PISSA-UNISON
SALUD Y SEGURIDAD EN NUESTRA COMUNIDAD

Las Uñas de Fantasía en el Laboratorio

Dra. Clara Rosalía Álvarez Chávez

Asesor de la Comisión de Higiene y Seguridad del Departamento de Cs, Químico-Biológicas

Asesor de PISSA-UNISON

Mi pregunta a miembros de la División de Seguridad de la Sociedad Americana de Químicos

We have seen that some people use quite long fancy nails while working in the lab. This topic was the object of a discussion in UNISON (University of Sonora).

The arguments included the respect of the person to use that type of nails. However, it was also commented that it is a risk for those who use those fantasy nails and also for those who are working around in the lab.

What is your opinion about it?

Have you implemented any policy in this regard?

Respuestas

If it is not interfering with the dexterity required for the operation, I won't have a problem with it.

Dr. Harry Elston. Consultant of Midwest Chemical Safety, LLC.

Damage to gloves can be a reason to limit them. Long nails will definitely damage the gloves. Hence possibility of chemical contamination.

Kim B, Jeskie. Directora de operaciones integrales del Oak Ridge National Laboratory (ORNL)
Tilak Chandra. Chemical Safety Specialist. University of Wisconsin.

The CDC said the long fingernails (more that 0.25 inches beyond finger are a bad idea if you want gloves to fit properly
http://blogs.hcpro.com/osha/2011/06/safe-work-practices-cosmetics-and-personal-property/

Dr. Jim Kaufman
Director of LSI

Years ago there was a short video showing these nails catching on fire from a Bunsen burner and when the person flicked her hand try to put out the flame, burning plastic drops flew into the air. It would be big help if someone could resurrect that old video

Dr. Monona Rossol
President, Arts, Crafts & Theater Safety

Acrylic nails are highly flammable! Within a matter of seconds.
Check out the following: "Beware flammable fingernails case report: synthetic fingernails result in full thickness burn and terminalisation"
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5241193/

Kenneth R. Roy, Ph.D. Chief Safety Compliance Adviser National Science Teachers Association (NSTA)

Take it from someone who wore 1.5 inch nails for years of nightclub gigs, they are thick, long, very flammable plastic. And if they catch fire, the are going to seriously burn the ends of the fingers. These longer ones also impair dexterity in the lab.

Dr. Monona Rossol
President, Arts, Crafts & Theater Safety

Excerpt from our *Safety Rules for Undergraduate Students in Chemistry Laboratories:*

You are advised to avoid wearing synthetic fingernails in the chemistry laboratory. Synthetic fingernails can be damaged by solvents and are made of extremely flammable polymers which can burn to completion and are not easily extinguished.

Barbara L. Foster
Director of laboratory safety
Eberly College of Arts and Sciences
West Virginia University

Respuestas

Flammability is but one issue with these nails.

Here are a few of the problems that employers of our students, including those going on internships, have stated.

For lab workers, many of the employers did not allow fingernails, including artificial nails, to extend beyond the fleshy part of the fingertip. This was not only for safety reasons, but also because of the limited dexterity the longer nails caused. Also, think about biological/medical laboratories and the impact of long nails in that setting.

* Contaminants can get trapped under the nails. Cleaning under the natural nail is already difficult. Artificial nails just make it worse.

* The adhesive does not form a continuous barrier between the edge of nail and the artificial nail, allowing contaminants to potentially get trapped in these channels against the nail.

* Long nails can pierce glove tips making the PPE ineffective.

* Some solvents/chemicals can dissolve or otherwise react the artificial nails and/or the adhesive.

Kirk Hunter, Texas State Technical College
(retired)Waxahachie, TX
Chair of Division of Chemical Technicians (ACS).

Respuestas…

Including the excerpt in your safety policies is such a great (and simple) idea!

My department's current safety policy does not include this concern, so I usually verbalize it during student training, along with ***leather*** closed toe shoes being a better choice for lab than ***cloth*** closed toe shoes. And, although during my annual training of the lab TAs I ask them to talk about it when training their students, I can't be sure they remember to do so.

Maybe my department should consider such an excerpt be written into the policy to ensure it's covered.

Thanks for the idea!

Mrs. Kimberly A. Elmore
Laboratory manager
Department of Chemistry and Physics
Campbell University, NC.

Respuestas

At my sister's wedding in 1980, I was a bridesmaid and was asked to polish my nails to match my dress, which I did. About an hour into the reception, the polish on my right thumb ignited as I put out a cigarette (I smoked in those days). Since I was in-expert when applying the polish, (and didn't routinely wear polish since it just came off in organic lab), some had run under the nail and extended into the nail bed. I was fortunate that my date had a soft drink in his hand when my thumbnail ignited, and the flames were both above and below the nail into the bed. He grabbed my hand and immersed my thumb, successfully extinguishing the flame, but I had third degree burns under the nail in the bed, and eventually lost the nail. It grew back, after several weeks, and I was fortunate enough not to be scarred or to permanently lose the nail, or the tip of the finger. But, it should be added to this discussion that the polish on ones own nails is also highly flammable, and such fires can also lead to significant injury. It doesn't have to be a polished artificial nail to cause a fire hazard, just the polish does the trick.

Meg Osterby
Adjunct Chemistry teacher
Western Technical College
Wisconsin

Arnaout A., Cubitt J., Nguyen D. 2016. Beware Flammable Fingernails. Case Report: Synthetic Fingernails Result in Full Thickness Burn and Terminalisation. Annals of Burns and Fire Disasters. XXIX(2):144-145.

Fig. 1

View of full thickness burn dorsal, left thumb - pre-operative (left). Overall view of the left hand with visible burn on left dorsal thumb preoperative (right).

Fig. 2

View of the post-operative left thumb reconstructed with a volarbased flap (left). Overall view of the post-operative hand post reconstruction (right).

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BEWARE FLAMMABLE FINGERNAILS. CASE REPORT: SYNTHETIC FINGERNAILS RESULT IN FULL THICKNESS BURN AND TERMINALISATION

ATTENTION AUX ONGLES FACTICES EN ACRYLIQUE. CAS CLINIQUE: BRÛLURE PROFONDE DU POUCE AYANT NÉCESSITÉ UNE AMPUTATION

Arnaout A., Cubitt J., Nguyen D.

The Welsh Burns and Plastics Centre, Morriston Hospital, Swansea, Wales

SUMMARY. Having long artificial (acrylic) nails is a current fashion trend, and they are becoming an increasingly popular cosmetic enhancement. We believe that they can be a potential burn hazard to their unknowing users. We present the first reported case in medical literature of a woman whose acrylic nail ignited from a cigarette butt a short distance from the nail while she was taking the final puffs. She sustained a full thickness burn to her dominant left thumb, resulting in terminalisation. Acrylic nails are very flammable and, once ignited, they burn to completion, with the source of flame removed. The temperature at the end of a cigarette can reach 900°C when the smoker takes a puff, which would explain how the artificial nail in our case study ignited. The flammability hazard of artificial fingernails is apparently well known in the beautician community. There are multiple beauty websites and blogs raising awareness of the danger of synthetic nails catching fire. We feel this potential risk should be further highlighted to the public.

Keywords: acrylic, synthetic nails, methyl-cyanoacrylates, flammable, nail glue, nail adhesive

RÉSUMÉ. *Le port d'ongles factices en acrylique est un artifice cosmétique à la mode actuellement. Nous pensons que ses utilisateurs ignorent leur danger potentiel. Nous présentons le premier cas de brûlure à cause de ces dispositifs. Il s'agit d'une patiente dont le faux ongle en acrylique a pris feu alors qu'elle tirait les dernières bouffées de sa cigarette, dont l'extrémité enflammée était donc très proche de ses ongles. Il en est résulté une brûlure profonde du pouce gauche (main dominante) ayant nécessité une amputation. Les ongles acryliques sont hautement inflammables, la combustion étant complète même quand a source de chaleur a été retirée. La température de 900°C atteinte à l'extrémité d'une cigarette quand le sujet tire une bouffée peut expliquer la mise à feu de l'acrylique. L'inflammabilité des ongles acrylique semble bien connue dans le monde de la cosmétique, puisque l'on trouve de nombreux avertissements à ce sujet sur les sites et blogs dédiés. Ce risque devrait être mieux transmis au grand public.*

Mots-clés: *acrylique, ongles factices, colle métyl-cyanoacrylate, inflammation*

Introduction

Long artificial (acrylic) nails are a current fashion trend, and are becoming an increasingly popular cosmetic enhancement.

We believe that they can be a potential burn hazard to their unknowing users. We present a case report of a significant flame burn from an acrylic (ethyl and methyl-cyanoacrylates) nail, and discuss our review of the available literature regarding the flammability of artificial nails and the adhesive glue used to apply them.

Case study

A 64-year-old woman had acrylic nails applied at a beauty salon, five weeks prior to presenting to the Welsh Burns Centre with full thickness burn to the dorsal side of her thumb. The burn extended from the dorsal tip to the distal intrapharyngeal joint (*Fig. 1*).

Fig. 1 - View of full thickness burn dorsal, left thumb - pre-operative (left). Overall view of the left hand with visible burn on left dorsal thumb pre-operative (right).

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ChemSumer

DEMO

Fire at Your Fingertips— The Flammability of Synthetic Nails

By Shawn B. Allin

Imagine life without plastics: no rollerblades, CDs, garbage bags, credit cards, or clear food wraps. Plastics and organic polymers even turn up as coatings for glossy paper, body panels on cars, and surgical implants used for repairing damaged heart valves. And even as fake fingernails!

A property shared by most polymers is flammability. The possibility that fake fingernails could be a safety hazard first came up in a lab discussion prior to the initial lab in our freshman chemistry class. A student asked a simple question: "Is it OK to wear my fake fingernails in lab?" Finding the answer prompted a two-student research project eventually published in the November 1999 issue of the *Journal of Chemical Education*.

Polymers

Modern plastics typically contain atoms of carbon, oxygen, hydrogen, nitrogen, and sometimes sulfur arranged in a chainlike fashion. Polymer science involves making chains with different types of links, repeating units called monomers. Testing determines how these links affect the polymer's physical properties—melting temperature, crystalline structure, toughness, and the stability of the polymer upon exposure to sunlight and water.

Flammability is a chemical property of polymers that raises both safety and environmental concerns. When any organic or carbon-based material is exposed to a spark in the presence of oxygen, there is always the possibility that it can react to form carbon dioxide and water. Under certain conditions, some of the carbon might be converted to carbon monoxide (CO). If the burning polymer contains any atoms of sulfur, these are released to the environment as sulfur oxides, pollutants that contribute to smog and acid rain.

But why do organic materials burn, and what can we do about it? For some polymers, it is simply favorable for them to burn. The products of the combustion reaction, such as carbon dioxide and water, are lower in energy than the reacting polymer and oxygen. You might think of the molecules as being "lazy", *wanting* to be in the lowest energy-state possible. Upon combustion, the energy of the molecules decreases as excess energy is released as light and heat. Strategies for reducing a material's flammability include making the material very low in energy to begin with, or especially for many household products, adding flame-retarding materials to suppress the spreading of flames.

Experimental design

We began our investigation by identifying the polymers found in fake fingernails. An examination of the various product labels showed that synthetic nails are composed of poly(acrylonitrile-butadiene-styrene), a polymer with stiffness and flexibility properties most resembling natural fingernails. Artificial nails get their shiny appearance from an outer coating of polyacrylate. The only elements present in these polymers are C, H, O, and N, the most common constituent elements of organic polymers.

Next, we researched chemical and fire safety sources to learn the standard experimental tests for flammability. The

Sample	Nail Type	Filled	Polished	Aged
1	Tip	No	No	No
2	Tip	No	No	Yes
3	Tip	Yes	No	No
4	Tip	Yes	No	Yes
5	Tip	No	Yes	No
6	Tip	No	Yes	Yes
7	Tip	Yes	Yes	No
8	Tip	Yes	Yes	Yes
9	Press-On	N/A	No	No
10	Press-On	N/A	No	Yes
11	Press-On	N/A	Yes	No
12	Press-On	N/A	Yes	Yes

The table specifies the 12 sample types. A nail tip is generally applied by a manicurist, whereas the press-on type is available in stores. "Filled" refers to the polyacrylate used to coat and install a nail tip. Aging is described in the article.

Link

American Society for Testing and Materials (ASTM) publishes uniform testing methods for determining almost any physical or electrical property of a material. Based on these standardized tests, the results from different laboratories can be fairly and reliably compared. Careful adherence to the published testing methods is a good example of scientific and industrial communities working together to make everyone's job a bit easier.

We chose ASTM Test Method D 3801-87, a method requiring two separate types of samples. The first one tests the material "as is", and the second tests the material after it is "aged" in an oven at 80 °C for seven days.

We completed two studies of 12 different types of samples (see Figure 1). And for each sample type, we tested and averaged the results for five nails. Statistics—the mathematical treatment of collections of data—allows scientists to judge whether their data are likely to be reproducible. Imagine if your entire grade was based on a single test. Sometimes this might work to your advantage, but basing your grade on a larger number of assessments increases the probability that the grade is an accurate reflection of your ability to perform that way again. In the same manner, the statistical averaging of five ignition times gives a more reliable indication of the predictable flammability of the synthetic nails than would the result of a single trial.

The ASTM method specifies using a Bunsen burner with specific flame characteristics. We decided to run the tests again, this time using a candle as the flame source. A person's artificial nails could be ignited by coming in contact with the flame from a gas stove, much like the flame from a Bunsen burner, or by the flame from a candle, a match, or a log fire, all of which have similar kinds of flames. By running two experiments in the fume hood, we were able to test laboratory and household flame sources. Not surprisingly, the Bunsen burner, with a flame temperature of approximately 490 °C caused faster ignitions than the birthday candle, with its flame temperature of approximately 300 °C.

We tried two methods for determining ignition times. The first one involved placing the nail in the flame and signaling a recorder to manually start and stop the timer. The alternate method involved counting the number of frames in a videotape between placement and ignition. Our video camera runs at a speed of 30 frames per second, so a frame-by-frame review of the tape allowed us to count the number of frames before ignition. Dividing the number of frames by 30 s^{-1} converted this count into an ignition time. This "high-tech" timing method, suggested by one of the students, was an important addition to our experimental design, because it allowed us to recheck our ignition times.

Data analysis

The ignition times for the various samples using the Bunsen burner and birthday candle are shown in Figures 2 and 3. Using the Bunsen burner resulted in an average ignition time of only 0.8 s with 87% of the samples igniting in 1 s or less. Agreement between the two timing methods was good, although video ignition times for all of the samples were unavailable. This was a result of "technical difficulties". I forgot to press "record" on the camera!

The birthday candle test resulted in a greater average ignition time of 1.1 s with only 58% of the samples catching fire in 1 s or less. All of the samples in both tests burned to completion. Once ignited, all of the nails curled into molten balls before falling from the forceps.

We decided to run the tests again, this time using a candle as the flame source.

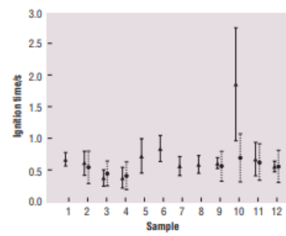

Figure 2. Ignition times using a Bunsen burner source for the 12 nail types. Error bars show the standard deviation for five trials. ▲ denotes the average of five trials using a manual timer. ● denotes the average of five trials using video frame data.

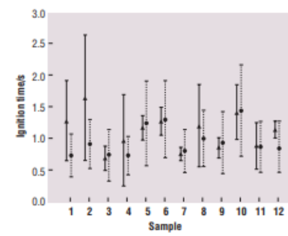

Figure 3. Ignition times using a birthday candle source for the 12 nail types. The data are displayed in the same manner as in Figure 2.

Conclusions

We found both brands of artificial fingernails to be highly flammable, whether or not they were coated with nail polish. Our results strongly suggest that wearing them introduces safety risks. The longer the nail, the more likely it is to accidentally ignite, producing a fiery ball of molten plastic. The natural reaction to shake the hand only contributes to the hazard.

We think that people should be informed of the risks. During the course of this research, several people related stories about how their nails were accidentally ignited while cooking on gas stoves or while lighting cigarettes. In fact, the employees at the beauty salon where we purchased our supplies were surprised by our ignorance.

For our class, a question raised during a routine lab safety briefing gave us an opportunity to carry out an enlightening scientific investigation. The work continues. Now, another student is investigating methods for reducing the flammability hazard of fake fingernails. Meanwhile, in our laboratory, wearers of synthetic fingernails may no longer work with open flames.

Shawn B. Allin teaches chemistry at Lamar University in Beaumont, TX. Two students, William Vanover and Jason Woods, contributed to this article.

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Safety Tips

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Synthetic Finger Nails as a Fire Hazard in the Chemistry Laboratory

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The current fashion trend of long artificial finger nails presents a potential hazard in chemistry laboratories. Specifically, synthetic nails are made from flammable polymers, typically poly(acrylonitrile–butadiene–styrene), with short ignition times (*1*). The existence of this potential hazard is apparently well known in the community. Discussions with students and professional manicurists prompted numerous stories of nails catching fire. In fact, they found our ignorance of the subject unbelievable. Unfortunately, while this hazard is acknowledged by the community, it was unknown to our entire faculty. To quantify the level of the hazard, we conducted a study into the flammability of synthetic finger nails.

Methodology

The flammability and ignition times of two types of artificial nails were studied. The testing procedure involved sets of 5 nails in each of the following categories: (i) unaltered nail tips;[1] (ii) filled nail tips; (iii) unaltered, polished nail tips; (iv) filled and polished nail tips; (v) unaltered press-on nails;[2] and (vi) polished press-on nails. All categories were tested in unaged and aged (80 °C for 7 days) forms (*2*). (See Table 1 for specifications of the samples.)

Table 1. Specifications of Sample Types

Sample	Type[a]	Filled[b]	Polished[c]	Aged[d]
1	Nail tip	—	—	—
2	Nail tip	—	—	✓
3	Nail tip	✓	—	—
4	Nail tip	✓	—	✓
5	Nail tip	—	✓	—
6	Nail tip	—	✓	✓
7	Nail tip	✓	✓	—
8	Nail tip	✓	✓	✓
9	Press-on	—	—	—
10	Press-on	—	—	✓
11	Press-on	—	✓	—
12	Press-on	—	✓	✓

[a]Nail tips are preformed synthetic nails that are typically installed by professional manicurists. They are described as sculptured nails and are often more than an inch long. Press-on nails are the more traditional form of fake finger nails and are available at most grocery and drug stores.

[b]Filled refers to the polyacrylate coating[3] used in conjunction with nail tips. The fill is applied in monomer form and polymerized in situ. It is used to coat and shape the nail tips as well as to fill the gap created at the base of the nail as the real nail grows.

[c]Polished refers to a sample having one side coated with nail polish.[4]

[d]The aging process is described in the text.

Two flammability studies were completed for each category: one using a standard Bunsen burner adjusted to a 19-mm stable blue flame, flame temperature ≈490 °C, and the other using common birthday candles, flame temperature ≈300 °C. Ignition times were measured in duplicate. The first set of ignition times was obtained during the experiment and the second was obtained by counting video frames from a tape recording of the experiment. The video times were obtained by counting the number of video frames between contact of the nail and source and ignition of the nail. Conversion to seconds was achieved by dividing the number of frames by the camera speed of 30 frames per second.

Results and Discussion

The results of the study are presented in Figures 1 and 2. Figure 1 includes the data obtained with the Bunsen burner as the ignition source. The average ignition time was 0.8 s, and 87% of the samples ignited in 1 s or less. Correlation between the two timing methods was high, with the counting of video frames resulting in a slight reduction in the reported ignition time. This reduction resulted from the elimination of the reaction time required to physically stop the timer.

Figure 2 includes the data obtained using the birthday candles as the ignition source. A slight increase in the average ignition time to 1.1 s was observed, with 58% of the samples igniting in 1 second or less. This increase in ignition time is a result of the significantly reduced flame temperature. Again, counting video frames resulted in a small decrease in the average ignition time.

All the synthetic nail samples burned to completion. Upon ignition, the flame source was removed and the nails burned while curling into molten balls. The nails then burned to completion (i.e., until the nail was consumed), often dripping pieces of flaming polymer. The presence of nail polish and polyacrylate filler had negligible effect on the nails' flammability. While not included in this study, tests of pure polyacrylate filler indicate that it is also highly flammable and burns to completion, but does not exhibit the same molten state as the synthetic nails.

Conclusions

The results of this study are quite clear. Both forms of synthetic nails studied were extremely flammable, had short ignition times, and burned to completion. Ignition times on the order of 1 s were observed for all samples. This, combined with the low flame temperatures, indicates the presence of a real hazard in undergraduate chemistry labs. This hazard is enhanced by the fact that the nails burn to completion and are not easily extinguished. Once ignition occurs the nails

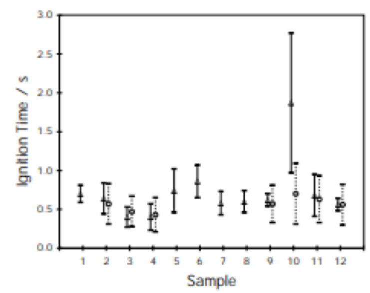

Figure 1. Ignition times using a Bunsen burner as the ignition source. Error bars represent standard deviation of five samples; △ ignition times determined during the experiment; ○ ignition times determined by counting video frames. No video data are available for samples 1 and 5–8 owing to a technical error during the taping process.

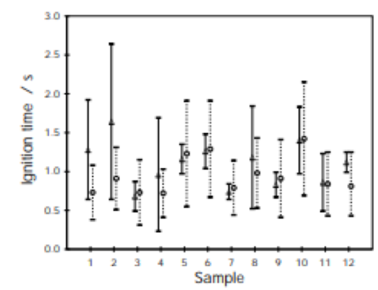

Figure 2. Ignition times using a birthday candle as the ignition source. Error bars represent standard deviation of five samples; △ ignition times determined during the experiment; ○ ignition times determined by counting video frames.

melt and may drip molten polymer. As the natural response would be to shake one's hand, this property of the material is significant given the danger of flying molten plastic.

A resolution to this problem, however, is less clear. Although both retail packages included the warning KEEP NAILS AWAY FROM DIRECT HEAT OR FLAME, the urgency of this statement was minimized. A complete ban of synthetic finger nails in chemistry labs at most colleges and universities is impractical. Sculptured nails are not removable, and many people wear them continuously for years at a time. We suggest that students be notified of the potential fire hazard and that nails be removed if feasible. Students who decline to remove artificial nails should be prohibited from using open flames—a course of action that is relatively simple in laboratories where students work with partners. Finally, we recommend consultation with your university's legal counsel in order to minimize the liability of the instructor and institution. Discussion on this topic has become a standard item during our safety lectures. An item, we might add, that lightens the mood of an otherwise somber subject.

Acknowledgments

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Notes

1. Terrific Tips®, Exotic Lady Curved (Brentwood Beauty Labs International, Inc.: Hillside, IL).
2. 5 Second®, Classic Pink French (International Beauty Design, Inc.: Gardena, CA).
3. Supernail Professional Liquid® (American International Industries: Los Angeles, CA); Kiss® Acrylic Powder (Kiss Products, Inc.: Port Washington, NY).
4. Nail Savvy®, Nail Enamel (Beauty Selectives: New York).

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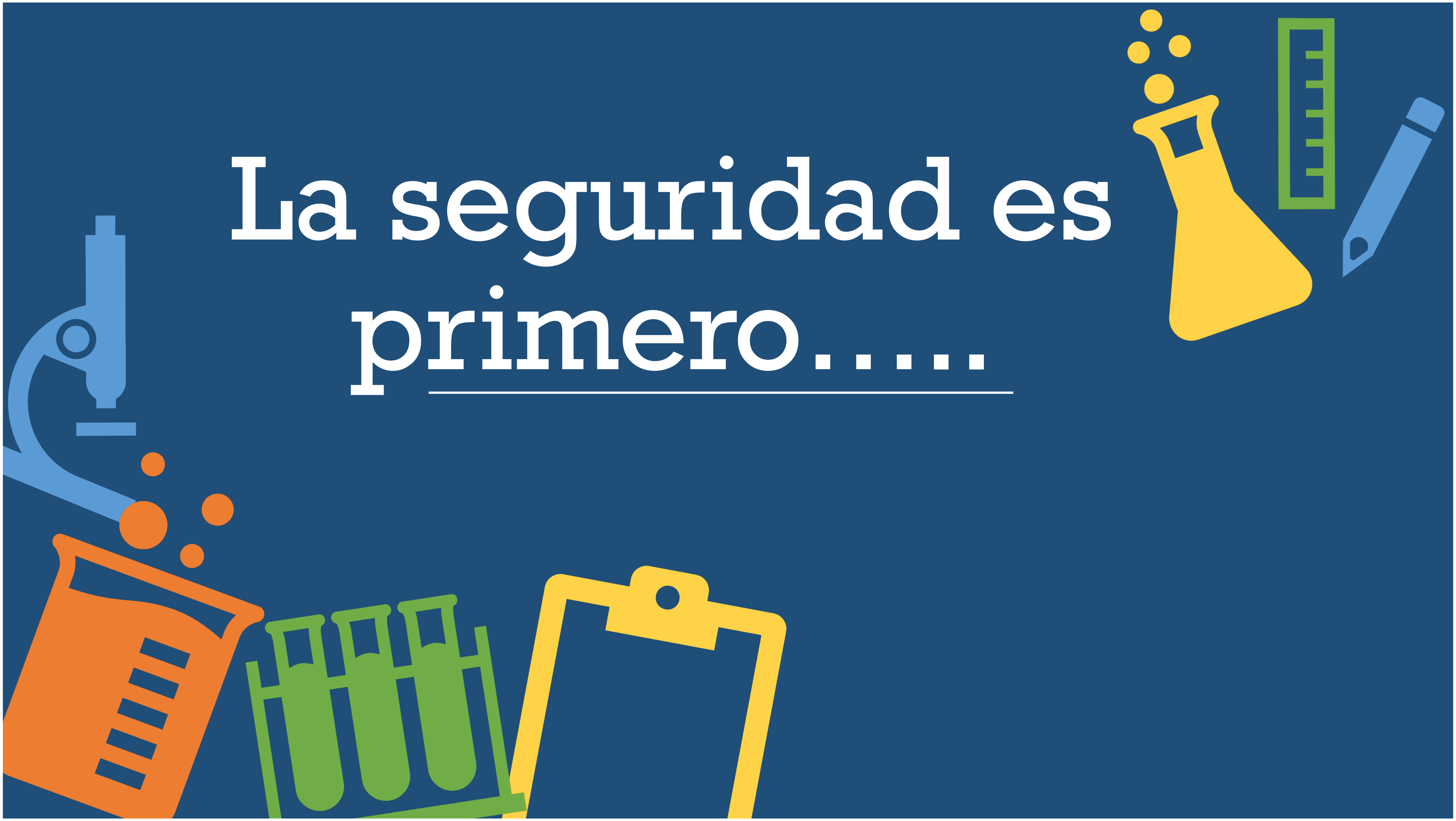
La seguridad es primero.....