from cancer by spreading awareness to everyone.

The Code Red project benefited the community and had huge impacts on firefighters locally, regionally, and at the national level. Our team member Josiah traveled with his father, a firefighter, to the National Firefighter Cancer Symposium 2020 in Florida. It was an amazing opportunity for Code Red to distribute brochures and hang posters there, as well as pass along this message to thousands of fire stations represented across the country.

The following are some of the ways Code Red has reached a vulnerable population with a real way of lowering their risk for cancer:

-Created a poster with the slogan, “Prevent it ‘fore you get it!”
-Created a brochure to educate firefighters about minimizing the risk of cancer
-Created a website (https://cancerhalt.weebly.com/) with many resources available
-Gave material straps to Lubbock Fire Department stations across the city to collect contaminants and learn more about the elemental risks locally
-Presented information, distributed brochures and hung posters in the following stations:
-Woodrow Volunteer Fire Station
-Fire Station 1
-Fire Station 2
-Fire Station 4
-Fire Station 7
-Fire Station 8
-Fire Station 19
-West Carlisle Volunteer Fire Station
-Shallowater Volunteer Fire Station
-New Home Volunteer Fire Department
-Slaton Volunteer Fire Department
-Whiteface Volunteer Fire Department
-Smyer Volunteer Fire Department
-Morton Volunteer Fire Department
-Morton Municipal Fire Department
-Sundown Volunteer Fire Department
-Idalou Volunteer Fire Department
-Causey Volunteer Fire Department
-Dora Volunteer Fire Department
-Pep Volunteer Fire Department
-Ropesville Volunteer Fire Department
-Partnered with Joseph Wallace, President of Last Line of Cancer Defense (LLOCD)

-Political initiative to require insurance companies cover retired firefighters diagnosed with cancer
-Community awareness of the need for two sets of bunker gear per person
-Fundraisers and grant applications to raise money for volunteer departments
-Learned from and told 2 oncologists about our project
-Created a survey for firefighters (received over 100 responses)
-Josiah presented information at the National Firefighter Cancer Symposium 2020 in Florida
-Talking to the TTU Geosciences department about this issue
-Featured in local newsletters and in the media
- Poster presentation alongside graduate students in the Geosciences Department
-Investigating the water repellent used on bunker gear called PFAS as it may be carcinogenic and posing additional risks

Uploaded Files:

- [View] **Community Outreach Poster** (By: JAM_Da_Doggo, 02/12/2020, .pdf)

  A poster was designed in Piktograph and distributed to fire stations throughout the region during the team outreach presentations. Along with an informational brochure, these messages informed career and volunteer fire departments about the importance of cleaning bunker gear to decrease the risk of cancer.

- [View] **Informational Brochure** (By: JAM_Da_Doggo, 02/12/2020, .pdf)

  A brochure was developed by the team to get information into the hands of firefighters throughout our region. We were particularly worried about 75% of firefighters who are volunteers and do not have resources.

- [View] **Speech to Firefighters** (By: JAM_Da_Doggo, 02/12/2020, .pdf)

  The team wrote an "elevator speech" after learning that a 30 second to three-minute talk to others is an effective way of getting a message's main idea across. The speech we used when sharing our project or teaching firefighters about the risks of cancer is uploaded here.

- [View] **Firefighter Survey Results** (By: JAM_Da_Doggo, 02/24/2020, .pdf)

  Over 100 firefighters responded to our survey asking how bunker gear is treated, their awareness of cancer risks, and more. Both career and volunteer firefighters participated and they ranked how effective our brochure and poster were in teaching new information.

- [View] **Website Link & QR Code** (By: JAM_Da_Doggo, 02/24/2020, .pdf)

  A link to our website and a QR code for fast access to that site is included in this document.

- [View] **Synthetics & What they Contain** (By: JAM_Da_Doggo, 02/25/2020, .jpg)

  One of the documents we used to determine what to look for in our strap detection method of identifying contaminants is attached. Synthetic furniture in our homes contains carcinogens when burned and pose a great risk to firefighters.

- [View] **Community Outreach by Code Red** (By: JAM_Da_Doggo, 02/25/2020, .pdf)

  Code Red visited many fire stations, meetings of fire chiefs, volunteer fire departments in rural towns, and cancer symposiums to spread the word about what we learned this year. Cleaning turnout gear is VITAL and must be done in a timely manner. Gross decontamination (hosing down with water immediately following fires) can lower risks but washing TWICE greatly decreased extended exposure to carcinogens.

Mission Verification

(1) Does your Mission Folder project involve vertebrate testing, defined as animals with backbones and spinal columns (which include humans)? If yes, team must complete and attach an IRB approval form.

Yes

(2) Did your team use a survey for any part of your project? If yes, team must complete and attach a survey approval form.

Yes

(3) You will need to include an abstract of 250 words or less. As part of the abstract you will need to describe your project and explain how you used STEM (Science, Technology, Engineering and Mathematics) to improve your community

Firefighters are our hometown heroes. We depend on their sacrifices to save our lives but they do so at great personal risk, not only from a bravery standpoint but from health risks related to their career. There is a 47% chance that a firefighter will have a cancer diagnosis and half of those will be fatal. Sixty percent of line-of-duty firefighter deaths are from cancer. These are staggering statistics, and Code Red is determined to find ways to lower the risk.

Several types of testing took place as we searched for a solution:

1. Rinse water from engine seats was evaluated using a photon spectrometer

2. Bioassay toxicity tests were performed on Daphnia magna

3. Straps were sewn from donated bunker gear and effectively collected contaminants from firemen inside structure fires

4. Strap-contaminants were identified using x-ray fluorescence

5. 30 samples of rinse water were taken from 4 different cycles of washing bunker gear and analyzed using an Inductively Coupled Plasma Spectrometer

Results show dangerous elements on the gear, in water exposed to smoke, and in rinse water collected between wash cycles of bunker gear. Gross decontamination on-site with water-only was found to have some effect on reducing exposure but washing gear multiple times instead of once greatly reduced the level of contaminants.

Using a 3-pronged approach including education, prevention, and contribution, these findings were reported to career firemen, and the 70% of firemen serving on volunteer forces. Armed with knowledge, we hope to save the lives of our heroes and my dad.

Uploaded Files:

- [View] **Survey Approval Form** (By: JAM_Da_Doggo, 02/22/2020, .jpg)

  This is our survey approval form with signatures obtained.

- [View] **IRB Approval Form** (By: JAM_Da_Doggo, 02/22/2020, .jpg)

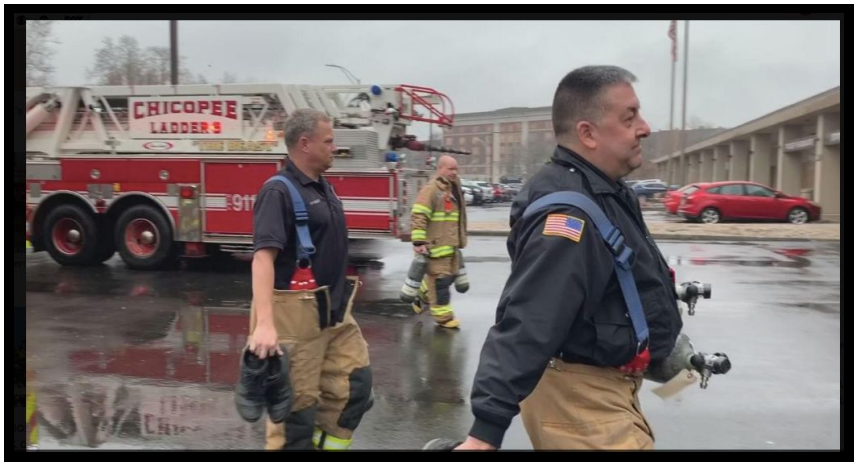
  This is our IRB approval form signed by the team advisor, school principal, registered nurse, and science fair coordinator.

Risk of Cancer is Greater for Firefighters

Evidence seen in the Research

During the initial research phase of eCYBERMISSION, while the team was deciding which community problem would be selected this year, the reports of an increased risk of cancer for firefighters kept coming to the forefront. With our team member Josiah's dad being a career firefighter, the issue became very personal and important to us. We considered the topics of high anxiety in children, drug abuse, and vaping as potential community problems on which to work, , but ultimately, the topic of cancer risks to firefighters was selected as the problem we would attack as 7th graders.

https://www.westernmassnews.com/news/firefighters-exposed-to-carcinogens-at-higher-risk-of-cancer/article_f8522cd6-4c4c-11ea-bd0e-fbb904af7848.html



https://www.azcentral.com/story/news/local/arizona/2020/02/11/how-keep-firefighters-safer-outsized-cancer-risk/4685548002/

Science Ideas for 2019-2020

(We included possible solutions for each topic but deleted them in this document because they may be some of the ideas we'll use for Ecybermission projects in 8th and 9th grade)

Firefighter cancer risks - can't cure cancer but what could be done to decrease the risk?

Obesity –

Vaping –

Cotton farming -

Water conservation –

Wild hog population –

Gun safety/control

Suicide –

Sunscreen –

Childhood hunger –

Weather damage -

Drunk Driving -

Child abuse and neglect –

Social media –

Support animal –

Conservation –

School shootings –

Diabetes –

Compost -

Biofilm –

Cleaning shrimp –

Sharing self driving cars –

Action Plan - Code Red

Community Problem

Firefighters have a greater risk of getting cancer than the general population because of the chemicals, materials, and agents to which they are exposed. This risk has recently been discovered and many firefighters are unaware of the facts. .

Hypothesis 1 --

Preparing straps to gather contamination can help us identify potential risks to firefighters

Experiment 1 --

Obtain out of commission bunker gear from LFD; cut and sew straps to be taken into a fire for collection

Solution 1 --

Identify dangerous chemicals by ICP in an analytical laboratory - knowledge is power to eliminate risks

Community Benefit 1 --

Spread the word of potential exposure to urban fire departments in the region - outreach campaign

Hypothesis 2 --

Cleaning bunker gear twice using washing machines decreases contamination significantly

Experiment 2--

Compare numbers of washes/rinses using commercial washing machines

Solution 2 --

Recommend commercial cleaning of gear twice to greatly reduce contaminants in the gear

Community Benefit 2 --

Campaign - “Prevent it, ‘fore you get it”

Hypothesis 3 --

Gross decon using water from hoses eliminates 50% of contaminants

Experiment 3--

Prepare contaminated straps and perform gross decon on them - testing for contaminant levels before and after

Solution 3 --

Recommend gross decon on site immediately following a fire as a way to reduce your risk in volunteer stations

Community Benefit 3 --

Potential reduced risk of cancer to firefighters who clean gear by gross decon method on site

August 2019 - November 2019

Began project and worked on lots of preliminary team building like action plan, team strengths

August 2019

September 2019
October 2019

Finished three (3) research papers, boosted teamwork, distillation experiment, interviewed experts

Performed spectrophotometer experiment, collected water from fire stations, performed Daphnia experiment

November 2019

December 2019 - February 2020

Interviews with: Oncologists and cancer survivors. Presentations at Fire Station 2 and Woodrow

December 2019

January 2020

Worked on Mission Folder questions, data tables, graphs, community outreach to volunteer fire stations

Meetings with: Drs. Barnes, Weindorf, Werts and Gotchey. Surveys to firefighters. National Firefighter Cancer Convention in Miami, Florida

February 2020

March 2020 - May 2020

Outreach to New Mexico volunteer fire stations in: Causey, Dora, Elida, Floyd, Portales. Follow-up to National Conference

March 2020

April 2020

Media outreach, public speaking to local service organizations, fundraisers for rural fire stations

Poster presentations to Geosciences and Environmental Sciences Departments with Masters' students

May 2020

Code Red: Team Strengths
Roles and Responsibilities

The members of Code Red bring very different personalities, strengths, and talents to the table. Each person is unique and is best able to contribute to the Mission in their own way. In this table, we tried to give you an idea of who we are and what we do best, the hobbies we love, a little about our personality, and list some of the major roles we took on this year when completing our 7th grade Ecybermission project.

Ethan ***Toxapex***	**Alexa** ***GlitterKittyXYZ***	**Josiah** ***JAM_da_Doggo***
Grammar Checker	Artist/Graphic Designer	Patient
Spelling Checker	Brainstormer	Kind
Computer Technician	Flaw Analyst	Listener
Logic analyst	Organizer of Mission Folder	On-time & on-task
Source-finder	Stays on task	Designed posters
Interviewer	Follower	Timekeeper
Researcher - Contaminants in fire	Researcher - Health Risks for Firefighters	Researcher - Contaminants that can get on bunker gear
Follower	Designed survey	Note-taker
Website Builder	Record keeper	Leader
Data analyzer	Presentation Builder	Encourager
Data organizer	Experimentation Leader	Personal interest in firefighters
Enthusiasm for teamwork	Brochure Designer	Community Outreach
Receives Data	Created Filing System	Conclusion maker
Lab Worker	Lab Worker	Organizer of Research
Loves music, playing in a rock band, national spelling bee participant, coding, video games, STEM, outgoing, extremely curious	**Loves art, theatre, computers, graphic novels, reading, quiet, hard worker, perfectionist, Hello Kitty**	**Loves singing and performing in community musical theatre, dance, family-oriented, video games, stable, calm**

Science & Engineering Work Schedule for Code Red

Date	Task	Team Member
9/6/19	Strengths, Timeline, Jobs, Experiment Schedule, Action Plan	Ethan, Alexa, Josiah,
9/12/19	Problem Statement	Ethan, Alexa, Josiah,
10/2/19	Worked on Mission Folder questions	Ethan, Alexa, Josiah
10/20/19	Experiment with distillation	Ethan, Alexa, Josiah
10/30/19	Completed Research Papers	Ethan, Alexa, Josiah
10/30/19	Experiment with spectrophotometer measuring absorbance of carcinogens	Ethan, Alexa, Josiah
11/2/19	Worked on Mission Folder Questions	Ethan, Alexa, Josiah
11/4/19	Continuing experiment with spectrophotometer	Ethan, Alexa, Josiah
11/5/19	Continuing experiment with spectrophotometer	Ethan, Alexa, Josiah
11/6/19	Continuing experiment with spectrophotometer	Ethan, Alexa, Josiah
11/14/19	Start “Daphnia Experiment”	Ethan, Alexa, Josiah
12/5/19	Interview with Dr. Oncologist	Ethan, Alexa, Josiah
12/10/19	Interview with Bryan Gross	Ethan, Alexa, Josiah
12/11/19	Presentation at Fire Station 2	Ethan, Alexa, Josiah
12/17/19	Presentation at Woodrow Volunteer Fire Station	Alexa, Josiah
1/23/20	Abstract and material list made	Alexa, Josiah, Ethan
2/5/20	Interview with Melonie Barnes	Alexa, Ethan, Josiah
2/2/20	Meeting with Wiendorf	Alexa, Ethan, Josiah
2/3/20	Meeting with Orin Gotchey	Alexa, Ethan, Josiah
2/4/20	Testing with Dr. Wiendorf	Ethan, Alexa, Josiah

2/4/20	Experiment with Handheld XRF	Alexa, Ethan, Josiah
2/1020	Experiment with Dr. Barnes	Alexa, Ethan, Josiah
2/11-26/20	Working on mission folder	Alexa, Ethan, Josiah

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Interview Questions for Cancer Survivors
(This document is from our interview with
Lieutenant Brian Gross, Lubbock Fire Department)

Code Red wrote interview questions for the people in the community who were experts in various fields associated with the project. Different questions were needed depending on the person with whom we spoke. These are the questions to cancer survivors and the notes we took in Google docs to help us write up the interview.

1. Please, tell us about yourself.
   Now a lieutenant. Dec 18, 2018 lifescan. Mass on left kidney
2. What have you endured?
   Clear cell renal cell carcinoma
3. When were you diagnosed?
   Dec 18, 2018 Feb 26, 19
4. Is there a side of cancer that not many people see?
   Through phone call was notified
5. If you don't have cancer anymore, what was the cure?
   Surgery, amputation of kidney. chemo didn't work
6. What type of cancer do/did you have?
   Clear cell renal cell carcinoma
7. What is the worst side of cancer?
   No sign of the cancer
8. How did your family react to your diagnosis?
   devastated
9. Did your values change when you got cancer? If so, what changed?
   Made him a better person, what his friends with cancer need.
10. Did the diagnosis of your cancer make you more aware of toxic carcinogens that could possibly get on your suit?
    Yes, although it was not immediately a suspected cause
11. Would you want to, if you knew that you would get cancer, this job all over again?
    Yes, would rather live a life of service towards man and God. Likes to comfort and help others as a firefighter.
12. How did cancer affect your occupation?
    Stopped it for a moment, went back as soon as possible
13. What effect did the diagnosis have on your feelings?
    Described it by someone locking him up and whispering through the door "you're going to die." He still cries about it

14. If you could, would you return to your job?
    He did go back to job in June, YES

EXTRA INFORMATION --

Ignited diesel = carcinogens
Heat from pants exposed to the kidney, thinks that is what the cause was
Wasn't slow growing cancer
Line of duty cancer

Difference:
Being safe is tied to a dollar
Educate:
Leaders
Representatives
Talk to whomever we can

70 percent of fire stations are volunteer

Interview Questions for Doctors
(This document is from our interview with Dr. Fred Hardwicke - Oncologist and Hematologist)

Code Red wrote interview questions for the people in the community who were experts in various fields associated with the project. Different questions were needed depending on the person with whom we spoke. These are the questions to doctors and the notes we took in Google docs to help us write up the interview.

1. Tell me about yourself
Fred Hardwicke
59 years old
Education: TT
Degree: Chemistry BS
Medical School: 4 years
Official school: oncologist medical
Took Chemotherapy class
Was a real child
Side interest: music

2. What cancers and blood diseases do you frequently deal with?

Gastroenterologist
Mouth - out
Colorectal

3. Have you dealt with any firefighters with cancer?

Yes, acute leukemia

Cigars contain carcinogens - combustible products - that cause leukemia

4. What are the symptoms of mesothelioma?

Coughing, chest pain, trouble breathing

5. What prevention methods exist out there?

A special “hazmat” team has to come in and take away asbestos

6. What treatments?
Chemotherapy. If noticed early, cancer

7. Survival rate?
<20%

8. What cancer is the most lethal in firefighters?
Mesothelioma, Lung Cancers

9. What are the most common cancers in firefighters?

Most Common cancers: lung cancer, colorectal, breast, prostate

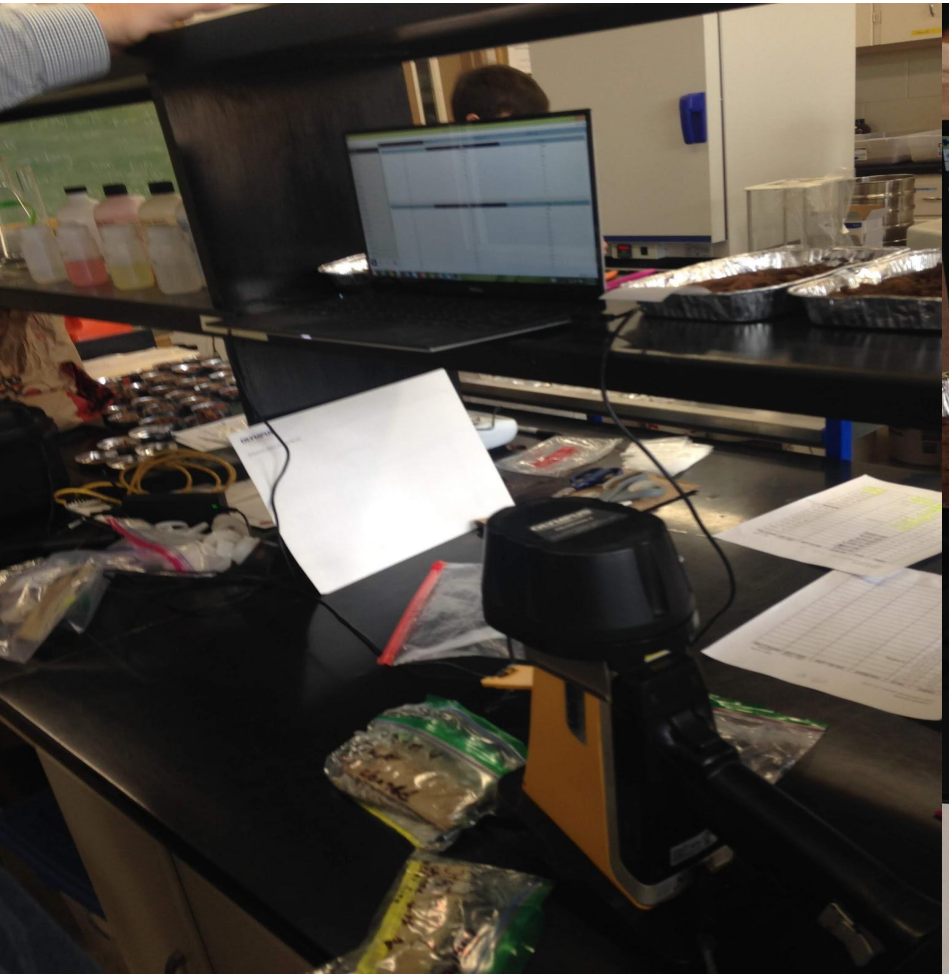
10. 7 symptoms (found in American Cancer Society): 1. Unexplained weight loss 2. New mass feeling 3. Changing moles 4. Difficulty swallowing 5. Pain/lumps 6. Triangles in bowel

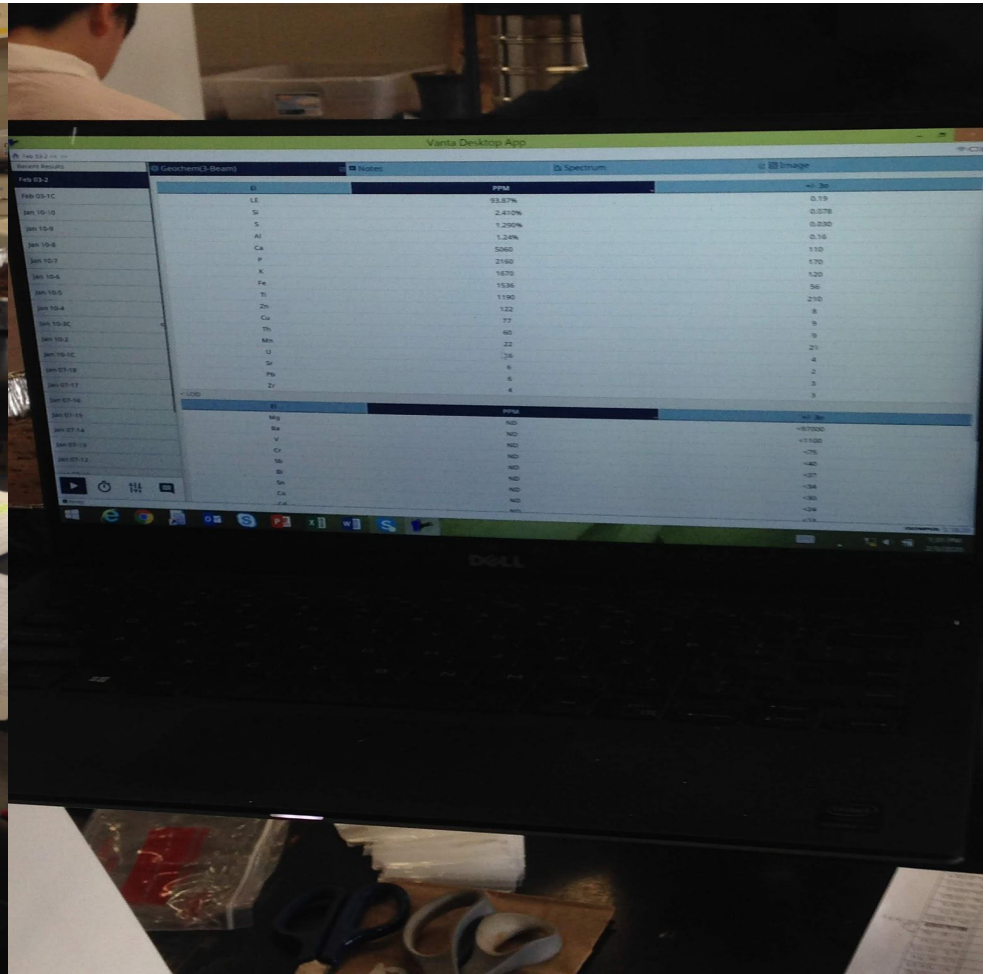
What is the best way to know what type of cancer firefighters may have developed?

Physical exams, then questions

The Weindorf Science Lab, Texas Tech University, Code Red Scientific Research Team

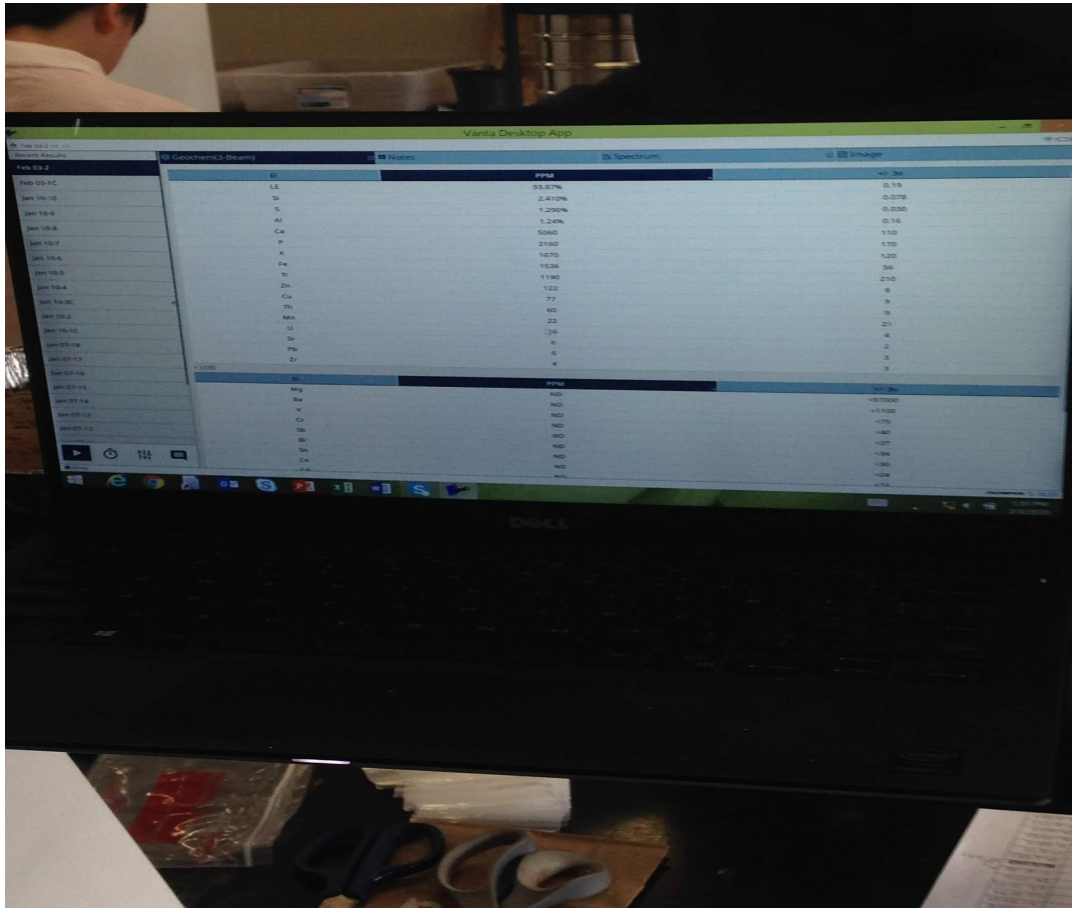
Handheld X-RF costs $40,000 dollars and is portable.



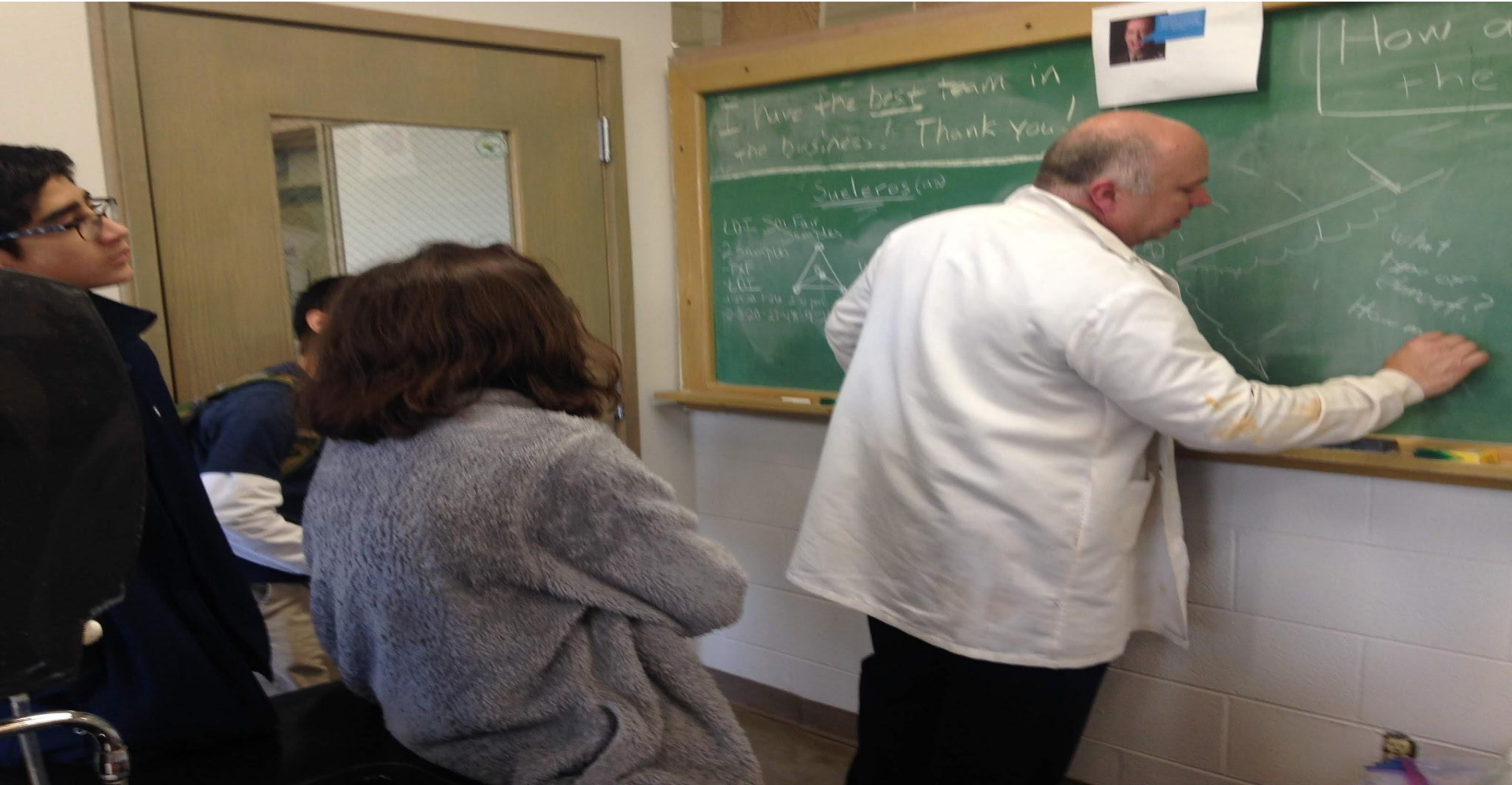


The instrument has 2 beams for every one scan. It scans the element for 30 seconds per beam. Each beam detects different elements. The machine uses a lead cup to protect humans from the radiation the x-ray emits.

The data that is found in the x-ray is recorded on a concordance sheet where we analyze the elements found. The x-ray cannot find light/stable elements such as carbon. Organics must be measured differently.



Dr. Weindorf teaching us 1-c is what you call the calibration and the calibration method is called Geochem.



iNotes from Fire Station #19
October 3, 2019

Fireman Abi Morales

Fuel
Oxygen
Source of Heat = **Fire Triangle**

Fire Tetrahedron=
Uninhibited Chemical Change
Fuel
Oxygen
Source of Heat

Construction Types
Type I – Fire Resistant:– parking garages, concrete, fire retardant insulation
Type II – Non-combustible: - aluminum buildings
Type III- Ordinary construction – wood-framed buildings
Type IV- Heavy Timber – log cabins; charring on a big piece of timber or beam actually 2-3 inches insulates it whereas a 2x4 will snap and collapse; 1.5-2 hours before collapse
Type V - Ordinary homes, wood-framed; quickest building collapse after mobile homes

Experiment Idea

Metal can sealed with one exit hole
Fill with wood
Outgases create charcoal in the can but no ash
Incomplete combustion, so it makes charcoal

Complete Combustion
Water Vapor
CO carbon monoxide

Monitors
QRAE3
"Low Explosive Levels"
Natural gas
CO
O
Hydrogen cyanide
CO_2

Safety Equipment

Masks work off of positive pressure, crack it and it will blow OUT
Law passed to do that because of CO pushing into a mask and uniform – firefighters suffocated

Nomex fire gear for protection – hoods – flame retardant but not flameproof because in an oxygen-rich atmosphere will burn
Normal oxygen is 21%

National Fire Protection Association NFPA codes control safety
How to clean gear is code 1851,
1971 code – all need outer shell, moisture barrier, and thermal barrier
Gear survives 30 seconds in a flashover

Experiments

Citrus based detergents are used to wash Nomex and then washer is rinsed with water + bleach afterward.

Class A foam is the foam most used and it's Dawn detergent + water to make it foamier.

80% of firefighters are rural and volunteer
Only 20% are trained professionals
This fact means most do not have the training to know what to do with the gear and how to wash it properly.

Firemen are getting cancer at higher rates than average people. Particularly groin, head, face, throat, neck, underarms areas. Washing with baby wipes those areas especially, could lower the risk???

Volunteer firemen still getting cancer even though they use water and class a foam (Dawn detergent basically + water)

Throat cancer, testicular cancer
Baby wipes – neck face groin underarms and hands

Woodrow Volunteer Fire Dept in Lubbock
West Carlisle Volunteer Fire Dept in Lubbock
Need extractors and don't have them; don't have the money for extra hoods or bunker gear; some don't wash the gear EVER

Lubbock Fire fighting Family – man was lost from cancer; his widow is Mrs. Watson. He is on the memorial wall in Colorado Springs for firefighters lost due to line of duty.

Station #4 has the special washing machines

NEXT STEPS DISCUSSED BY THE TEAM ---

1. **Conduct a test to make charcoal with Abi (1-hour process) either at school or home**
2. **Meet with volunteer units to get their feedback (set up by Mrs. Wilbanks)**
3. **Abi will schedule a time for us to go with him to Station #4**
4. **Mrs. Wilbanks and Mrs. de Farias have reached out to chemists and engineers at Tech to find the right people who can help you with your project. As we hear back from these folks, we will let you know.**
5. **Dr. Hickey said that if the liquid in the washing machines doesn't contain the contaminants that are water-soluble, we can still test for that using the outgases from the uniforms by performing gas chromatograms.**

Video Clips of Code Red

Here is a collection of video clips of the team in action this year. They are short & sweet and represent a variety of activities in which we participated.

1. **Learning to use a micropipette** with Dr. Barnes and Dr. Welks at Texas Tech University in the Geosciences Laboratory for the ICP
   https://youtu.be/5bLkspL01Bo

2. **Data Analysis with the ICP** - learning how to interpret results from the ICP as Dr. Barnes teaches us to look for elements and not compounds. Texas Tech.
   https://youtu.be/FgW8EUcJa7E

3. **Tour of Station with Washing Machines** - learning about the few fire stations that can afford the commercial washers for bunker gear with Fireman Abi Morales.
   https://youtu.be/zoc-MyzD4hs

4. **Water tension & fire fighting** -Fireman demonstrating water tension and the use of additives to fight fire more effectively.
   https://youtu.be/BziLi0NH-fc

5. **Cancer survivor describes his life scan** - Fireman Brian Gross tells us about the day he got his life scan that detected cancer.
   https://youtu.be/0zyN7d3j9rM

6. **Role of synthetics in cancer risks for firemen** - Fireman Brian Gross explains the role of synthetic materials in the increased risk of cancer for firemen.
   https://youtu.be/k4uuZ1Ud74M

Combustion Products Measured at Fires

This is a list of many of the combustion products whose exposure causes significant health risks for firefighters. Provided by *Last Line of Cancer Defense* through Lubbock Firefighter Abi Morales.

Acetaldehyde
Acrolein
Aldehydes (mixed)
Alkanes, straight chain (inc. propane) Alkenes, straight chain (inc. propene, 1-butene/2-methylpropene)
Arsenic
Asbestos
Benz[a]anthracene
Benzene*
Benzaldehyde
Brominated hydrocarbons (low) 1,3-Butadiene
Carbon dioxide
Carbon monoxide
Chlorinated alkanes (low) Chlorobenzenes (low) Cycloalkanes
Cyclopentenes
Dioxins and furans (including 2,3,7,8-dibenzodioxin and –furan*) Dichlorofluoromethane
Ethylbenzene
Formaldehyde
Glutaraldehyde
Hydrogen chloride/cyanide/fluoride Isopropylbenzene
Isovaleraldehyde
Methylene chloride Naphthalene (a PAH)
Nitriles (mixed)
Nitroarenes (analogues of PAHs) Nitrogen dioxide
Particulate matter (fine) Phosgene
Polycyclic aromatic hydrocarbons (mixture, including naphthalene) Sulfur dioxide
Styrene Tetrachloroethylene Toluene* Tricholoroethylene
Vinyl chloride
Xylenes (including o-xylene)

Measured "Chemicals" in the Breathing Zone of FFs at the Fireground

IARC Group 1 – known carcinogen
Arsenic
Benzene
1,3-Butadiene
Formaldehyde
Silica (crystalline)

Radioactivity (α,β,Y)
Asbestos
Benzo[a]pyrene
Cadmium
Sulfuric acid
2,3,7,8 TCDD
Diesel exhaust

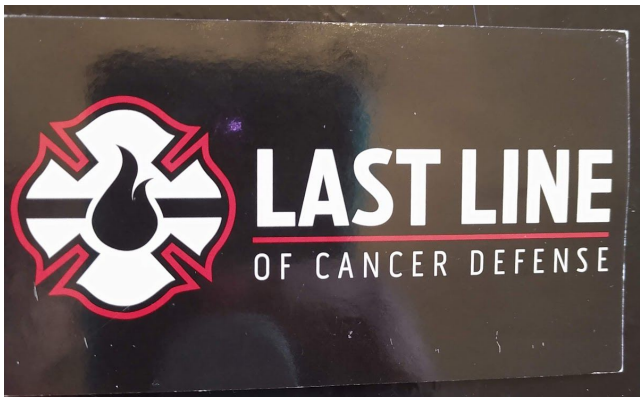
Measured "Chemicals" in the Breathing Zone of FFs at the Fireground

IARC Group 2A – probable carcinogen
Dibenz[a,h]anthracene
Lead (inorganic)
Polychlorinated biphenols (PCBs)
Tetrachlorethylene (perc)
Trichlorethylene

IARC Group 2B – possible carcinogen
18 Chemicals

Code Red

Partnership with *Last Line of Cancer Defense*



Joseph Wallace
President, Last Line of Cancer Defense
Contact Information

From: **Joseph Wallace** <joseph@llocd.com>
Date: Fri, Dec 20, 2019, 3:05 PM
Subject: Fire gear cleaning info
To: <lwilbanks@southcrest.org>

Laura,

Attached are the lists of contaminants found in structure fires. I also attached a cleaning guide from a detergent company but it is the recommended cleaning cycle for properly cleaning fire gear. I am sifting through some other info I have to see what is pertinent to what they are working on as well as reaching out to some people to see if they are willing to have a conference call with the kids. Let me know if they have any questions as I am very interested in assisting them.

Joseph Wallace

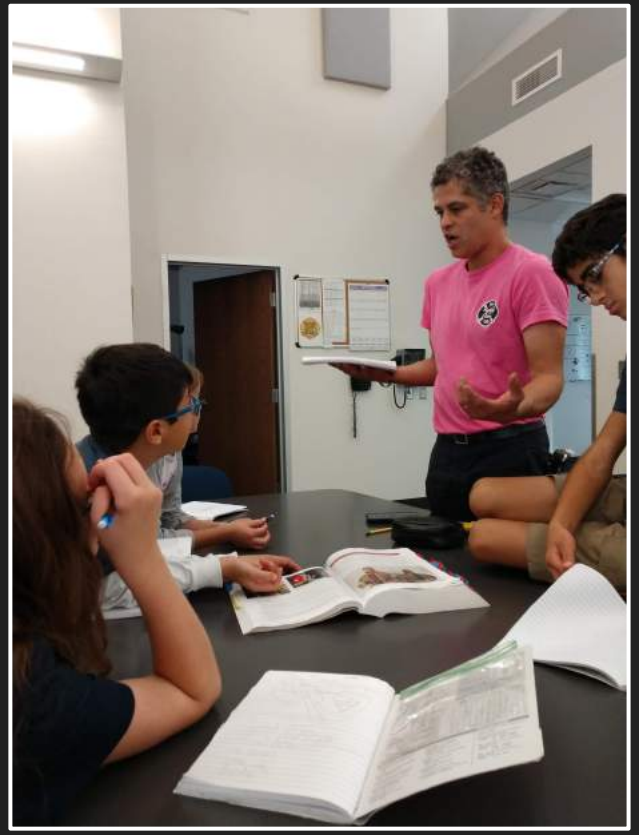
President
Last Line of Cancer Defense, LLC
432-553-5652
Joseph@LLOCD.com
P . O. Box 93503
Lubbock, TX 79493

Code Red: Photo Essay

A dirty helmet was a badge of honor. It signified courage, hard work, the proof a fireman had been invaluable. To clean it was to dishonor the man.

Today, we know it is the sign of contamination - the increased risk of cancer every fireman fears. Today, we say CLEAN YOUR HELMET.

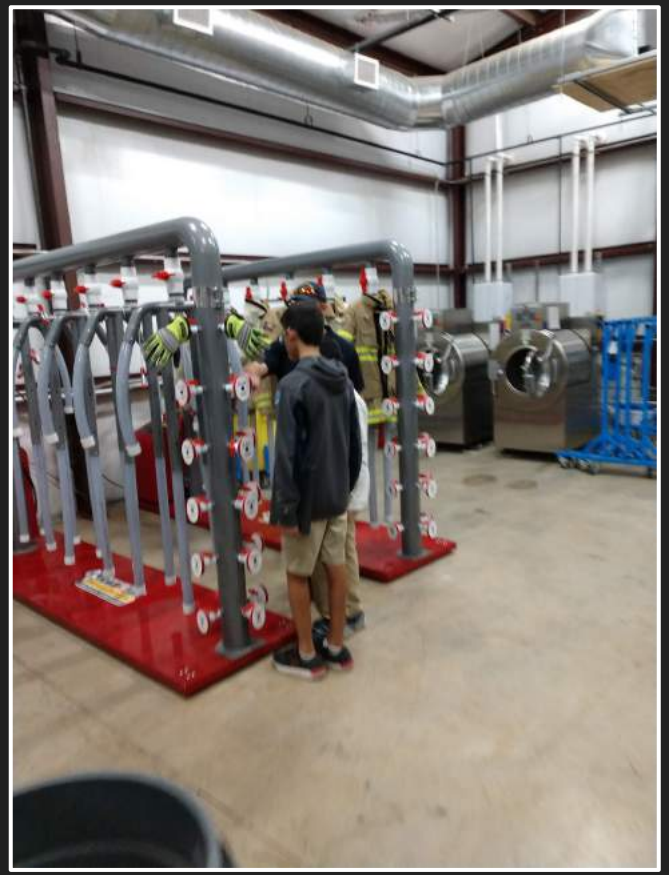
Our friend and hero Firefighter Brian Gross



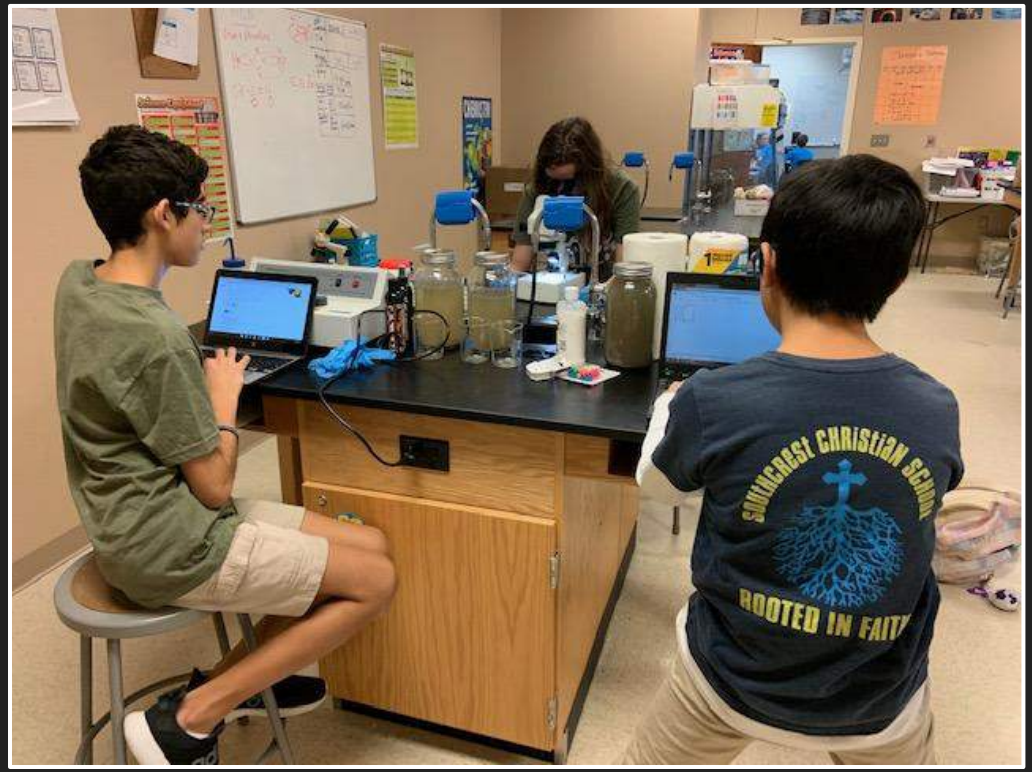
Starting the project at Station 19 - Firefighter Abi Morales

Sewing Indicator Straps from donated Firefighter Gear

Learning about Washing Machines



School Experiments - Testing contaminants in the water taken from a washed hook and ladder truck using spectrophotometry to identify risks to firefighters.



Examining the effect of contaminated water on the invertebrate *Daphnia magna* - an indicator species of poor water quality.

Community Benefit: Sharing our brochures and posters with the Woodrow Volunteer Firefighter Department - wash your gear!

Interviews with Oncologists Dr. Hardwicke Dec 5

Dr. Tijani Dec 19 University Medical Center

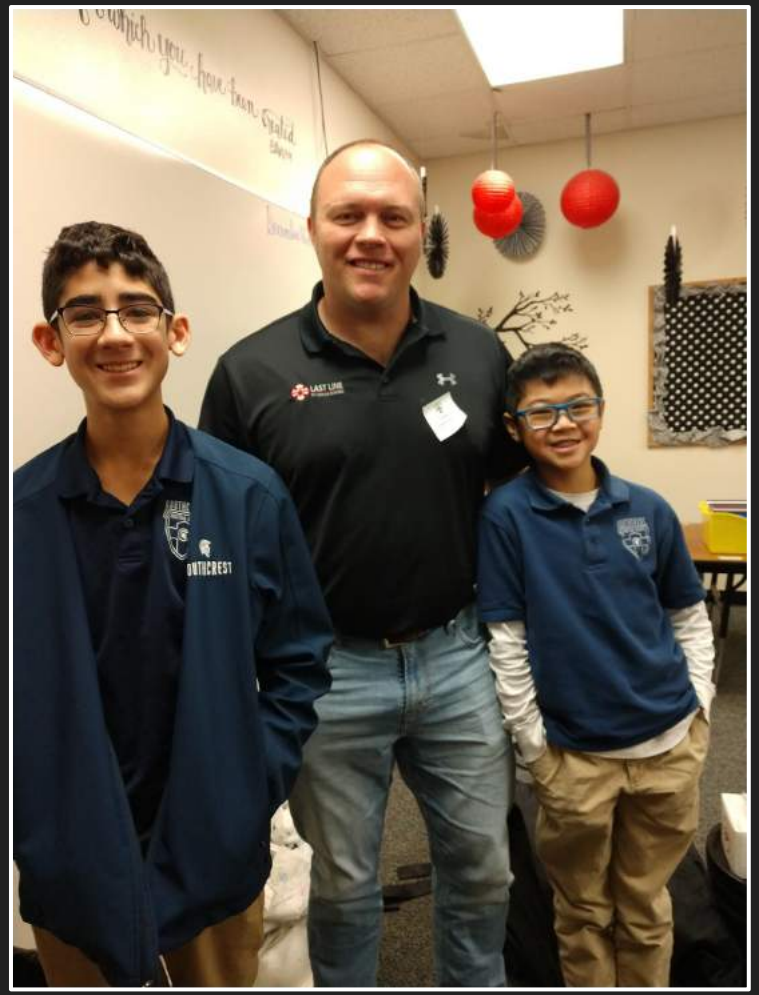
Talking with Analytical Chemists

- ➔ Learning methods to detect organic and inorganic substances.
- ➔ Learning instruments designed to detect elements in contaminated water and clothing.

Outreach to Lubbock Fire Department - Meeting of the Fire Chiefs Dec 11

Outreach to the Lubbock Fire and Rescue

Interview with Fireman Brian Gross - Cancer Patient

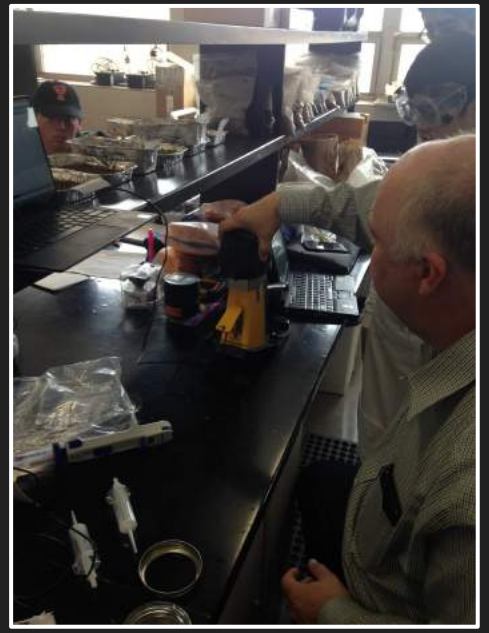


Interview with Joseph Wallace from *Last Line of Cancer Defense*

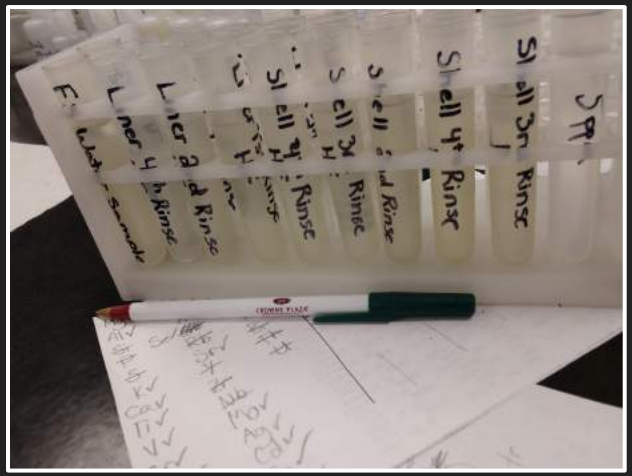
- ➔ Learning about the contaminants most commonly encountered by firefighters.
- ➔ Learning what we can do to help lower the risk of cancer for firefighters.

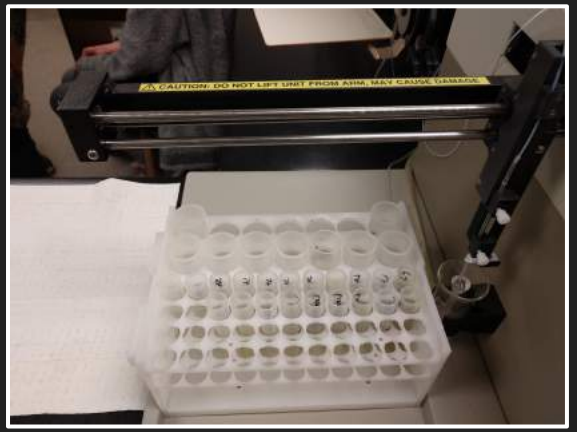
Dr. Weindorf's Lab - XRF

X-ray Fluoresence



Dr. Melanie Barnes' Lab - ICP Analysis





Problem

Firefighters are at higher risk of cancer, especially in this age of synthetic building material. How can we help prevent this?

Hypothesis

If we clean firefighting gear at least twice, we can significantly lower the amount of carcinogens firefighters are exposed to.

Application To The world

Firefighters are at increased risk of cancer compared to the general public. If we can reduce their exposure to carcinogens on the job, we can help prevent this.

Increased use of synthetic materials in buildings, furniture and in our lives, have increased the amount of carcinogens firefighters are exposed to during fires and out-gassing.

The information can help firefighters, who selflessly provide a much needed service in the world, do their job as safely as possible.

Materials

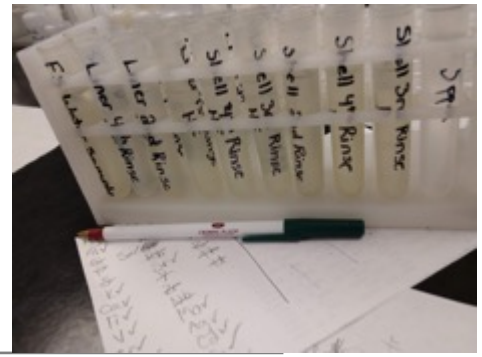
- Sample Jars
- Consent Forms
- Distilled Water
- Daphnia Magna
- Test Tubes
- Petri Dishes
- Microscope
- Computers
- Spectrophotometer
- Inductively Coupled Plasma Mass Spectrometer (ICP-MS)
- Bunker Gear
- Sewing Machine
- Snap Button Kit
- Scissors
- Seam Ripper
- Portable X-ray Fluorescent
- Goggles
- Zip-lock bags
- Gloves

http://clipart-library.com/clipart/8i65axzbT.htm

Procedure

1. Recruit firefighters – volunteer and career, over 18 years old and older, sign consents
2. Got decommissioned bunker gear and permission to cut it up.
3. Designed a strap to meet criteria – 2 inches, snaps on and off firefighter's air container easily, and can be brought into fires to catch contaminants. Minimal off-gassing.
4. Met with Firefighter Chiefs and distributed straps
5. Waited for fires to occur and collected straps in Zip-lock bags after fires
6. Sent collected straps to Firestation 4 where the specialized washing machine and detergent are, and collected water sample after each wash – 4 wash cycles.
7. Brought water samples to Texas Tech University, Department of Soil Sciences and Chemistry, and ran the samples through the ICP-MS and Portable X-ray Fluorescent.
8. Collected data from the ICP-MS and X-ray Fluorescent machines and graphed findings
9. Made poster, brochure, survey and webpage on experiment and findings, and distributed to firefighters in the community
10. Placed Daphnia magna into contaminated water and distilled water and counted heart rate and death rate to see effects of contaminants.
11. Talked to Oncologists, firefighters, cancer survivors and their families to gather information.
12. Distribute findings to community firefighters.

Experiments



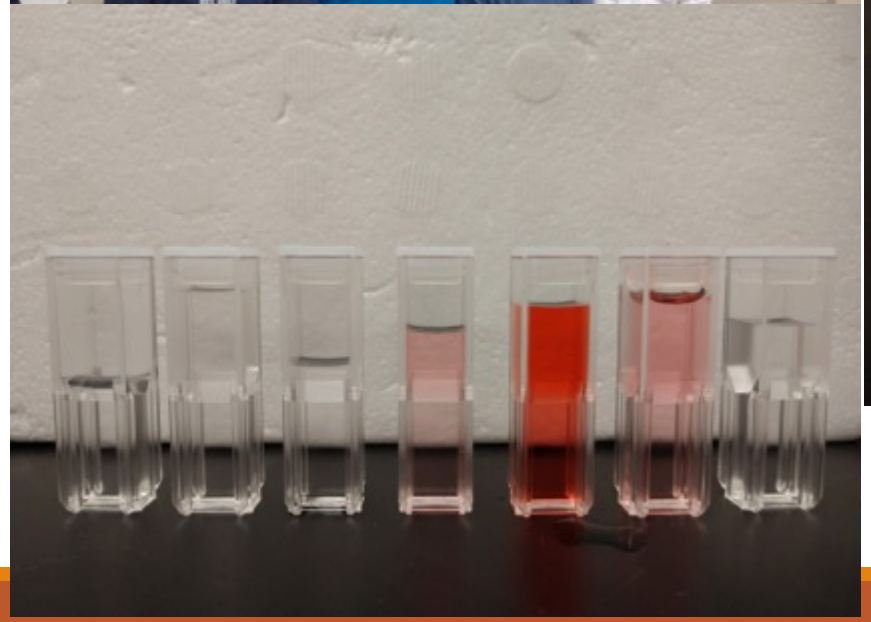
We had several small experiments that tied together to help us form our hypothesis. The following slides have a short summary of each of the experiments:

Experiment I

The use of a spectrophotometer to evaluate contaminants in fire engines as a health risk to firefighters

We took water from the washes of fire engine seats to the lab at school. We set the spectrophotometer to a specific wavelength range, and then tested the wash water for transmission and absorption of photons.

What we did…Experiment I



Experiment II

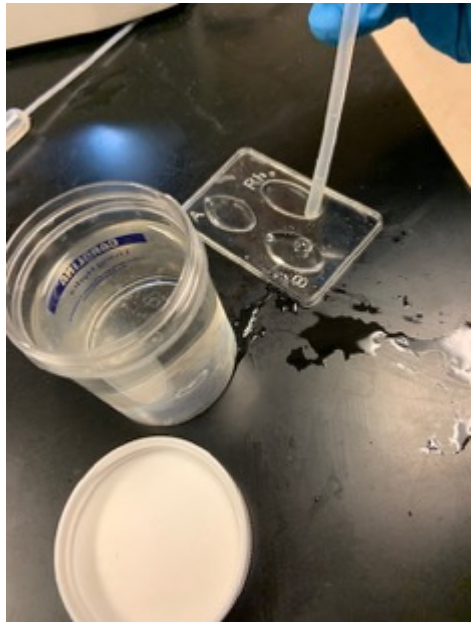
The effect of contaminants in rinse water on living organisms

We placed Daphnia magna into petri dishes filled with distilled water, and counted their heart rates under a microscope.

We then placed Daphnia magna into petri dishes filled with the water from the wash of a contaminated fire engine seat and counted their heart rates under a microscope.

We also noted if the Daphnia died faster in the contaminated water vs. distilled water.

What we did… Experiment II



Experiment III

Engineering a strap to collect contaminants from firefighters during exposure to a structure fire.

We were given a decommissioned bunker gear and permission to cut it up. We thought of making approximately 60 straps from the bunker gear by cutting it into 2 inch strips, and thought of how to attach it to the firefighter without causing him/her to be in danger in a fire. We ensured that the strap could easily strap together and come apart, so it doesn't get caught in anything that would endanger the firefighter, and we thought about different materials to use to ensure we minimize off gassing when exposed to fires.

Our end designed were 2 inch straps sewn together using cotton thread, with metal snap buttons which attach and detach easily.

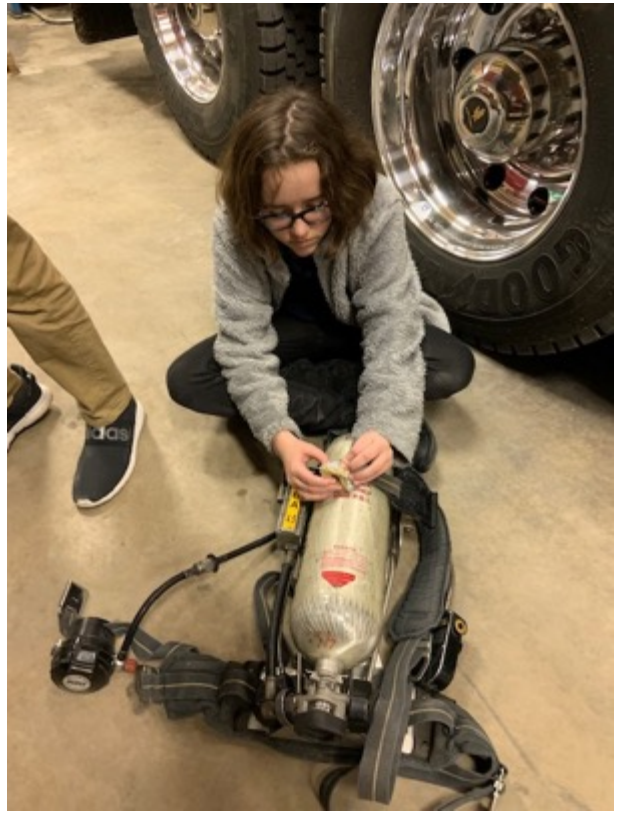
What we did… Experiment III

Experiment IV

Evaluation of straps – exposure to elements in a structure fire

Straps were distributed by Fire Chiefs to their firefighters. These were strapped onto their air containers, and when they went into a fire, the straps went with them. Immediately after the fire threat was over, the straps were placed into Ziplock bags and sealed. Our team member collected the bags and took it to Firestation 4 which has the specialized washing machine and detergent. As the straps were washed, the residue water was collected after each wash and placed into jars and labeled. These were then taken by our team to Texas Tech University, Geosciences and Chemistry department and tested using the ICP-MS and portable X-ray Fluorescent.

What we did… Experiment IV



Experiment V

Evaluation of bunker gear: Contaminants found during the washing process

We tested distilled water, and water from each of the different wash cycles (wash one, wash two, wash three and wash four) and measure the concentration of different elements. We found that there were a lot of elements – Magnesium, Aluminum, Silicone, Phosphorus, Potassium, Calcium, Manganese, Copper, Zinc, Arsenic, etc. in the washes, and that their concentration in general decreased after the second wash

What we did… Experiment V

Variables

- **Independent Variables**
  - Bunker gear used to make straps
  - Rinse number of fire engine seat
  - Concentration of contaminated water to distilled water
  - Bag of straps from which we tested
  - Stage of wash water being used during the investigations

- **Dependent Variable**
  - Amount of photons in each wavelength
  - Our observations of the Daphnia's death by heart rate
  - The amount of carcinogens collected
  - The amount of chemicals on the straps
  - The amount of contaminants in the water when it has been washed – once, twice, three times, and four times.

Control

- Distilled water
- Unwashed shell and liner bunker gear water

Constants in Experiment

- Bunker gear used – straps used
- Water samples from each stage
- Jars water samples are in
- Daphnia magna species used
- Microscope used
- Bags kept in
- Washing machines used
- Amount of time washing machine run
- Amount of gear/load
- Way water tested in lab

Qualitative Data

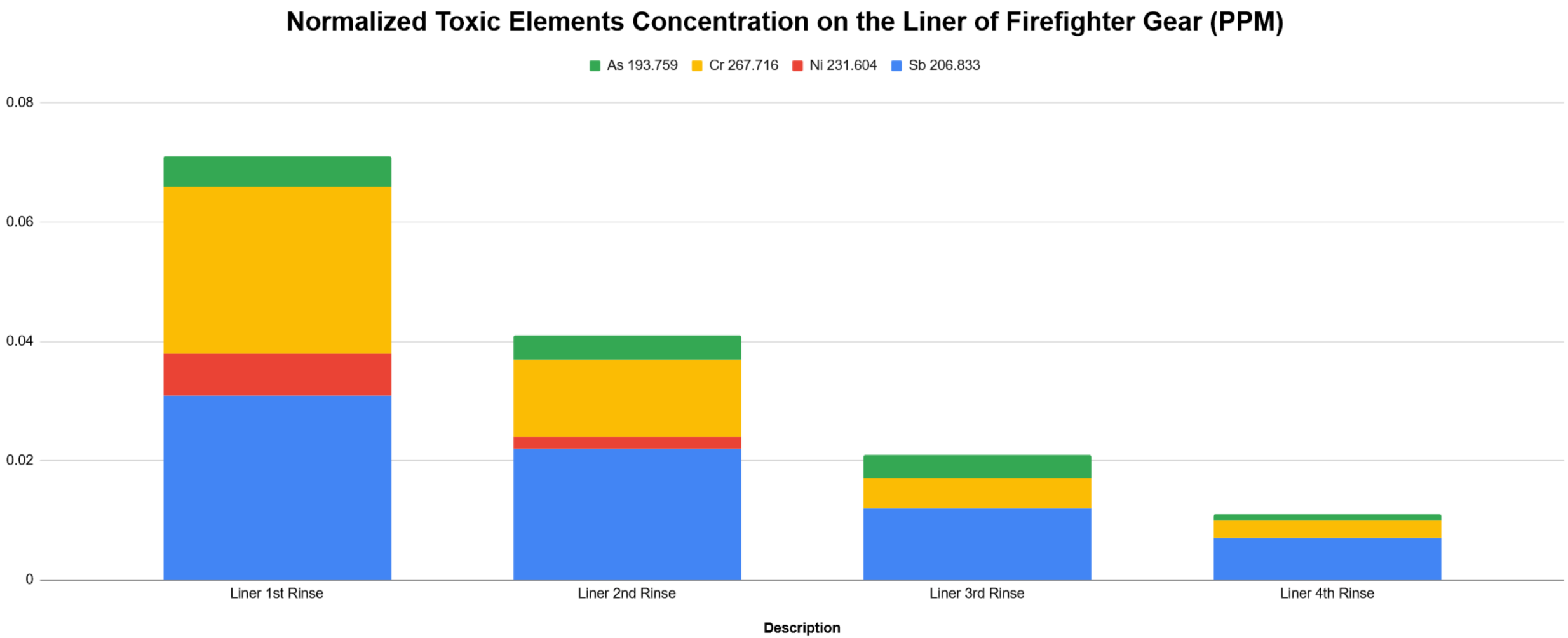
- Meetings with Fire Chiefs and Firefighters
- Meetings with Oncologists
- Meetings with cancer survivors and families of cancer victims

Data

Description	Sb	Ni	Cr	As
Shell 1st Rinse	0.02	0.003	0.044	0.005
Shell 2nd Rinse	0.146	0.018	0.481	0.01
Shell 3rd Rinse	0.056	0.003	0.17	0.005
Shell 4th Rinse	0.04	0	0.125	0.006

Description	Sb	Ni	Cr	As
Liner 1st Rinse	0.031	0.007	0.028	0.005
Liner 2nd Rinse	0.022	0.002	0.013	0.004
Liner 3rd Rinse	0.012	0	0.005	0.004
Liner 4th Rinse	0.007	0	0.003	0.001

Quantitative Data



Quantitative Data

Description	Mn	Fe	Zn	K	Ca	Ti	Se	Sb	Sn	Ni	Cr	As	Al	Mg	Sr	Sr	Ba
Shell 1st Rinse	0.023	0.248	0	0.4621	1.3162	0.051	0.003	0.02	0.01	0.003	0.044	0.005	0.33	0.2616	0.144	0.191	0.035
Shell 2nd Rinse	0.053	2.348	0.099	1.2241	2.0732	0.963	0.005	0.146	0.018	0.018	0.481	0.01	2.992	0.4548	0.159	0.225	0.07
Shell 3rd Rinse	0.014	0.621	0	0.2945	0.8832	0.274	0.005	0.056	0.009	0.003	0.17	0.005	0.816	0.1576	0.088	0.127	0.033
Shell 4th Rinse	0.007	0.366	0	0.1776	0.8388	0.171	0.003	0.04	0.006	0	0.125	0.006	0.512	0.1292	0.104	0.15	0.032
Description	**Mn**	**Fe**	**Zn**	**K**	**Ca**	**Ti**	**Se**	**Sb**	**Sn**	**Ni**	**Cr**	**As**	**Al**	**Mg**	**Sr**	**Sr**	**Ba**
Liner 1st Rinse	0.018	0.413	0.531	1.4232	1.6907	0.078	0.009	0.031	0.021	0.007	0.028	0.005	0.873	0.3727	0.189	0.275	0.051
Liner 2nd Rinse	0.007	0.214	0.114	0.4747	0.8286	0.043	0.019	0.022	0.012	0.002	0.013	0.004	0.476	0.1815	0.119	0.156	0.036
Liner 3rd Rinse	0.002	0.071	0	0.1501	0.6397	0.017	0.011	0.012	0.01	0	0.005	0.004	0.206	0.1186	0.108	0.143	0.029

Results

After at least 2 washes, there is a significant decrease in the amount of contaminant in the fire gear.

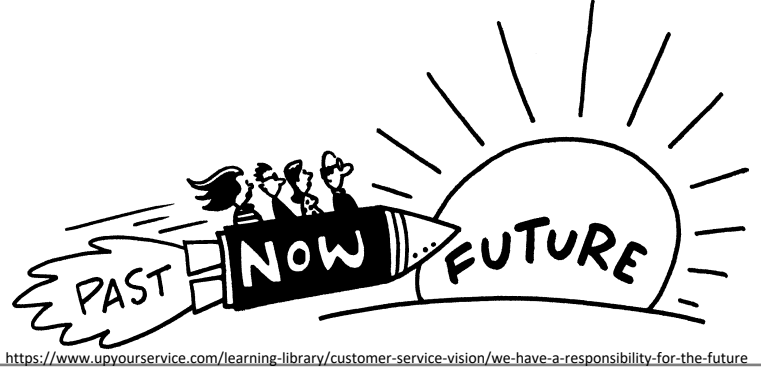
Conclusion

Our experiment supported our hypothesis that cleaning the gear at least twice, significantly decreased the level of contaminants on the firefighter's gear.

If firefighters can be more aware of these risks of cancer and their ability to lower their risks by cleaning their gear thoroughly, they can save themselves. The evidence of this is that many firefighters have died from occupational cancer deaths. Many of these deaths have been proven to be caused by a lack of education and not cleaning the suits timely and well.

Therefore, we believe we can educate the firefighters and lessen the rate of cancer among them with our project.

Future Application



https://www.upyourservice.com/learning-library/customer-service-vision/we-have-a-responsibility-for-the-future

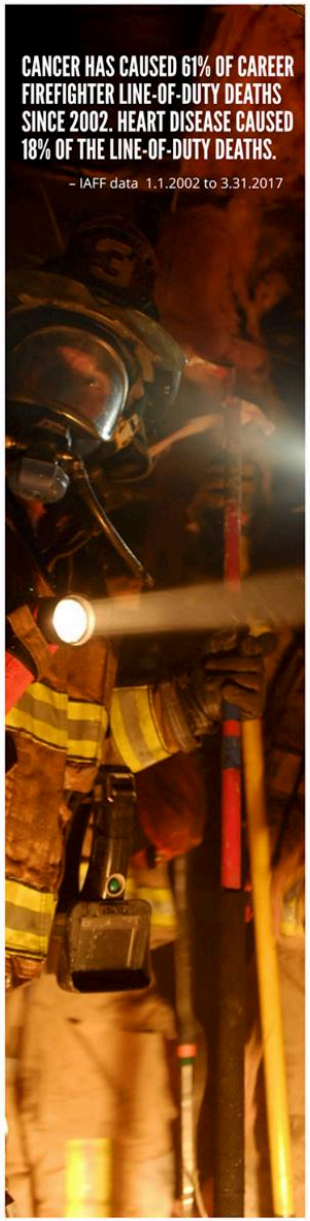
We have big aspirations for the project. We would like to pass our findings to all fire departments across the country – both volunteer and professional. The information can be used and money raised to get dedicated washing machines and detergents to help reduce cancer rates in our heroes.

The results from this experiment can educate firefighters and the communities they serve to help prevent an occupational hazard that those who selflessly give to their communities. We can spread knowledge, awareness, and help heroes live well to fight another day!

Code Red: Hypotheses & Evidence

Abridged Hypothesis	Proposed Experiment	Independent Variable Rationale	Dependent Variable Rationale	Evidence of Research-based Information
If material can collect contaminants, then more can be learned about specific risks of elements encountered in fires.	Design straps sewn from firefighter bunker gear to be attached to firemen when entering buildings; then returned to us for analysis.	The layer of bunker gear used in straps to collect contaminants; Rationale - different materials behave uniquely in fire and smoke.	Use a handheld X-ray Fluorescence instrument to identify elements found as contaminants on the test straps. Rationale - some elements pose known health risks	Researchers have listed known contaminants on urban firefighter gear but little has been researched on bunker gear contaminants in smaller settings and rural settings.
If engines are washed where firefighters have been sitting in bunker gear, then contaminants will be found in the water used to clean seats.	Spectrophotometer in the high school lab is used with water samples to show contaminants are indeed in vehicles where equipment is placed.	The water used for cleaning the inside of the fire engine; rationale - bunker gear is contaminated and when sitting inside the fire truck, contaminants are spread.	The presence of chemicals and materials found in the wash water before and after rinsing; Rationale - there will be contaminants left behind that pose health risks.	Many contaminants found in synthetic building materials and furniture emit dangerous chemicals when burned and pose risks to firefighters
If we obtain and test water used to rinse a firefighter's bunker gear, then we can see what chemicals the firefighter comes in contact with during a fire.	Collect water from a wash cycle at a fire station with washing machines, then from the water source from that sample, then gather data using an	Whether it was a veteran or a rookie who went into a fire, and if it was the inner or outer layer of the bunker gear. Rationale - Different materials/times absorb different	Use an Inductively Coupled Plasma Mass Spectrometer to identify all elements in the water samples.	An ICP-MS can be used to identify elements compared to standards placed inside the instrument. Research shows this is a chemical analysis performed on materials of many kinds.

	ICP-MS and analyze data.	chemicals		
If we test the water samples in different testing devices, then the results will differ, giving us more definitive results.	Take the same water as before, and go to a different professor who has a portable X-ray Fluorescent, and test our water, and analyze the data.	Whether it was a veteran or a rookie who went in could determine time of exposure.	The results of the testing with the portable X-ray Fluorescent to attempt to find all elements on the straps.	X-ray Fluorescents can find some elements on any material, but used mainly for soil. This might give us different results than the ICP-MS.
If we create an informational brochure and website and survey people about it, then people will be educated on the topic of carcinogens in fire.	Create a survey and ask multiple firefighters from different departments (rural and city) and look at the answers of each one and how they vary from each other.	Our independent variable is the people that take the survey because their answers change the results of our survey.	Our dependent variable is the results because it depends on the answers of our survey.	We need to know how many times firefighters wash their suits to know how much the carcinogens affect their cancer risk rate.



Firefighter cancer fact check

Although cancer is the leading cause of firefighter line-of-duty deaths, firefighters are not "68 percent more likely to develop cancer than the general population." Accurate data is crucial when quantifying occupational cancer's toll on – and threat to – firefighters and their families. Recently, a number of well-intended journalists, legislators, manufacturers, and others have cited **inaccurate firefighter cancer statistics**, including **the following erroneous examples**:

- "...the risk of cancer in firefighters is 250% greater than in people not in our line of work."
- "In all, researchers found that more than two-thirds of firefighters – 68 percent – develop cancer, compared to about 22 percent for the general population..."
- "Firefighters...have a 68% higher risk of being diagnosed with cancer than the general population."
- "Research is showing 68% of firefighters will come down with cancer on average."
- "...More than two-thirds of firefighters are diagnosed with...cancer."
- "...63% of all firefighters will get cancer."
- "...[Researchers] found that firefighters are twice as likely to be diagnosed with cancer..."
- "...[F]irefighters are 50 percent more likely to be diagnosed with cancer than the...U.S. population."
- "A firefighter has a 29% higher risk of contracting cancer than the rest of our population."

The proliferation of inaccurate statistics concerns **Robert D. Daniels**, PhD, CHP. In 2010, Daniels led the largest cancer study of U.S. firefighters to date for the National Institute for Occupational Safety and Health (NIOSH). **"Some sources cite our study as reporting a two-fold excess of cancer among firefighters, then go on to say that two-thirds of firefighters are diagnosed with cancer," Daniels said. "Neither statement is correct."**

Here are the facts: Firefighters have a 9 percent higher risk of being *diagnosed with* cancer and a 14 percent higher risk of *dying from* cancer than the general U.S. population, according to the NIOSH study results. The cancers mostly responsible for this higher risk were respiratory (lung, mesothelioma), GI (oral cavity, esophageal, large intestine), and kidney.

It's important to note that firefighters' risks are significantly higher *for some specific types of cancer*. The NIOSH researchers did report a two-fold excess of malignant mesothelioma, a very rare cancer. Put another way, firefighters have a 100 percent increased risk (100 percent = double = 2 times) of getting mesothelioma. Firefighters have a

Firefighter Cancer Support Network | FirefighterCancerSupport.org

129 percent increased risk of *dying* from mesothelioma. (The earlier LeMasters meta-analysis also reported a two-fold excess for testicular cancer.)

Firefighters have a 62 percent higher risk of getting esophageal cancer, and they have a 39 percent increased risk of *dying* from esophageal cancer, according to the NIOSH research.

Here's an overview with some specific additional risks for firefighters noted:

- testicular cancer - 2.02 times the risk (again: 100% = double = 2 times)
- mesothelioma - 2.0 times greater risk;
- multiple myeloma -1.53 times greater risk;
- non-Hodgkin's lymphoma - 1.51 times greater risk;
- skin cancer - 1.39 times greater risk;
- malignant melanoma - 1.31 times greater risk;
- brain cancer -1.31 times greater risk;
- prostate cancer - 1.28 times greater risk;
- colon cancer -1.21 times great risk; and
- leukemia - 1.14 times greater risk.

Note that some fire departments are addressing occupational-cancer rates that are higher than national averages. FCSN instructors cite insurer statistics for Miami-Dade Fire Rescue: 32 percent (nearly one-third) of MDFR's active members were diagnosed with cancer or receiving cancer treatment between 2008-2010.

Bottom line: Firefighters *do* have higher cancer risks than the general population, and their risks are *significantly* higher for some specific types of cancer.

We encourage journalists, legislators, and others who address occupational cancer to contact the nonprofit Firefighter Cancer Support Network at PIO@fcsn.net for accurate information and vital context about cancer in the fire service.

In the meantime, if you see inaccurate claims, please politely share these correct statistics and suggest a revision.

Code Red

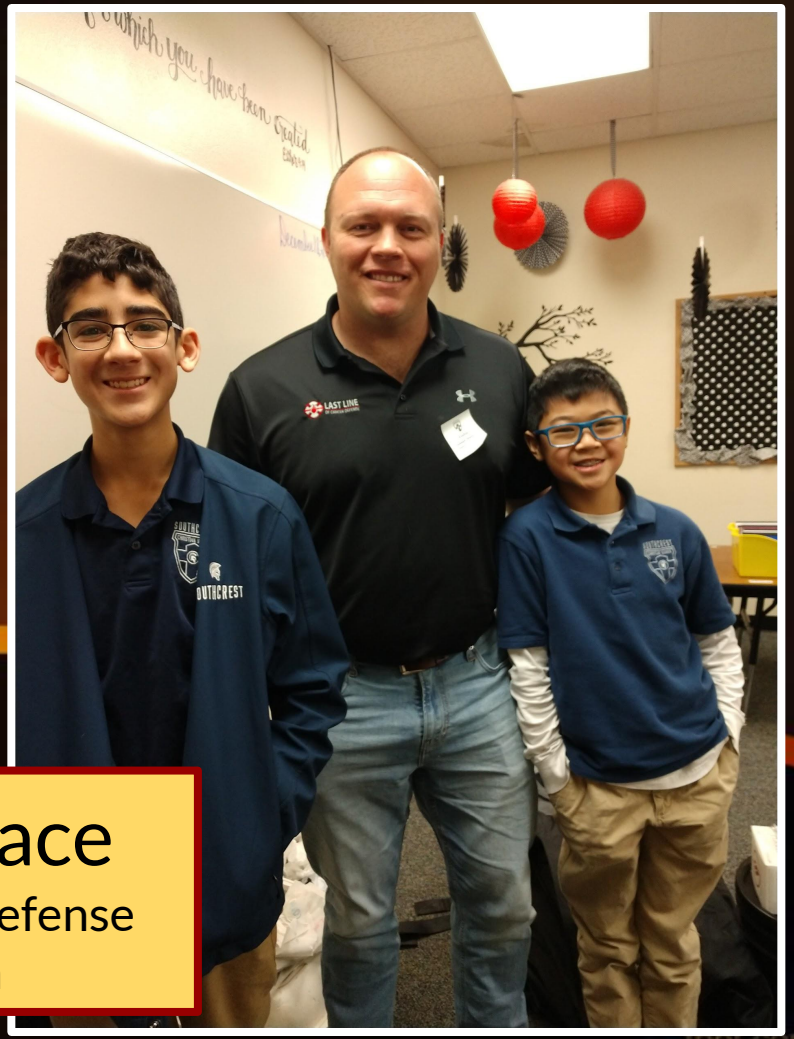
Interviews with Experts

7th Grade
eCYBERMISSION

Scientific Research Team

LogoType™

- Director & Founder LLOCD
- Fights for firefighters to be safe
- Supports research-based methods of cleaning gear
- Encouraged Code Red team to focus efforts on the volunteer fire departments who have less training in safety



Joseph Wallace

Last Line of Cancer Defense

www.llocd.com

- Hematologist and oncologist
- Currently treating firefighters with cancer
- Increased interest in the number of firefighters with cancer since learning of the increased risk due to our project
- Cancer screenings annually - his recommendation
- Avoiding contaminants by cleaning scrupulously

Dr. Hardwicke

Texas Tech University Health Sciences Center
Associate Director of Oncology

- Hematologist and oncologist
- Currently treating firefighters with cancer
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- Cancer screenings annually - his recommendation
- Avoiding contaminants by cleaning scrupulously

Dr. Lukman Tijani

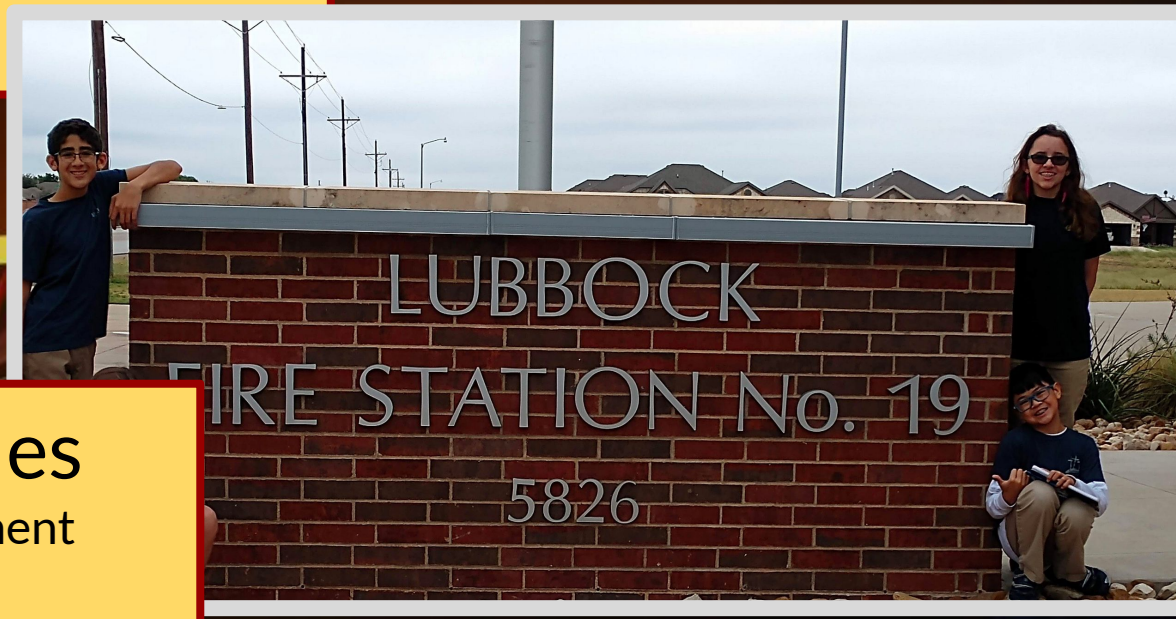
Texas Tech University Health Sciences Center
Associate Director of Oncology

- Diagnosed December 2018
- Life Scan saved his life
- Life forever changed
- Recommends extreme care with equipment

Mr. Brian Gross

Lubbock Fire Department
Firefighter ~ with cancer

- Initial meeting with firefighters
- Learned about the risks and what urban departments are doing about it
- Made an action plan based on what we learned.



Mr. Abi Morales

Lubbock Fire Department
Firefighter

Mr. Abi Morales

Lubbock Fire Department

Firefighter

- Analytical Chemists
- Biochemistry Department
- Taught us about analysis of elements

Texas Tech University

Analytical Biochemists

Had instruments useful for analysis

- Volunteer fire department
- News we shared was not common knowledge for them

Woodrow Volunteer Fire Dept

Lubbock, TX

Woodrow Volunteer Fire Dept

Lubbock, TX

Fire Station #4

Lubbock, TX

Fire Chiefs Meeting

Lubbock, TX

Description	Mn 257.610	Fe 259.940	Zn 213.856	K 766.491/10	Ca 422.673	Ti 336.122	Se 196.090	Sb 206.833	Sn 189.991	Ni 231.604	Cr 267.716	As 193.759	Al 308.215	Mg 279.553/10	Sr 421.552	Sr 460.733	Ba 493.409
Shell 1st Rinse	0.023	0.248	0	0.4621	1.3162	0.051	0.003	0.02	0.01	0.003	0.044	0.005	0.33	0.2616	0.144	0.191	0.035
Shell 2nd Rinse	0.053	2.348	0.099	1.2241	2.0732	0.963	0.005	0.146	0.018	0.018	0.481	0.01	2.992	0.4548	0.159	0.225	0.07
Shell 3rd Rinse	0.014	0.621	0	0.2945	0.8832	0.274	0.005	0.056	0.009	0.003	0.17	0.005	0.816	0.1576	0.088	0.127	0.033
Shell 4th Rinse	0.007	0.366	0	0.1776	0.8388	0.171	0.003	0.04	0.006	0	0.125	0.006	0.512	0.1292	0.104	0.15	0.032

Description	Mn 257.610	Fe 259.940	Zn 213.856	K 766.491/10	Ca 422.673/10	Ti 336.122	Se 196.090	Sb 206.833	Sn 189.991	Ni 231.604	Cr 267.716	As 193.759	Al 308.215	Mg 279.553/10	Sr 421.552	Sr 460.733	Ba 493.409
Liner 1st Rinse	0.018	0.413	0.531	1.4232	1.6907	0.078	0.009	0.031	0.021	0.007	0.028	0.005	0.873	0.3727	0.189	0.275	0.051
Liner 2nd Rinse	0.007	0.214	0.114	0.4747	0.8286	0.043	0.019	0.022	0.012	0.002	0.013	0.004	0.476	0.1815	0.119	0.156	0.036
Liner 3rd Rinse	0.002	0.071	0	0.1501	0.6397	0.017	0.011	0.012	0.01	0	0.005	0.004	0.206	0.1186	0.108	0.143	0.029

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Liner 1st Rinse	0.031	0.007	0.028	0.005
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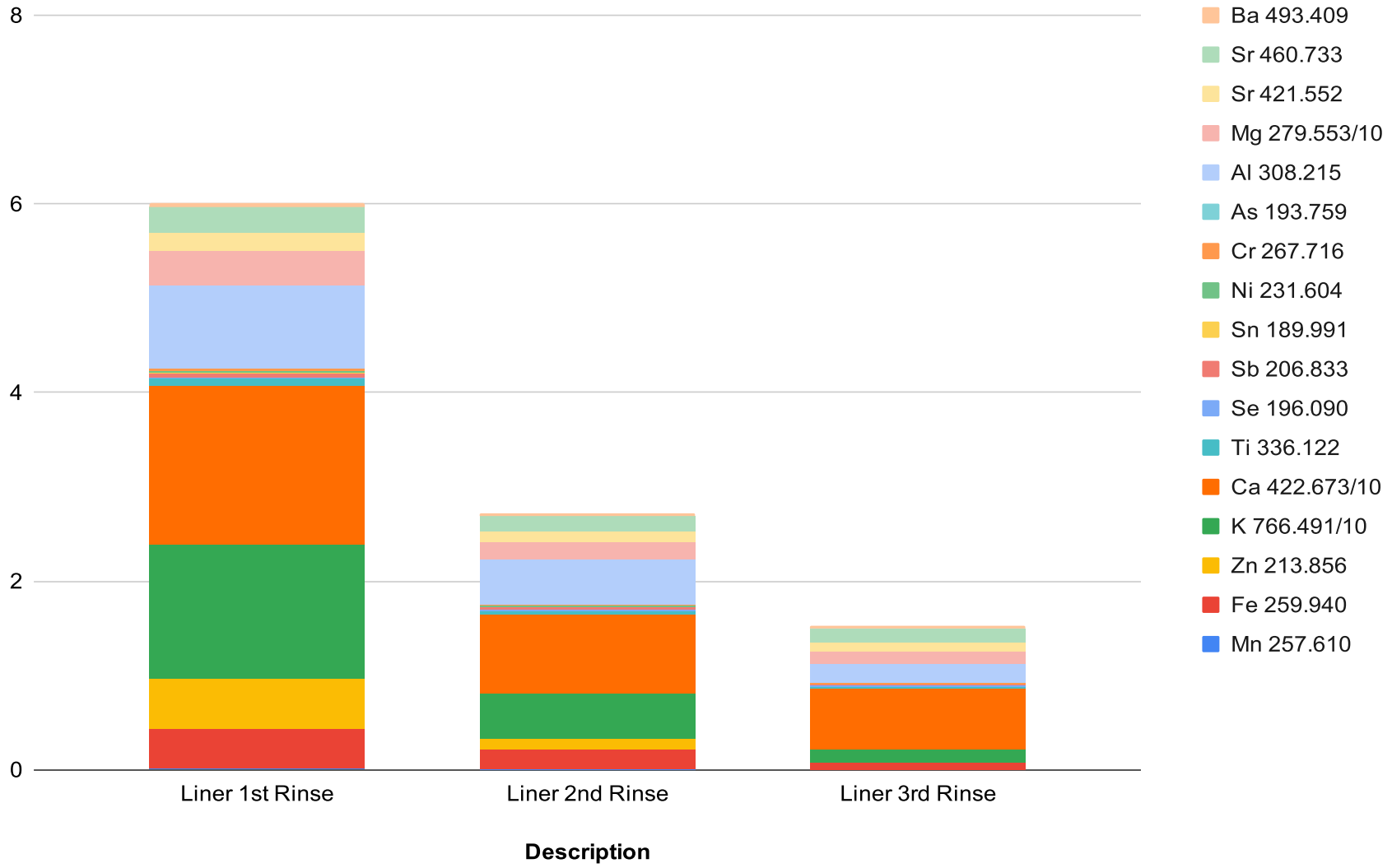
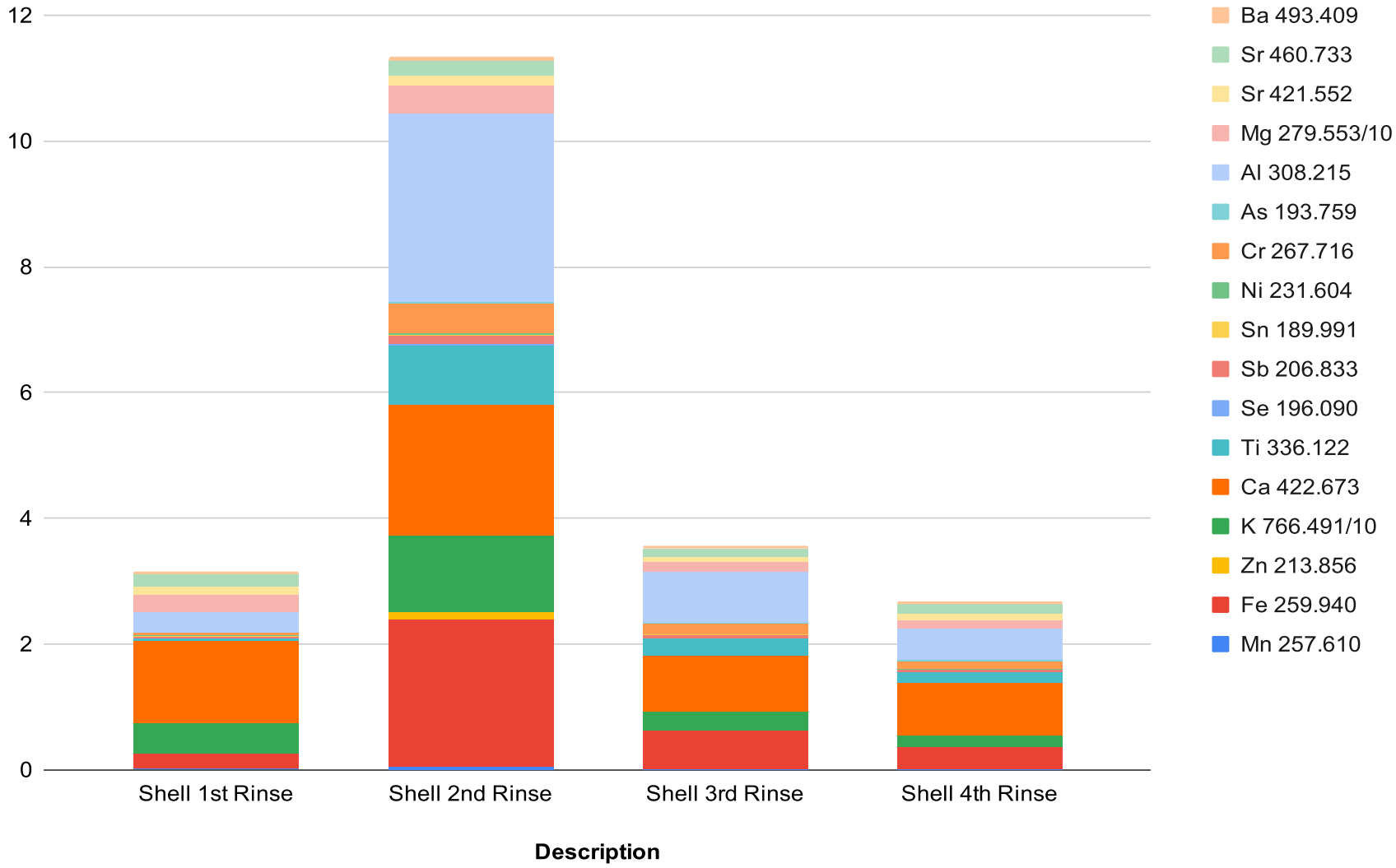
Liner 3rd Rinse	0.012	0	0.005	0.004
Liner 4th Rinse	0.007	0	0.003	0.001

Description	V	Sb	Hg	Pb	U
cleaned with HOQ after fire-Station 4	0	0	0	0	16
truck not cleaned-Station 4	0	0	0	0	13
engine not cleaned-Station 4	0	0	0	0	15
no further specification-Station 6	0	0	0	0	17
no further specification-Station 8	0	0	0	0	17
no further specification-Station 10	0	0	0	0	0
control-	1540	6180	106	104	0

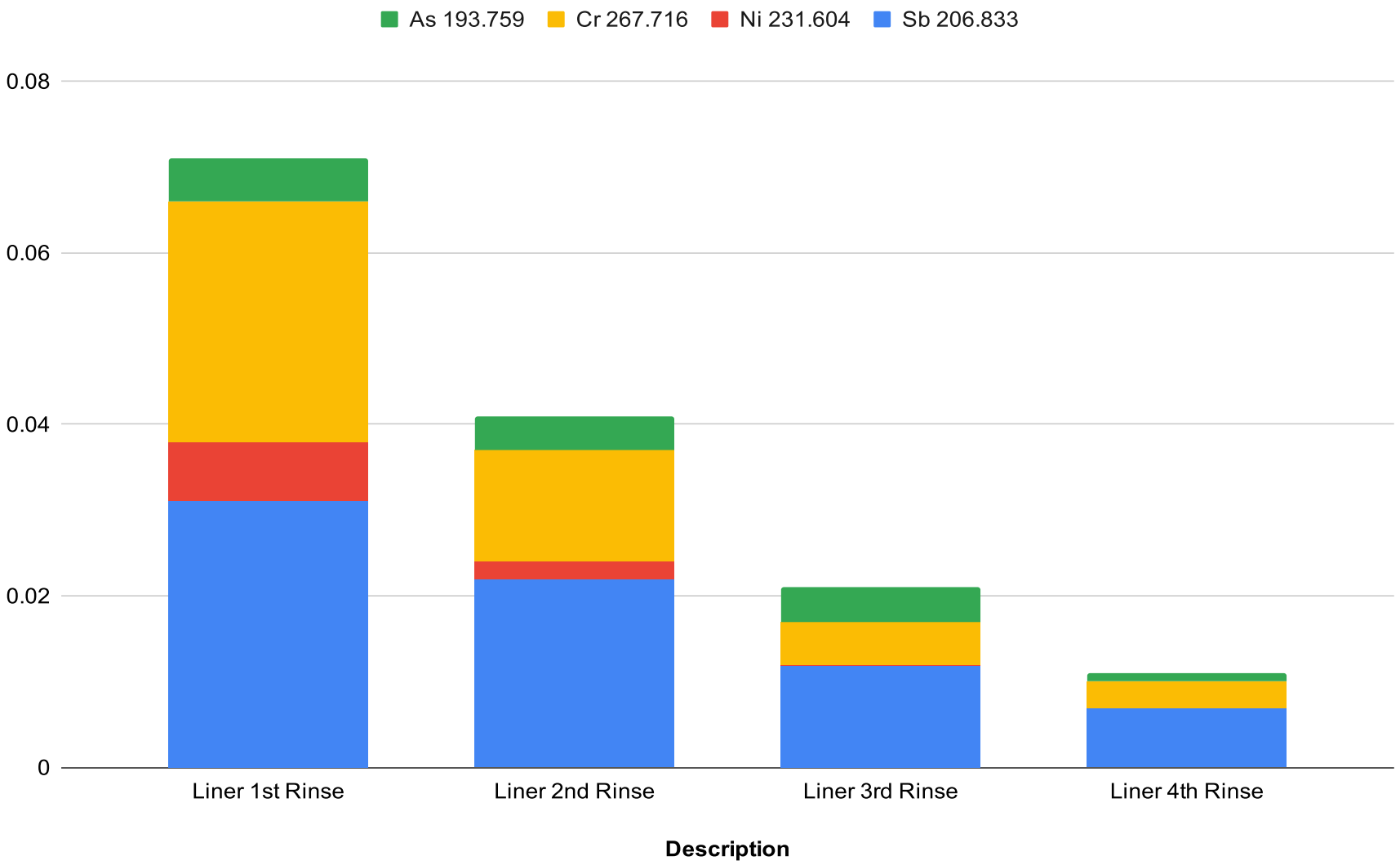
Normalized Elements Concentration Measurements on the Liner of Firefighter Gear (PPM)



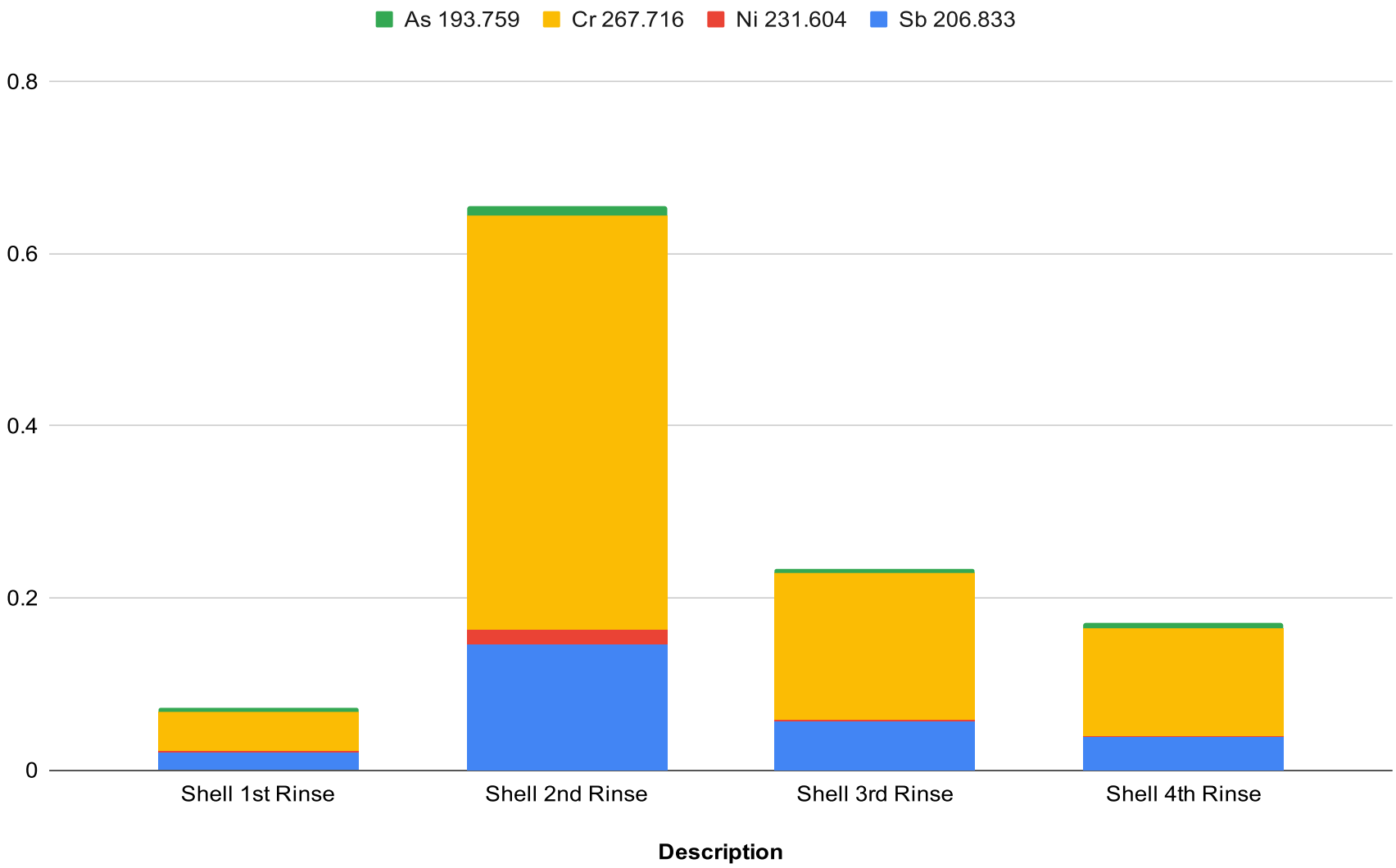
Normalized Elements Concentration Measurements on the Shell of Firefighter Gear (PPM)



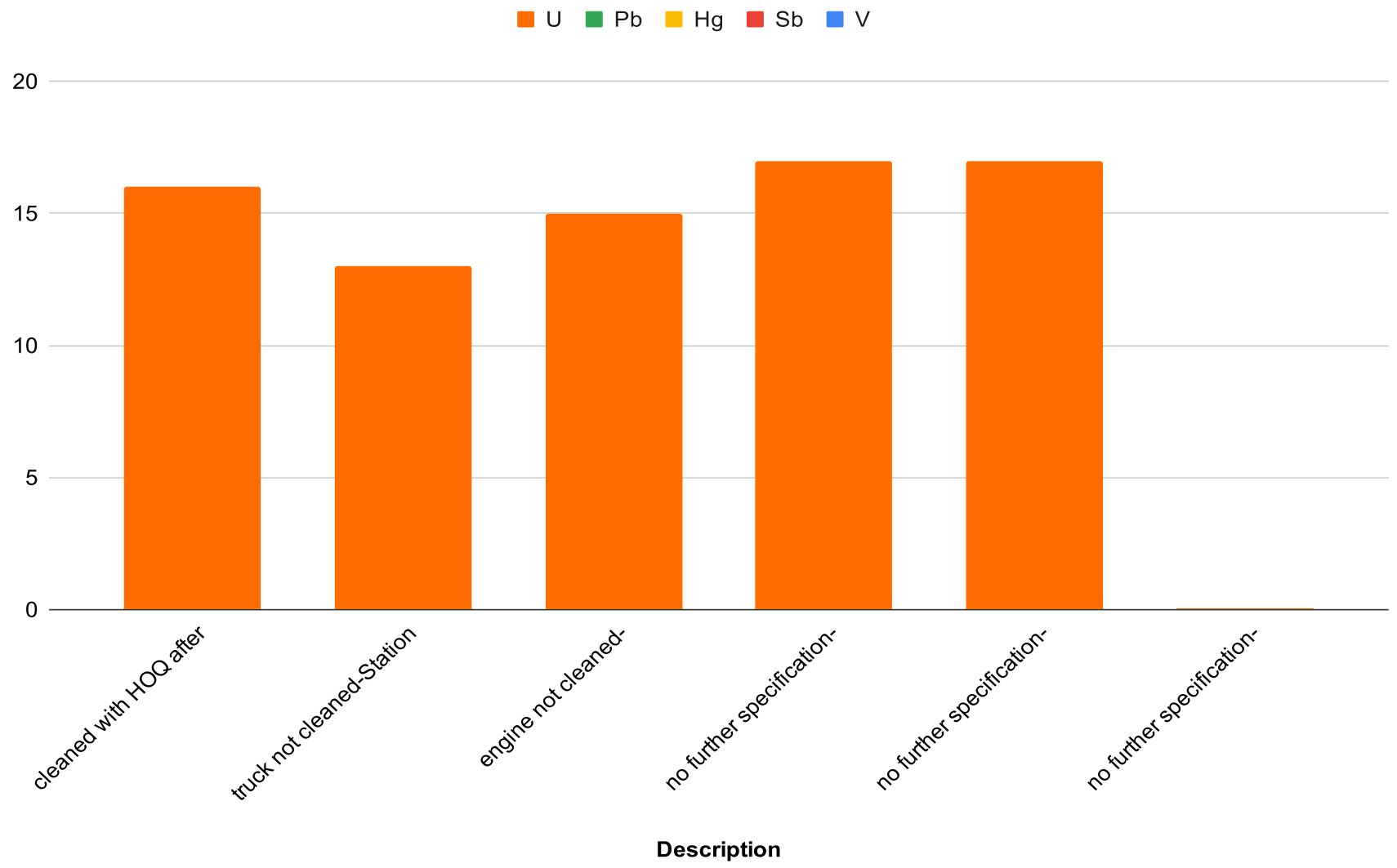
Normalized Toxic Elements Concentration on the Liner of Firefighter Gear (PPM)



Normalized Toxic Elements Concentration on the Shell of Firefighter Gear (PPM)



Normalized Toxic Elements Concentration on Straps that have been in Fires



Transmission (Range 500)	Control (soap)	0		Absorbent (Range 500)	Control (soap)	N/A
Average set 1	Control (50% soap, rest water)	0		Average set 1	Control (50% soap, rest water)	N/A
30.66666667	Control (25% soap, rest water)	1		0.51	Control (25% soap, rest water)	1.93
32	Control (12.5% soap, rest water)	5		0.49	Control (12.5% soap, rest water)	1.27
30	Control (6.25% soap, rest water)	29		0.52	Control (6.25% soap, rest water)	0.52
30	Control (3.125% soap, rest water)	53		0.52	Control (3.125% soap, rest water)	0.27
Average set 2	Control (1.5625% soap, rest water)	83		Average set 2	Control (1.5625% soap, rest water)	0.08
24.66666667				0.6033333333		
27				0.56		
20				0.69		
27				0.56		
Average set 3				Average set 3		
11.66666667				0.92		
13				0.88		
11				0.94		
11				0.94		
Transmission (Range 570)	Control (soap)	2		Absorbent (Range 570)	Control (soap)	1.6
Average set 1	Control (50% soap, rest water)	6		Average set 1	Control (50% soap, rest water)	1.21
37	Control (25% soap, rest water)	68		0.4266666667	Control (25% soap, rest water)	0.16
39	Control (12.5% soap, rest water)	54		0.4	Control (12.5% soap, rest water)	0.27
36	Control (6.25% soap, rest water)	94		0.44	Control (6.25% soap, rest water)	0.02
36	Control (3.125% soap, rest water)	97		0.44	Control (3.125% soap, rest water)	0.01
Average set 2	Control (1.5625% soap, rest water)	88		Average set 2	Control (1.5625% soap, rest water)	0.05
29.33333333				0.495		
28				0.53		
25				g		
35				0.46		
Average set 3				Average set 3		
17.33333333				0.7433333333		
19				0.7		
16				0.78		
17				0.75		
Transmission (Range 640)	Control (soap)	7		Absorbent (Range 640)	Control (soap)	1.1
Average set 1	Control (50% soap, rest water)	6		Average set 1	Control (50% soap, rest water)	1.2
41.33333333	Control (25% soap, rest water)	67		0.3966666667	Control (25% soap, rest water)	0.17
50	Control (12.5% soap, rest water)	55		0.3	Control (12.5% soap, rest water)	0.26
45	Control (6.25% soap, rest water)	91		0.35	Control (6.25% soap, rest water)	0.04
29	Control (3.125% soap, rest water)	97		0.54	Control (3.125% soap, rest water)	0.01
Average set 2	Control (1.5625% soap, rest water)	90		Average set 2	Control (1.5625% soap, rest water)	0.04
34.33333333				0.4733333333		
44				0.36		
34				0.46		
25				0.6		
Average set 3				Average set 3		
36				0.45		
42				0.37		
42				0.37		
24				0.61		

Carcinogens can collect on your suit. So what can you do?

- Don't leave your bunker gear in the cab of your car.
- Keep your SCBA on at all times.
- Wash your helmet and any other gear you might have.

Do you as a fire fighter realize how many potentially dangerous chemicals you come in contact with during emergency situations?

Contact Information:
lwilbanks@southcrest.org

Alexa Tindall Josiah Morales Ethan Djajadi



https://cancerhalt.weebly.com

Code Red

Prevent it 'fore you get it

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Carbon Monoxide
produced during the incomplete burning of fuels at a fire

Benzene
found in cigarette smoke, glues, adhesives, cleaning products, and paint strippers

Sulphur Dioxide
produced from the burning of fossil fuels (coal and oil), is commonly used as a preservative and as a disinfectant for food containers and fermentation equipment

Hydrogen Cyanide
present in car exhaust fumes, building fires and cigarettes

Aldehydes
some compounds are used to make other chemicals used in resins, perfumes, dyes and organic acids

Hydrogen Chloride
synthesis of organic and inorganic chlorides, brining of foods and other materials, treatment of swimming pool water, maintaining the proper acidity in oil wells, etching of concrete surfaces

Dichlorofluoromethane
used as a propellant in aerosols and fire extinguishers and as a refrigerant

Particulates
mixture of solid particles and liquid droplets found in the air. Some particles, such as dust, dirt, soot, or smoke, are large or dark enough to be seen with the naked eye. Others are so small they can only be detected using an electron microscope.

Can lead to . . .

Most common types of cancers in fire fighters. . .

- Gastrointestinal cancers -oral, esophagus, stomach, gallbladder, colorectal
- Lung cancers/ mesothelioma
- Skin cancers
- Brain cancers
- Blood Cancers
- Prostate Cancers
- Testicular cancers

Practices to help prevent firefighter cancers

1. Spray gear with water after getting out of a fire.
2. Change clothes immediately after a fire.
3. Put bunker gear in a trash bag after a fire to prevent it from offgassing around people and animals.
4. Shower within an hour of exiting a fire.
5. After a fire, clean everything in the fire truck.
6. Wash the bunker gear twice.

Code Red Elevator Speech

Ethan:

According to the International Association of Fire Fighters (IAFF), about 60% of line of duty firefighters deaths from Jan, 2002 – March, 2017 was caused by cancer. Heart disease was the second with about 18%. Firefighters face a 9% increase in cancer diagnosis, and 14% increase in cancer-related deaths compared to the general population. The most common types of cancer in firefighters include: respiratory (lung, mesothelioma), Gastrointestinal – oral, esophageal, large intestine, and kidney. Generally an increase of 1-2X increased risk compared to the general public. Some of the increased cancer risks include:

Testicular cancer – 2X

Mesothelioma – 2X

Multiple myeloma – 1.5X

Non-Hodgkin's lymphoma 1.5X

Skin cancer – 1.4X

Brain cancer – 1.3X

Prostate cancer 1.2X

Colon cancer 1.2X

Leukemia 1X

Josiah:

Our plan to reduce this risk is a 2-prong approach: 1) Spreading Education and Awareness amongst firefighters, especially the volunteer firefighters and smaller units with fewer resources;

2) Test effective and timely ways to clean their gear using analytical chemistry equipment

1) Spreading education and awareness – website, brochure, posters on statistics, importance of cleaning well and timely. We live in a community with many volunteer firefighters and smaller firefighting units who may not have all the washing equipment available onsite, and as much training as some of the larger firefighter communities. We would like to keep them updated on our findings to keep them safe.

2) Test effective and timely ways to clean their gear – change the perception of dirty gear as a badge of honor, and rather clean them often and timely to reduce their cancer risk. We will be attaching strips made from cutting a fire suit to the firefighters' gear as they go into fires. Once they are done with the fire, they will send the strip to a designated fire station, where the strips will be washed. The water from the washing will be collected and sent to TTU Chemistry Department, who will then run it through their spectrophotometer to see what is on the strips. We will then wash the strips again, and then collect the water from the washings and run it through the same spectrophotometer. We expect that the amount of carcinogens will decrease with each wash, thus reducing the firefighters' exposure.

Alexa:

Firefighters face mental and physical health risks everyday. The stress of the job can cause anxiety, depression, PTSD, and even suicide. Sleep deprivation can lead to many health issues including dementia, and a greater risk for anxiety, depression, and forgetfulness. Our focus for this year is on the physical risks of being a firefighter. Burning buildings' smoke which releases chemicals like carbon monoxide can cause cancer, putting firefighters at much greater risk than the general population. This number must decrease! We hope the information you find in the brochure and on the poster will benefit you and your families. Thank you for your service to our community and for being our hometown heroes.

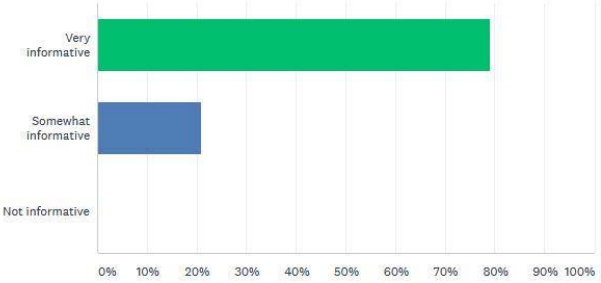
I am a career firefighter	52.00%	52
I am a volunteer firefighter	60.00%	60

Q2

Customize Save as

Have the brochure and poster been informative?

Answered: 100 Skipped: 0



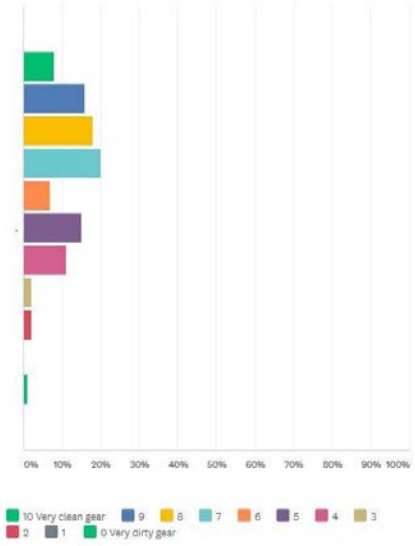
ANSWER CHOICES	RESPONSES	
Very informative	79.00%	79
Somewhat informative	21.00%	21
Not informative	0.00%	0
TOTAL		100

Q3

Customize Save as

Using any number from 0 to 10, where 0 is the dirtiest gear and 10 is the cleanest gear, what number would you use to rate the cleanliness of your fire gear?

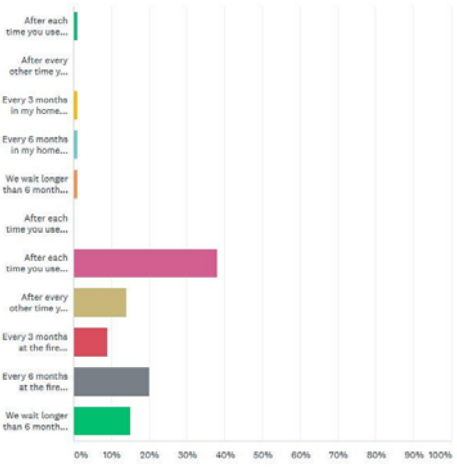
Answered: 100 Skipped: 0



	10 VERY CLEAN GEAR	9	8	7	6	5	4	3	2	1	0 VERY DIRTY GEAR	TOTAL	WEIGHTED AVERAGE
.	8.00% 8	16.00% 16	18.00% 18	20.00% 20	7.00% 7	15.00% 15	11.00% 11	2.00% 2	2.00% 2	0.00% 0	1.00% 1	100	7.79

How often do you clean your gear?

Answered: 100 Skipped: 0



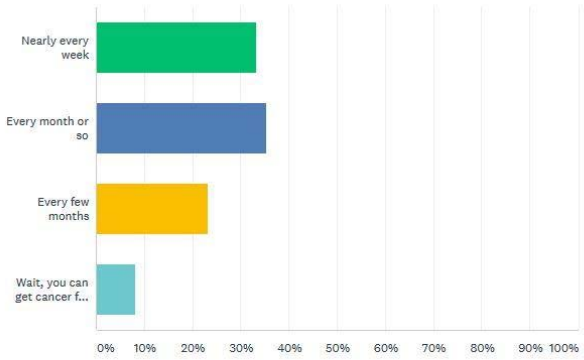
ANSWER CHOICES	RESPONSES	
After each time you use it in my home washer	1.00%	1
After every other time you use it in my home washer	0.00%	0
Every 3 months in my home washer	1.00%	1
Every 6 months in my home washer	1.00%	1
We wait longer than 6 months in my home washer	1.00%	1
After each time you use it in my home washer	0.00%	0
After each time you use it, at the fire station	38.00%	38
After every other time you use it, at the fire station	14.00%	14
Every 3 months at the fire station	9.00%	9
Every 6 months at the fire station	20.00%	20
We wait longer than 6 months at the fire station	15.00%	15
TOTAL		100

Q5

Customize Save as

How often are you told about cancer risks that come with being a firefighter?

Answered: 99 Skipped: 1



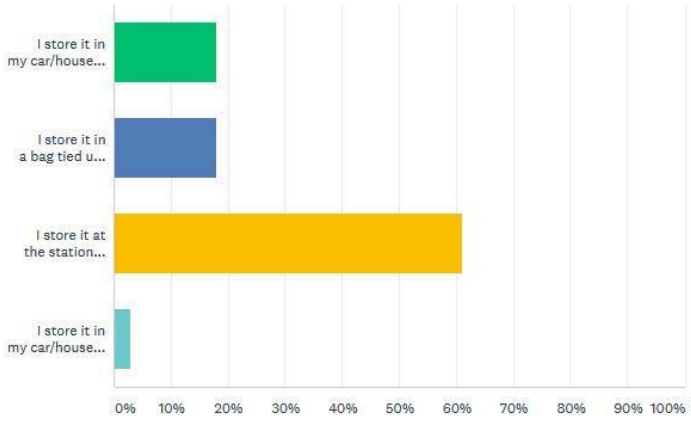
ANSWER CHOICES	RESPONSES	
Nearly every week	33.33%	33
Every month or so	35.35%	35
Every few months	23.23%	23
Wait, you can get cancer from this job?	8.08%	8
TOTAL		99

Q6

Customize Save as

Where do you store your gear right after a fire?

Answered: 100 Skipped: 0



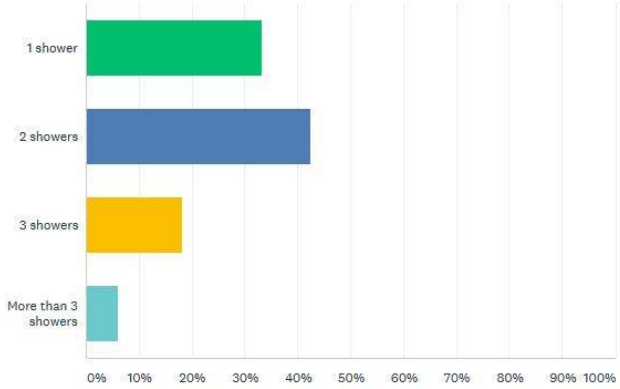
ANSWER CHOICES	RESPONSES	
I store it in my car/house in a designated area	18.00%	18
I store it in a bag tied up and isolated	18.00%	18
I store it at the station until I use it next	61.00%	61
I store it in my car/house in a general area	3.00%	3
TOTAL		100

Q7

Customize Save as

How long after a fire does it take you to get the smell out of your skin? (showering normally)

Answered: 99 Skipped: 1



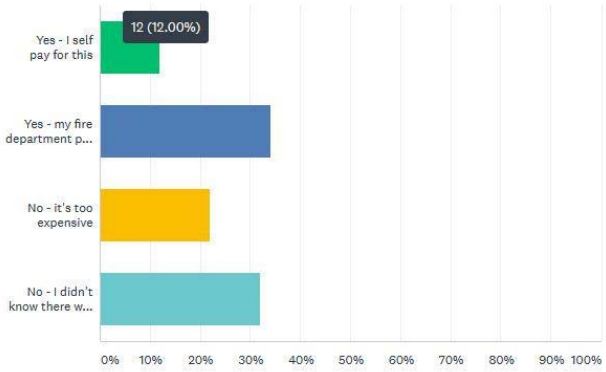
ANSWER CHOICES	RESPONSES	
1 shower	33.33%	33
2 showers	42.42%	42
3 showers	18.18%	18
More than 3 showers	6.06%	6
TOTAL		99

Q8

Customize Save as

Do you get screened specifically for cancer annually?

Answered: 100 Skipped: 0



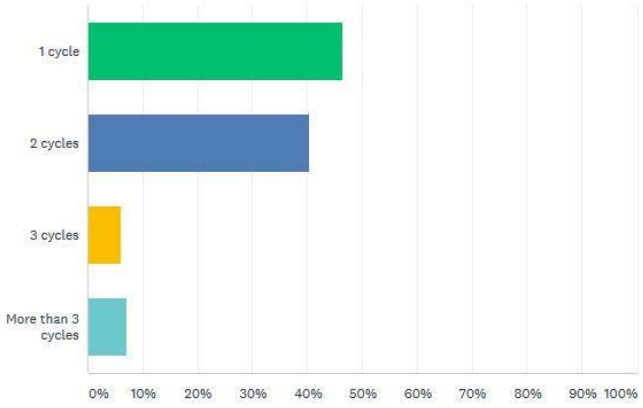
ANSWER CHOICES	RESPONSES	
Yes - I self pay for this	12.00%	12
Yes - my fire department pays for this	34.00%	34
No - it's too expensive	22.00%	22
No - I didn't know there was such a thing	32.00%	32
TOTAL		100

Q9

Customize Save as

How long does it take you to get the smell out of your clothes in the wash?

Answered: 99 Skipped: 1



ANSWER CHOICES	RESPONSES	
1 cycle	46.46%	46
2 cycles	40.40%	40
3 cycles	6.06%	6
More than 3 cycles	7.07%	7
TOTAL		99

Feedback

- “Very informative project!”
- “We wash our gear after each use and every 6 months. Our gear also gets an advanced inspection by trained personnel annually as well as a general inspection every 6 months.”
- “Some volunteer firefighters may not have time after calls to take showers before having to go to work.”
- We also begin gross decon on scene by spraying down gear with water and scrub brush with soap if needed. We also have “rescue wipes” (baby wipes) that we wipe down with on scene after fires.
- “We wear protective suits and face socks; goggles and air masks if needed, but never stop to think about the hidden dangers involved in our fire fighting efforts.”

Code Red

A website was created to have a way of keeping information handy for firefighters, have a reference for adding material to, and spreading the word to many rural stations lacking the information of larger urban fire departments.

Please take a look at the website or use the QR code provided to jump on over! Thanks!

https://cancerhalt.weebly.com

Table 3-4: Effluent gases detected in combustion of material-level test samples.

Sample	CO_2 Yield	CO Yield	Other Detected Gases (in decreasing yield order) [1]
Auto air intake plastic	2.552	0.227	Acetylene, HCN, Methane, Ethylene
Auto door panel plastic	2.979	0.156	Ammonia, Acetylene, Methane, Ethylene, HCN, *2,3-Dimethyl-1-hexene*
Auto headliner	2.894	0.289	Pentanol, Acetylene, HCN, Ethylene
Auto hood insulation	1.185	0.443	**HCN,** Formaldehyde, Methane, Ethylene, Phenol
Auto seat	2.164	0.273	**Acetylene,** HCl, HCN, Methane, Ethylene, Phenol
Bed sheets	2.586	0.368	Formaldehyde, Ethylene, Methane, *Phenyl isocyanate*
Carpet	3.022	0.164	Acetylene, Pentanol, Ethylene
Carpet padding	2.310	0.317	**HCN,** Acetylene, HCl, Ammonia, Formaldehyde, Ethylene, *Isocyanic acid*
Carpeting and padding	2.744	0.223	Acetylene, Ammonia, Methane, Ethylene
Christmas tree	0.785	0.313	**HCl, Benzene, Methanol,** Acetylene, Methane, Phenol, Ethylene
Composite floor padding	3.020	0.333	**Styrene,** Methanol, Acetylene, Phenol, Ethylene, HCN
Composite flooring	1.635	0.119	Ammonia, Methane, HCN, Methanol, Formaldehyde
Composite siding	2.037	0.246	Methane, Ammonia, HCN, Propane, Methanol, Ethylene, Phenol
Countertop	1.844	0.117	Methane, Ammonia, HCl, Formaldehyde, Methanol, HCN, Ethylene, Phenol
Crib mattress	1.995	0.515	**HCl,** HCN, Acetylene, Methane, Ethylene
Deck Chair	2.911	0.214	**Propanol,** Ammonia, Acetylene, Ethylene
Deck chair pad	2.497	0.335	Acetylene, Acetic Acid, HCN, HCl, Methane, Ethylene
Deck table	3.083	0.140	Acetylene, Ethylene, *Acetone, 2,3-Dimethyl-1-hexene*
Dresser composite board	1.908	0.194	Methane, Ammonia, Methanol, Formaldehyde, Ethylene, HCN, Phenol, *Isocyanic acid*
Fiberglass insulation	0.428	0.437	**Ammonia, Formaldehyde,** Ethylene, Acetylene, Methane, *Isocyanic acid, Octanol*
Housewrap	3.126	0.153	Acetylene, Formaldehyde, Ethylene, Acrylonitrile
Kitchen cabinet wood	1.894	0.107	Methane, Ammonia, Formaldehyde, Methanol, HCl, Ethylene, HCN, Phenol, *Phenyl isocyanate*
Latex paint on wall board	0.199	0.111	Methanol, Formaldehyde, Phenol, Ethylene
Mattress materials	3.116	0.165	Acetylene, Formaldehyde, HCN, Ethylene, Methane
OSB	1.926	0.144	Methane, Ammonia, Formaldehyde, Methanol
Plastic deck box	2.828	0.212	**Pentanol,** Acetylene, Ethylene
Plywood	2.155	0.340	Formic Acid, Methane, Ammonia, Formaldehyde, Methanol, Phenol, Ethylene
Polyester	2.434	0.572	Acetylene, Formaldehyde, Ethylene, Methane, HCN, Phenol
Pressure treated deck lumber	1.965	0.146	Methane, Formaldehyde, Methanol, Ethylene, Phenol
PS insulation	3.701	0.245	**Styrene, CFC-142,** Acetylene, Ethylene, HCN
PVC pipe	0.722	0.154	**HCl, Benzene, Acetylene,** Methane, Ethylene, HBr
PVC siding	0.994	0.208	**HCl, Benzene, Methanol, Acetylene,** Methane, Ethylene
PVC wiring	1.747	0.252	**HCl, Acetylene, Benzene,** Methane, Ethylene, HCN, *2-propyl-1-pentanol*
Room trim	2.531	0.132	**Styrene, Acetylene,** Ethylene
Shingle	3.420	0.535	**Ammonia,** Acetylene, Methane, Ethylene
Sled	2.426	0.232	Formaldehyde, Ethylene, Acetylene, *Octanol*
Sofa cover and padding	2.139	0.481	**Toluene Diisocyanate,** HCN, Acetylene, Methanol, Methane, Ethylene, Phenol
Tar paper	2.588	0.394	**SO2,** Acetylene, Ammonia, Methane, Ethylene, Formaldehyde, Methanol, Phenol
Tire	3.553	0.492	**Acetonitrile, SO2, Acetylene,** Methane, Ethylene
TV housing plastic	1.205	0.259	**Styrene, Acetylene, Benzene, HBr,** Methane, Ethylene, HCl, HCN
Wood stud	1.704	0.164	Methane, Formaldehyde, Methanol, Ethylene, Phenol
WPC deck board	2.694	0.050	Formic Acid, Formaldehyde, Methanol, Ethylene, Acetic Acid

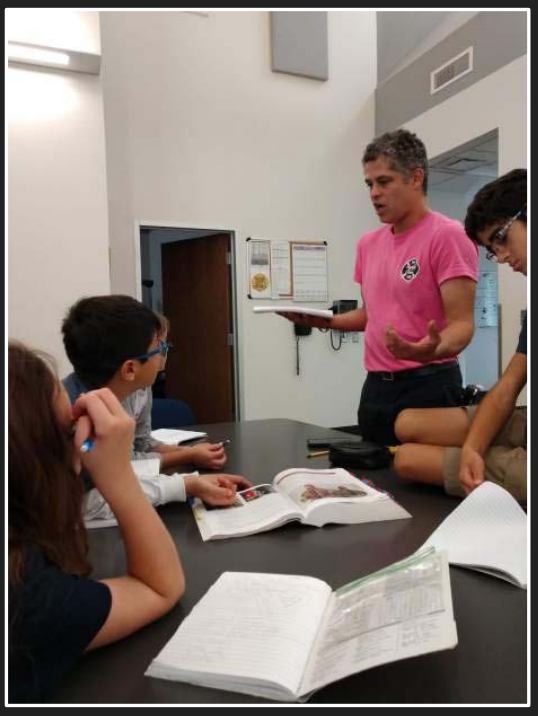
Note: [1] Gases with yields greater than 0.01 g Gas produced per g Consumed material are in **bold**; Gases in *italics* were detected but no reference concentration existed for quantification.

Code Red: Photo Essay

A dirty helmet was a badge of honor. It signified courage, hard work, the proof a fireman had been invaluable. To clean it was to dishonor the man.

Today, we know it is the sign of contamination - the increased risk of cancer every fireman fears. Today, we say CLEAN YOUR HELMET.

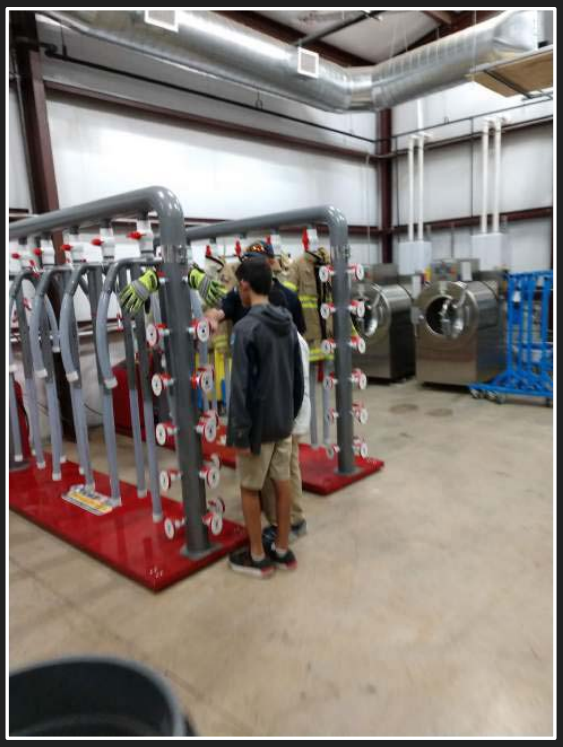
Our friend and hero Firefighter Brian Gross



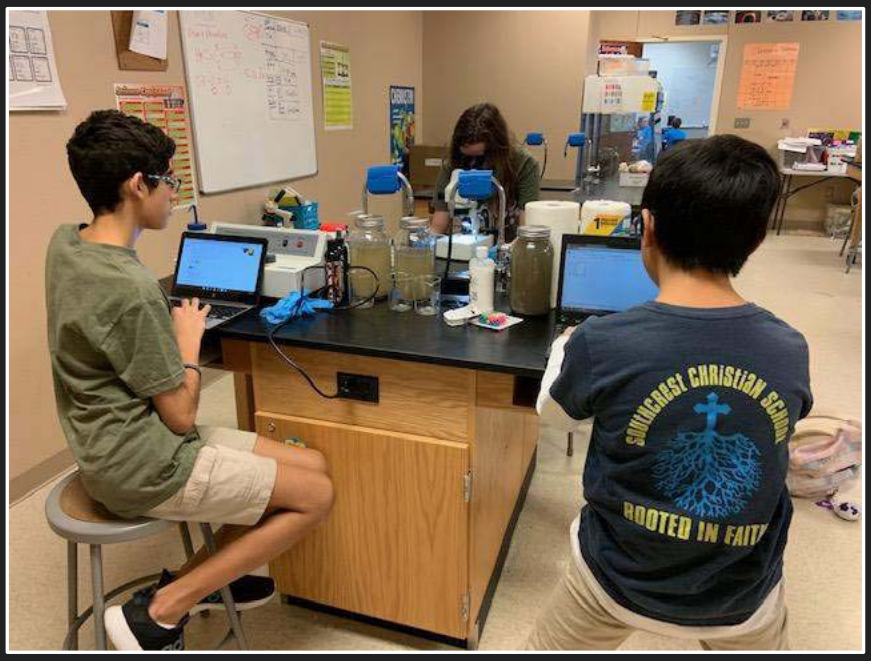
Starting the project at Station 19 - Firefighter Abi Morales

Sewing Indicator Straps from donated Firefighter Gear

Learning about Washing Machines



School Experiments - Testing contaminants in the water taken from a washed hook and ladder truck using spectrophotometry to identify risks to firefighters.



Examining the effect of contaminated water on the invertebrate *Daphnia magna* - an indicator species of poor water quality.

Community Benefit: Sharing our brochures and posters with the Woodrow Volunteer Firefighter Department - wash your gear!

Interviews with Oncologists Dr. Hardwicke Dec 5

Dr. Tijani Dec 19 University Medical Center

Talking with Analytical Chemists

- ➔ Learning methods to detect organic and inorganic substances.
- ➔ Learning instruments designed to detect elements in contaminated water and clothing.

Outreach to Lubbock Fire Department -
Meeting of the Fire Chiefs
Dec 11

Outreach to the Lubbock Fire and Rescue

Interview with Fireman Brian Gross - Cancer Patient

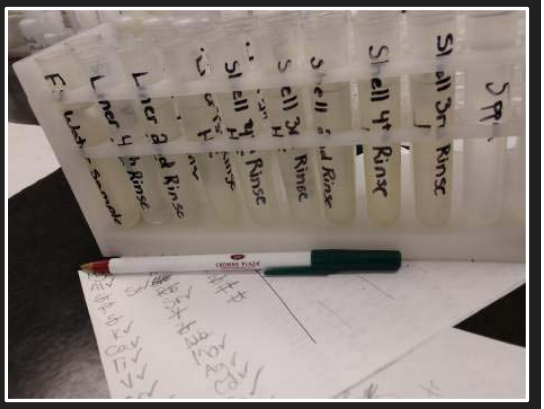
Interview with Joseph Wallace from *Last Line of Cancer Defense*

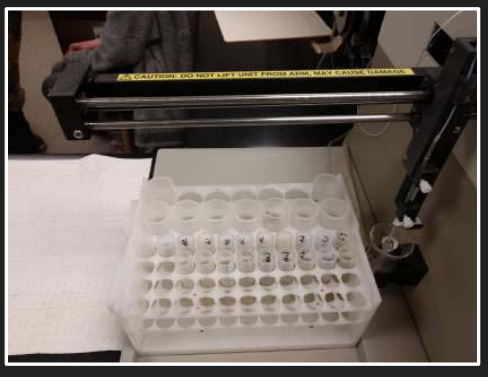
- ➔ Learning about the contaminants most commonly encountered by firefighters.
- ➔ Learning what we can do to help lower the risk of cancer for firefighters.

Dr. Weindorf's Lab - XRF

X-ray Fluoresence

Dr. Melanie Barnes' Lab - ICP Analysis





aeop ARMY EDUCATIONAL OUTREACH PROGRAM | eCYBERMISSION ACCEPT THE CHALLENGE U.S. ARMY

eCYBERMISSION Survey Approval Form**

eCYBERMISSION team name: Code Red

Team Advisor name: Milene de Farias

Team Advisor email: mdefarias@southcrest.org

Team Advisor phone: 716-474-3037

Student usernames: GlitterKittyXYZ, JAM_Da_Dogge, Toxapex

School name: Southcrest School

School address: 3801 S. Loop 289 Lubbock, TX 79423

Describe the survey your team will conduct:

Survey will ask 10 questions to firefighters about how they treat bunker gear and how effective our message was for their education.

Describe the participants you plan to distribute your survey to:

Urban & rural firefighters, ages 18+

Project approved by school administration?

☑ Yes ☐ No

Approved by: Susie Driscoll

Title: Principal

Date approved: 8/15/19

Signature, School Administrator: Susie Driscoll

*Please have form completed, signed and dated BEFORE surveys are administered.

**As of August 2017, an IRB approval form (below) must be completed for all surveys as well as the information requested above.

aeop ARMY EDUCATIONAL OUTREACH PROGRAM | eCYBERMISSION ACCEPT THE CHALLENGE U.S.ARMY

INSTITUTIONAL REVIEW BOARD

APPROVAL FORM

Student(s) User Name(s): GlitterKitty XYZ, JAM-Da-Doggo, Toxapex

Grade: 7 Team Advisor: Milene de Farias

Team Name: Code Red

Brief Description of Project:
Firefighters will be asked to take a survey online on how they treat bunker gear. They are 18+ & may withdraw at any time. No personal info is collected

Team Advisor: Please sign here if the project proposed is a viable eCYBERMISSION Project in which neither animals nor humans will be harmed.

Team Advisor Approval Signature: Milene de Farias Date: 8/15/19

IRB Waiver of Written Informed Consent for Human or Animal Participation

The IRB may waive the requirement for documentation of written informed consent/assent/parental permission if the research involves **only minimal risk *and* anonymous data collection *and* if it is one of the following**: (NOTE: This statement only applies to providing the written certification mentioned in 1a or 2a above).

- Research involving normal educational practices.
- Research on individual or group behavior or characteristics of individuals where the researcher does not manipulate the subjects' behavior and the study does not involve more than minimal risk.
- Surveys, questionnaires, or activities that are determined by the IRB to involve perception, cognition, or game theory and do NOT involve gathering personal information, invasion of privacy or potential for emotional distress.
- Studies involving physical activity where the IRB determines that no more than minimal risk (Daily Activity) exists and where the probability and magnitude of harm or discomfort anticipated in the research are not greater than those ordinarily encountered in DAILY LIFE or during performance of routine physical activities.

If there is any uncertainty regarding the appropriateness of waiving written informed consent/assent/parental permission, it is strongly recommended that documentation of written informed consent/assent/parental permission be obtained.

HUMAN or ANIMAL SUBJECTS

Permission Slips needed? (see above to determine) Yes ☐ No ☑
(Scan and attach slips to Mission Folder)

Check-up of Human or Animal Subjects required by Doctor, school nurse or Veterinarian? (see above to determine) Yes ☐ No ☑

If yes, Doctor's, Nurse's or Veterinarian's (before and after experimentation) current evaluation report must be attached to Mission Folder.

APPROVALS –

Principal / Administrator Signature — Date Reviewed: 08-15-19

Doctor or Medical Professional Signature — Date Reviewed: 08-15-19