iGEM Toronto presents:

L.S.S.E.

A NOVEL APPROACH TO LAB SAFETY

~ TEST YOUR TEAM ~

SAFETY PROTOCOLS/RULES ARE FORGOTTEN QUICKLY. THEY ARE TESTED USUALLY VIA WRITTEN TESTS THAT DO NOT TRANSLATE TO REAL LIFE SCENARIOS. USING SITUATIONAL EXERCISES, WE INTEGRATE PROPER ACCIDENT RESPONSE PROTOCOLS INTO OUR MINDS.

ADAPTED FROM PARAMEDIC AND LIFEGUARD TRAINING METHODS

Laboratory Safety Situational Exercises

A Novel Approach to Lab Safety

Conventional laboratory safety protocols are often ignored or forgotten because the dangers, precautions, and procedures taught to us are read very few times. Also, the knowledge read is not effectively integrated into our brains, making accident prevention or response not nearly as effective as it should be. A new approach should be established to provide real accident simulations.

Paramedics and lifeguards deal with hundreds of different life threatening scenarios everyday, all over the world. They learn to use the knowledge of how to respond to each and every specific scenario through life-like simulations, during their training, after which they are evaluated. Their protocols are integrated into their brain much more effectively, because they have had to actually use all of these protocols during their simulation training.

Through role-playing situational exercises, very much like the type that paramedics and lifeguards use, we want to change the way we learn to deal with the dangerous situations and potentially life-changing accidents that can occur in the lab. This will give even the novice laboratory researcher actual experience on cleaning up a strong acid spill, and at the same time, test if the senior researcher knows how to properly deal with a gas leak, and so on.

H O W ?

- The members of your lab are to play a specific role to simulate a normal working lab.

- The subject must be told to do a specific activity such as run an electrophoretic gel, etc.

- Depending on the exercise, the subject will have to prevent an accident, or the role-players must *cause* an accident and the subject must act accordingly to deal with it.

- The P.I. or "overseer" will then bring everyone together once the exercise is done; discuss the positives and negatives of the subject's response to the prevention/response to the accident and everyone will learn more about dealing with such a problem, especially the subject.

* The subject can know he/she is being tested or it can be a pop-quiz ordeal, where everyone is aware that an LSSE is taking place except him/her.
** The subject should not be in the room while the P.I. plans the accident/LSSE so that the subject does not know what he/she is going to have to deal with.

OVERVIEW

Planning

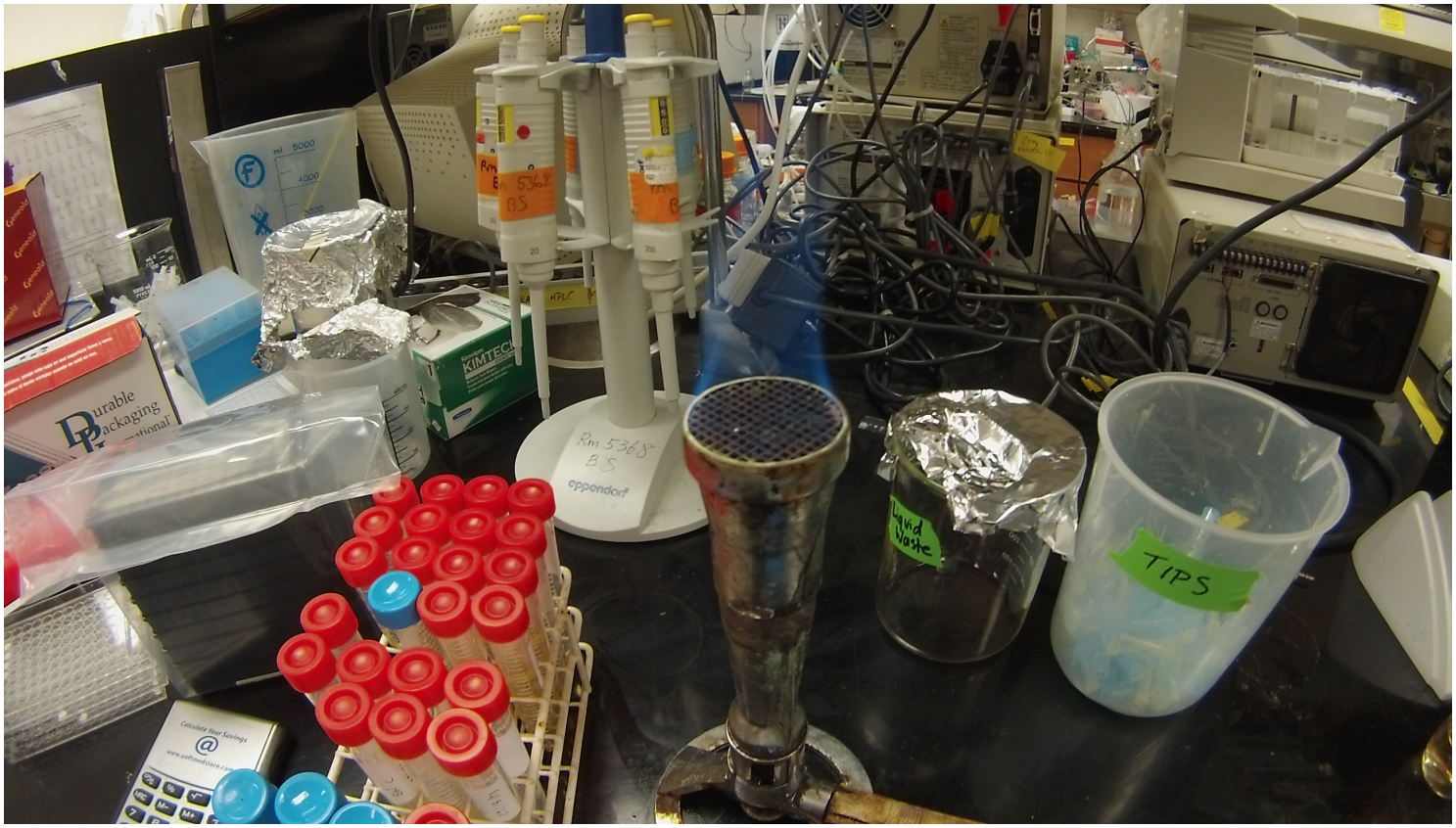
The subject must not be in the room/hear when the Overseer designates roles for each person in the lab. Someone might be told to knock over a bottle labeled "10 M Sulfuric Acid," while others may just be told to be bystanders which the subject can use to help deal with the situation at hand. The goal is to simulate a real working lab, and not a training exercise. Everyone must be serious and professional about every given LSSE.

Execution

The execution stage will start by asking the subject to enter the lab and perform a set of given tasks outlined in every LSSE. His ability to prevent or deal with a lab accident will be tested and he must act accordingly while the P.I. or Overseer of the LSSE watches and assesses his effectiveness. Any and every positive or negative issue should be noted and addressed once the LSSE is dealt with.

Evaluation

Everyone will gather around and the PI/Overseer will lead a discussion based on the positives and negatives of how the LSSE was dealt with. All participants are strongly encouraged to ask any question they have at this point. The P.I. should also discuss how he/she would have dealt with the situation, and which emergency contacts should be called (if any) depending on the circumstances.



Safety Concerns

We minimize the risk of an actual accident happening by adapting each and every LSSE to make the subject think they are dealing with something dangerous so they act accordingly yet are not in any real danger. This is outlined in the safety section of an LSSE.

Tips

We recommend you introduce these exercises to your lab members as a routine, whether it be three situational exercises at the beginning of each month, or one situational exercise at the beginning of your weekly lab meetings. Either way, these should not cut into your lab time by more than an hour per week. You decide how often you want an LSSE to take place, and it will reflect on how well your lab team deals with common, yet dangerous, laboratory accidents.

You, the PI, must make sure that the appropriate emergency personnel are “pretend called” with each accident. This will ensure your team knows who needs to be called incase of a bio-hazardous spill versus a gas leak, and so on.

Situational Exercise 1: Hazardous Liquid Spill

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Overview

The subject will be working alongside a lab member who spills a beaker on the side of the lab bench, getting some on the floor. The exact chemical label is up to you to decide although the contents will be solely water.

Roles to be filled:

- **The Subject** will be told to stock pipette containers with tips and prepare them to be put in an autoclave cycle, once he/she enters the room.
- **The Spiller** will be pouring some "hazardous liquid" from a big beaker into a smaller beaker.
- **All other lab members should be helpful yet clueless bystanders.**
  - Do what the Subject tells you to do in terms of helping out.

Events

At some point, the **Spiller** will look over to talk to the Subject, while pouring and accidently pour some onto the bench thereby spilling onto the floor as well. The **Spiller** will react very irresponsibly in fear, to the point that the Subject must step up and take care of the situation at hand as best as possible.

Evaluation

- Based on the hazardous and toxicity nature of the chemical you decided to designate the liquid as, was the situation handled in a way that it minimized the risk of harm to everyone?

- Were the right authorities called?

- How was the clean up approached and subsequently did the Subject put himself/herself in harms way?

- How would you have done this differently?

- Are there chemical fumes that this liquid could have given off that could have caused harm to someone? If so, was this avoided and how?

Materials

- Big beaker
- Small beaker
- Tape/label

Safety

Hazardous chemicals are not used in this situational exercise. A beaker of water is spilled and the subject is told it is something more hazardous, although in reality it is not.

Furthermore, an MSDS of this chemical should be kept in the lab if the lab members working there use it.

Lab members should know where the MSDS sheets are kept, and should have read them all, so that they know how to handle a situation like this.

This exercise screams safety because, essentially the PI should designate a hazardous liquid that is used in his/her lab and should therefore know, along with the other lab members, how to handle a spill of that type and magnitude.

Key Points

The trick to this exercise is that the **Spiller** working with the water must tell the Subject, that he is working with a certain hazardous liquid (and not water). To make this trickier, have the other bystanders leave the room just prior to the accident, drastically reducing the Subject's resources.

Situational Exercise 2: Corrosive Chemical Contact

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Overview (similar to LSSE #1)

The subject will be working alongside a lab member who spills the "corrosive" contents of a beaker on his wrist and subsequently running down his sleeve/forearm. The exact chemical label is up to you to decide although the contents will be solely water (example: 5M HCl)

Roles to be filled:

- **The Subject** will be told to tidy up the lab and clean off the surfaces of the lab benches.
- **The Spiller** will be pouring some "corrosive" liquid from a big beaker into a smaller beaker.
- **All other lab members should be helpful yet clueless bystanders.**
  - Do only what the Subject tells you to do.

Events

While the **Spiller** is nervously pouring this dangerous liquid, he will spill some onto his wrist so that it goes down his sleeve and onto his forearm as well. The **Spiller** will freak out due to the onset of pain on his arm, to the point that the Subject must step up and take care of the situation as best as possible.

Evaluation

- Based on the hazardous and toxicity nature of the chemical you decided to designate the liquid as, was the situation handled in a way that it minimized the risk of harm to everyone?
- Were the right authorities and safety personnel called?
- How was the clean up approached and subsequently did the Subject put himself in harms way?
- How would you have done this differently?
- Are there chemical fumes that this liquid could have given off that could have caused harm to someone? If so, was this avoided and how?

Materials

- Big beaker
- Small beaker
- Tape/label

Safety

Corrosive chemicals are not used in this situational exercise. Water is spilled on the **Spiller**'s arm yet the **Subject** thinks it is a corrosive chemical so to act accordingly.

Furthermore, an MSDS of this chemical should be kept in the lab if the lab members working there use it.

Lab members should know where the MSDS sheets are kept, and should have read them all, so that they know how to handle a situation like this.

This exercise screams safety because, essentially the PI should designate a corrosive liquid that is used in his lab and should therefore know, along with the other lab members, how to handle a spill of that type and magnitude.

Key Points

The trick to this exercise is that the **Spiller** working with the water must tell the Subject, that he is working with a certain corrosive liquid (and not water). To make this trickier, have the other bystanders leave the room just prior to the accident, drastically reducing the Subject's resources.

Situational Exercise 3: Fume Hood Work & Accidents

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Overview

The subject will be tested on how effectively he can work with objects in the fume hood without his movements disrupting the airflow. He will then be tested on dealing with a gas leak due to this same machinery.

Roles to be filled:

- **The Subject** will be told to dissolve contaminated dry ice into water under the fume hood so that the poisonous chemicals don't get released into the lab.
- **The Lab Tech.** will run into the room and let the Subject know that the fume hood exhaust is broken and the fumes are being released into the lab.
- **All other lab members should be helpful yet clueless bystanders.**
  - Do only what the Subject tells you to do.

Events

The subject will be told to dissolve dry ice under the fume hood. The visible smoke that this gives off will indicate whether he is disrupting the airflow (in which case the smoke will come out of the fume hood window) or not. A few minutes after this has been going on, the **Lab Tech** will burst into the room and tell the Subject that the fumes are being released into the room, due to a malfunctioning exhaust system. The **Subject** will then be tested on how to deal with a potentially harmful gas leak. Improvise this procedure as you see fit.

Evaluation

- Did the Subject's hand movements draw any gas out of the window of the fume hood?
- Although the contaminant is unnamed throughout the whole exercise, did the Subject assume the worst and make sure everyone got out of the lab and away from it as soon as possible?
- Were the right authorities and safety personnel called?
- How was the clean up approached (if at all, in this situation) and subsequently did the Subject put himself in harms way?
- How would you have done this differently?
- Did the subject ask the nature of the contaminant at all? If not, why would it be important to know something like this before working with it?

Materials

- Fumehood
- 500 mL Dry Ice
- Beaker of water

Safety

The dry ice should be handled with gloves at all times.

Fume hoods are not specifically prone to malfunctions of this sort but the reaction to a gas leak is the same no matter the source.

Gases are not always visible or able to be detected unless you have the right equipment. You should not try to fix a problem such as a gas leak unless you are properly trained to do so (which common laboratory researchers are not). This exercise does not deal with any sort of real danger but it will test the reaction of the Subject to this sort of situation.

Key Points

It is very important that someone, preferably the P.I. oversees the work done in the fume hood. This will make sure the Subject does not perform hand motions drawing the gas out into the lab.

To increase the difficulty, a bystander should resist leaving the lab in an attempt to fix the gas leak even when the Subject asks him to evacuate the lab.

Situational Exercise 4: EtBr Contamination

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Overview

The subject will be tested on how effectively he can work with Ethidium Bromide, a common carcinogen used in the lab, without contaminating himself or the rest of the lab.

Roles to be filled:

- **The Subject** will be told to cast an Ethidium bromide gel using a new diluted type of Ethidium bromide that has been borrowed from a neighboring lab.
- **The Knocker** will knock on the lab door 5 minutes after the subject has been working on the gel, and all lab workers should urge the Subject to answer the door.
- **All other lab members should work on something in the lab to make themselves look busy.**

Events

Prior to the Subject entering the room, fill a small glass bottle with food-colouring, label it "Ethidium Bromide," and rub some food colouring on the outside of the bottle as well. Once the Subject uses it to prepare the gel mixture his gloves will be stained with it and it will be evident what he touches. Once he has to go get the door, he will have to take off his gloves without getting any of this "EtBr" on his hands and subsequently on the door handle. After which the exercise will be over and the P.I. will examine the door handle and the subject's hands carefully to look for colourful signs of contamination.

Evaluation

- Did the Subject contaminate himself or any part of the lab?
- Did he scratch his nose or head potentially getting a carcinogen on his body?
- What is the proper way to take off nitrile or latex gloves so that you do not contaminate your clean hands?
- Did the subject rush to answer the door? Why is this a bad idea?
- Does Ethidium bromide pose a significant risk if handled correctly?

Materials

- Red food colouring
- Small glass bottle
- Agarose powder
- Distilled water

Safety

Real Ethidium bromide is not used in this exercise, food colouring is used as a substitute therefore there is potentially no risk

Follow the procedure you would normally use while casting an agarose gel. The safety precautions and considerations of the exact agarose powder you are working with, should be read and followed. You should not get to the point where you actually use the electrophoretic device, the exercise ends when the Subject answers the door.

Key Points

Make sure to get a lot of food colouring on the outside of the bottle so that it gets on the Subject's glove.

Also, be sure to check very carefully for signs of "contamination" at the end to judge how well the Subject did.

Situational Exercise 5: Broken Equipment Prevention

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Overview

The subject will be tested to see if he can spot signs of malfunctioning or broken equipment in the lab that he is instructed to use. This exercise should be relatively short. It is also not set in stone and should be improvised.

Roles to be filled:

- **The Subject** will be told to turn on the Bunsen burner to use to grow overnight cultures (or some other role).
- **All other lab members should work on something in the lab to make themselves look busy.**

Events

Prior to the Subject entering the room, wrap the hose of the Bunsen burner with a bunch of rolls of tape so that it looks like there has been a makeshift repair out of tape. The Subject should clearly be able to see this and ask questions about it and avoid using it.

Improvise as you see fit, and set up a realistic scenario that will test the Subject's ability to prevent a potential accident from happening by simply asking someone in the lab what's wrong with the equipment.

Evaluation

- Did the Subject see the sign of temporary repair (tape, glue, etc.) and therefore stop himself from working with the equipment?
- Did the Subject ask someone in the lab what is wrong with the equipment? If not, why would this be a good idea?

Materials

- Bunsen burner
- Tape

Safety

The gas valve of the lab should not be turned on so that even if the Subject tries to turn on the Bunsen burner, no gas will come out. When improvising, always make sure you consider the safety of your exercise and take any necessary precautions that you think you should.

Key Points

To make these preventive exercises realistic you need to make the sign of temporary repair visible yet not terribly obvious. Realistically, we don't inspect every little inch of every equipment we use although it would probably reward us with more safety. Therefore take this into consideration when improvising a preventive exercise.