Lab Techniques & Safety: Crash Course Chemistry #21

Crash Course: Chemistry
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===== Introduction (00:00) =====

Some of the best moments of my life have happened in labs. Also some of the worst. Like the time that I took a week to prepare a sample for NMR analysis, and then a classmate washed out the vials while I was sleeping for the first time in three days. Because he "couldn't find anything else" to use for his experiment. Interestingly, that resulted in my personal most significant laboratory injury. We all have one; I cut my hand while punching a paper towel dispenser in frustration. No one ever brought it up again.

Today, we're going to talk about how to avoid injury in the lab, and some good techniques for using laboratory equipment correctly. First two lessons already learned: never wash out a vial you aren't familiar with and don't punch paper towel dispensers.

[intro music]

===== Safety Basics: Attire and Behavior (00:52) =====

Let's start with some very basic safety stuff; your hair. If your hair is long, it shall always be up in the lab. If it is not, it will catch on fire. I've seen it happen. It can also knock stuff over, and occlude your vision, and droop into your flasks. Same thing goes for anything that might hang off your body in the lab. Droopy clothing, especially sleeves, are a total disaster.

Clothes should cover your body as much as possible; I like to go long-sleeve even. Never, ever, ever, ever, ever wear sandals in a lab. Long pants, closed-toed shoes, and socks; clothing that covers your entire torso. Always. I'm sure you look hunky in your muscle shirts, and I have nothing against exposed midriffs as a principle, but not in the lab.

Of course your eyes are your most vulnerable organ. Always wear eye protection, and no, just glasses do not count. And if you feel like your eyes are starting to tingle, or hurt, or even if you don't know how something might have gotten in there, use the eye wash. Because it never hurts to be careful, and, you know, we've all wondered what it feels like. I've actually never done this, so this will be a new experience for me. [Hank uses the eye wash.] Aaagh. Gah! It does not feel particularly pleasant, but it's better than having your eyes burned out.

Do not eat or drink in the lab. Despite our best efforts, stuff does sometimes get where we don't want it to be, and if it gets in your food, or you accidentally pick up the wrong cup, that's just a really embarrassing story for your obituary. Also I would generally suggest avoiding working alone in a lab, especially if you're working with any machinery or hazardous substances. But it will be up to you and your advisers to make that decision when the time comes.

===== HazMat Diamond (02:26) =====

You may have seen this little symbol before, here. It's the Hazardous Material or HazMat diamond, and it's got some useful information in it. Each little box is rated zero to four. Zero being no big deal, and four being holy monkey, be careful.

Blue is for health, the red is for flammability, and yellow is for chemical reactivity. A four in health means certain kinds of exposure will kill you. A four in fire is both very flammable and gaseous, so impossible to control outside of a closed container. And a four in reactivity means that it is capable of exploding at room temperature. The little area underneath is for any extra information like if it's radioactive or reacts violently with water or something.

===== MSDS (03:05) =====

If you ever need to know more about a chemical and what it might do to you or to the world, there is the good 'ole MSDS, the material safety data sheet. Every chemical has one, and it'll tell you all the terrible things that it might do to you. If you ever need to find one really fast, you don't need to go to the cabinet anymore; you can just Google 'MSDS HCl' or whatever chemical you think is in the process of killing your friend. There will be information on how best to treat the person who got exposed. Of course, you should have always read the MSDS before you even touch a chemical. Also, you should probably assume that every liquid in a lab that is not water is flammable.

===== Fume Hoods (03:38) =====

This baby here is a fume hood. It sucks all the air in there out, so you don't have to breathe whatever is going on in there. It's also why it's impossible to keep chemistry labs at the proper temperature because the A/C units and heating units are constantly pumping in controlled air and these are constantly sucking it out. So if you're doing some chemistry that might contain some noxious fumes, that goes on in here.

And if you want it to work properly, first you gotta turn it in. That's the vent and that's the blower [Flips the corresponding switches.] . Now it is sucking air. The second thing you want to do is make sure the sash is at the right level. This has a little thing that tells you where the sash is supposed to go. If you go above that, on this model, it'll buzz at you. [Pushes the sash up; the fume hood buzzes.] If the sash is higher than that, it's not gonna properly vent all the stuff to the outside; some of it might get into your face and that would be bad.

As a side note here, if something happens to you in the lab and if you don't know whether it was serious or minor; you're not sure, just tell your instructor. I once inhaled a bit of nitric oxide which, though initially extremely unpleasant, seemed to subside after a while. But it can have longer term effects: headache, nausea, disorientation, dizziness, pulmonary edema, death. So I'm glad I fessed up, so that I could get taken care of.

Speaking of, if you want to know what something smells like, do not stick your face in it. Waft, waft it toward your face. Also never test something by tasting it, obviously.

===== Transferring Liquids: Pipetting and Pouring (04:54) =====

And never pipette by mouth. I hear people say that and like who would, but then I just found out that Heiko, the chemistry consultant for Crash Course, has twice gotten HCl in his mouth by-from pipetting by mouth, which I will never forgive you for. That is what these things are for. You put that on the end there, and then you go one; you draw the liquid up with this thing. That's what that's for! Also, these days, most pipetting is done by these guys, which are way cooler anyway.

Pipetting is one way to move a substance from one container to

another, and it's a pretty good one. But if you want to pour, you can pour, but let me just give you a tip: commit. We tend to get all nervous when pouring stuff in the chemistry lab and go all slow with it, but that's terrible; you won't overcome the surface tension and it'll dribble down the side of the container, so just commit! At the beginning and at the end. Destroy that surface tension!

===== Avoiding Common Lab Accidents (05:40) =====

Okay, back to safety. The most common lab injuries are cuts and punctures, and the most common source of those is cleaning up broken glass, which you should not do with your hands, but with a broom and a dustpan, and then deposit the results into a bin specifically for sharp stuff.

But the worst thing, and it has happened so many times and it's so terrible, is forcing a glass rod, or thermometer, or a piece of tubing through a stopper and then it breaks and then right into and through your hand. And it's - you're in the hospital and you're in pain for the rest of your life, probably. So when you're doing this, and it is sometimes necessary, you can use a bit of water or lubricant or some kind of Vaseline to make it easier to go through, and then you hold it close and make sure your hand is not on the other side. So very close to make it go through like that; not like this, 'cause that's... no. [Both examples are demonstrated.]

===== Disposing Chemicals Safely (06:30) =====

When you're done with an experiment, do not just dump the results into the sink, unless this has been explicitly approved by the person in charge of chemical safety. For some chemicals, like common acids or bases, dilution is the solution to pollution. When they get diluted, all that's left is common ions like chloride ions from HCl or sodium ions from sodium hydroxide, in addition to some protons or hydroxide ions that are neutralized by buffer ions that are present in your sewage system anyway. Bottom line is they can be flushed with lots of water.

For other chemicals, flushing is not a good idea. It probably won't hurt you, but it might hurt the environment. Do put the products into an appropriate waste container, but not just any waste container. Different solvents and reagents have to be disposed of differently, and if you dump some stuff into the wrong container, it can totally end up reacting with the other things that have been dumped in there. Not good. Rule of thumb: always know the right way to dispose of something before you even start to use it.

===== Chemicals on Clothing (07:24) =====

This is an apron. It protects you and your clothes just a bit extra in case you're working with something hazardous like concentrated acids. Aprons are nice because they're easy to get off if you spill something on them, while if you're wearing pants, you might hesitate a bit too long before you ditch 'em.

Which reminds me: if you spill more than just a bit of anything super bad on your pants, modesty goes out the window; just take them off. Also, while you're taking them off, you might want to run over to this guy here. His job is to dump a gigantic amount of water on you really fast. Now usually you don't get to see these things in action unless there is an actual emergency, but to thank you for sticking with us through this somewhat disjointed lecture on safety in the lab... I'm gonna take this off. [Removes microphone. Pulls safety shower.] That's a lot of water! Aah!

===== Credits (08:16) =====

Thank you for watching this episode of Crash Course Chemistry. If you were listening, you learned what to wear in the lab, how to dispose of chemicals, how to avoid the most common accidents in the laboratory, how to pour properly, what the HazMat diamond is, what an MSDS is, and how to use a fume hood.

This episode was written by me, our editor is Blake de Pastino, our chemistry consultant is Dr. Heiko Langner who is sitting right there laughing at me, this episode was filmed at the environmental biogeochemistry lab at the University of Montana, so thank you to them. It was filmed, edited, and directed by Nicholas Jenkins, our script supervisor was Dr. Heiko Langner, our sound designer is Michael Aranda, and our graphics team is Thought Café.

[Endscreen]