CHAPTER 1

Strategies for Teaching Lab Safety

What Is It?

Lab safety includes the behavioral expectations, rules, and procedures that students follow during an interactive lab.

Why We Like It

During the first week of school, teachers can focus on getting to know their students. In addition, they can provide opportunities for their students to learn about each other, the teacher, and the classroom. See Chapter 14: Strategies for Cultural Responsiveness for resources that help you to get to know your students.

We've found that lab safety is the logical first unit in a science class. Students need to know the teacher's expectations and have time to practice safe behavior prior to doing science labs. Lab safety, when implemented correctly, reduces the risk of injury to the teacher and their students while also minimizing damage to lab equipment. Most important of all, lab safety can enhance student engagement and learning in science.

Supporting Research

Every science class should be teeming with lab and fieldwork that requires students to behave in specific ways to avoid injury. The National Science Teachers Association (NSTA) declares that "inherent in conducting science activities, however, is the potential for injury" (NSTA, 2015). Students need to learn how to proactively avoid injury as well as how to appropriately react if an accident occurs.

Teaching students to follow lab safety rules provides them with an opportunity to practice taking personal responsibility. Some teachers believe punitive measures, such as receiving an F on a quiz, is an effective way to teach personal responsibility. However, simply receiving a bad grade does not teach students how to behave in a more responsible manner. Students are more likely to learn how to manage their behavior and attitudes when they receive guidance from an adult who takes the time to encourage students to reflect on their actions (Wormeli, 2016). Instruction on lab safety is a meaningful way to show students the bigger picture of a situation and, thus, enhance personal responsibility.

Skills for Intentional Scholars/NGSS Standards

The activities in this chapter require students to practice thinking critically as they apply their newly learned lab safety rules and procedures. Simply memorizing the rules won't suffice, especially in the case of an emergency. Students will not have time to read the lab safety rules when an emergency arises. They must know the rules well enough in order to instinctively react appropriately in a dangerous situation.

Application

There are multiple ways to introduce and teach lab safety in science classrooms. We will highlight the use of a contract and safety rule story, as well as list several other interactive methods that we use to reinforce appropriate lab behavior.

SCIENCE SAFETY CONTRACT

We use a Science Safety Contract to introduce the rules. It is important to read every rule with students before having them sign the bottom. Students then take the contract home to obtain a parent signature. Figure 1.1: Science Safety Contract English is an example of a lab safety form that can be adapted for all grade levels. A Spanish version of the contract is available in Figure 1.2: Science Safety Contract Spanish.

LAB SAFETY RULES STORY

This activity gives students an opportunity to interact with their new learning about lab safety. It can also be used as a formative assessment to determine how well students understand lab safety rules in context. See Chapter 17: Strategies for Assessing Student Learning for additional formative assessment resources.

To personalize the lesson for our students, we replace the student names in Figure 1.3: Identifying Broken Lab Safety Rules with our current students' names. Every class period receives a unique copy that includes four of the students from the respective class. We find that students tend to be more engaged when they find their names in the story, which helps us build a positive rapport with them. Figure 1.4: Identifying Broken Lab Safety Rules—Answer Key provides the answers, assuming a teacher is using Figure 1.1: Science Safety Contract.

OTHER INTERACTIVE WAYS TO TEACH LAB SAFETY

There are many fun and interactive ways to teach lab safety that require students to do more than memorize a list of rules. Here are some ideas for activities that students can do to demonstrate their understanding of lab safety:

- Draw a cartoon showing what happens when lab safety rules aren't followed.
- Produce a video explaining why it's important to follow lab safety rules.
- Write and act out a skit that demonstrates the lab safety rules. Have small groups create two skits each—one showing how to correctly follow lab rules and the other showing an example of not following them. Not only can students have fun with this juxtaposition, but showing "bad" examples is also an effective learning and teaching strategy (Taylor, Wirth, Olvina, & Alvero, 2016).
- Analyze a "lab scene." Before class begins, set up a lab scenario where several lab rules were broken and someone has fallen victim to the violations. To make this interactive, the victim can be a parent or student volunteer. Include props such as a broken beaker, a Bunsen burner that's been left unattended, and water on the floor. Students then analyze the scene to determine which rules were violated and what changes need to be made in the lab to avoid future accidents. Crime scene tape can be added and is available at most local dollar stores.
- Each student creates a poster that focuses on one rule; some rules may be duplicated, depending on class size. Students share their posters during a gallery walk during which they provide constructive ideas and feedback to their peers by applying a sticky note to other students' posters. (This is always the first student work we display, and it's available for students to add to their portfolios for parent/teacher conferences.)

Students must pass a test demonstrating their knowledge of lab safety rules and procedures. Figure 1.5: Science Lab Safety Quiz is our true/false test.

DIFFERENTIATION FOR DIVERSE LEARNERS

All lab safety activities can be modified by allowing students to have more time or to work with a partner.

When we watch online lab safety videos in class, English language learners and hearing-impaired students can benefit from closed captioning. In addition, consider playing the videos at a slower speed to make them more accessible to all.

Learning lab safety is usually easier for older students because they've experienced most, if not all of the rules, in previous classrooms. Younger students may require more instruction and practice. We sometimes use a reading strategy called Cloze, which is discussed in depth in Chapter 8: Strategies for Teaching Reading Comprehension. Cloze activities provide students with the lab safety rules contract with keywords missing. Students are challenged to use context clues and background knowledge to guess the word that best fits in the blank. For example, using Figure 1.1: Science Safety Contract, rule number 1 would read like this:

> Wear lab safety _____ when chemicals are used or something is being heated.

Students then work independently or in pairs to determine that the blank should be filled with the word "goggles." After providing ample time for students to fill each blank, we then provide them with a word bank so they can begin to check the validity of their answers. The word bank can also be shared at the beginning of the activity with students who may need extra scaffolding.

Differentiation can also occur when assessing students.

Instead of taking a traditional summative test, students can prove they've learned a concept using other formats. We provide a variety of options for students to review and ask them to select one. When students are given choices, they can perceive classroom activities as more important because they feel their choice is going to impact their grade so they must make a good one (Marzano, n.d.). Also, giving students choices can enhance a sense of autonomy and increase motivation (Ferlazzo, 2015). In our experience, students who are provided options also tend to complete more work.

Students can choose from any of the following to demonstrate their new learning:

- Take an oral test (particularly for students who have reading comprehension challenges).
- Create a lab safety hero. The student chooses five lab safety rules they think are the most important. The hero they create then "explains" why these five rules are the most important, including the consequences of not following these rules. After giving the hero a catchy name, the student then draws and colors a

picture of his/her hero. Teachers can allow students the option of choosing how to present their heroes (PowerPoint, Google Slides, Prezi, a skit, or a poster).

- Find an online article dated within the last year where someone didn't follow lab safety rules. Students write a summary of the event including who, what, when, where, why, and how with an emphasis on the specific lab safety rule(s) that was broken and the consequence(s) that followed. Searching "lab accidents" followed by the year will generate many options.
- Write a letter to a younger student explaining the lab safety expectations of their future classroom. The student's letter must explain the lab safety rules in a meaningful way so the younger student understands the expectations of how to behave in a lab and why it is important to follow lab safety rules.
- Create a lab safety board game that includes three or four players. The student's board game must cover at least ten of the lab safety rules.

Differentiation can also be accomplished in how a teacher writes directions. For example, Figure 1.5: Science Lab Safety Quiz is a simple true-false quiz teachers can use to assess their students. The directions state, "Indicate if the following statements are true or false." This quiz can be made more difficult for advanced students by altering the directions. Here is one example of how the directions could read:

> Answer the following true-false questions. If a statement is false, you must alter the statement so it is true.

See Chapter 17: Strategies for Assessing Student Learning, for more assessment strategies that can be utilized in a science classroom.

Student Handouts and Examples

Figure 1.1: Science Safety Contract English (Student Handout)
Figure 1.2: Science Safety Contract Spanish (Student Handout)
Figure 1.3: Identifying Broken Lab Safety Rules (Student Handout)
Figure 1.4: Identifying Broken Lab Safety Rules—Answer Key
Figure 1.5: Science Lab Safety Quiz (Student Handout)

What Could Go Wrong?

Students cannot participate in a lab until two things are complete. First, students must return their signed Science Safety Contracts. Second, they must prove they know the lab safety rules either by passing a lab safety test or accurately completing an alternate summative activity.

Some students struggle to obtain their parent's signature on the contract. To help these students, we email the Science Safety Contract to the parents and ask them to respond to the email. If a parent doesn't have email, we make a phone call and ensure the child has a copy of the contract to take home that afternoon. We also work with our administration and district to develop translated versions of the contract based on student and family needs. Figure 1.2: Science Safety Contract is a Spanish-language version of our contract.

Some students don't pass a lab safety test the first time or complete an alternate summative activity accurately. To ensure they know safety rules and procedures prior to participating in science labs, these students must retake the original test, retake a different version of the test, or redo their summative activity. Their new grade replaces the original grade. They should be allowed to test and redo their activities until they earn at least 90% on the assessment. We let English language learners use online translators while taking the safety test.

Technology Connections

There are many YouTube lab safety videos that are appropriate for all ages. They are usually made by secondary teachers or their students and include humor. Some are parodies, some are cartoons, and yet others are raps. Simply search for "lab safety videos."

Attribution

Many thanks to Monica Valera for translating our Science Safety Contract from English into Spanish.

Figures

Student Name_____

Science Safety Contract

Safety is the number one priority in our classroom. The following rules will be strictly enforced. If you choose to violate a lab safety rule, you will be removed from the current lab and possibly future labs.

Dress Code

1. Wear lab safety goggles when chemicals are used or something is being heated. Know where the eye wash station is. If something gets into your eye, go directly to the eye wash and start rinsing your eye. I will come to you at the eye wash station and help you.

Figure 1.1 Science Safety Contract English (Student Handout)

2. Tie back long hair to avoid it accidentally mixing with chemicals or catching on fire. To avoid contamination, don't apply make-up in the classroom and don't comb your hair here either.
3. Remove loose jewelry and secure loose clothing to ensure these items do not catch on fire, causes spills, or contaminate chemicals.

General Safety Rules

4. Come into our classroom quietly and go directly to your desk. Do not interact with lab materials until you have been instructed to do so. It is very common for you to come into our room and find lab materials on counters and tables. Exercise self-control and avoid them until you receive directions for how to use them properly and safely.
5. Read and listen to all directions. Start with step number 1 and when you're done with #1, go on to #2. If you aren't sure about something, then ask! It's better to be safe than sorry!
6. To ensure your safety and the safety of those around you, horseplay will NOT be tolerated during a lab. If you don't keep your hands to yourself, then you will be asked to leave for the rest of the period and you may be excluded from future labs.
7. Do NOT eat in our classroom. This room has been used for mixing chemicals, dissecting specimens, and other science projects. I don't want you to consume something that will make you sick. You can drink water but it needs to be clear and in a closed container. It also needs to be kept at your desk. Do not take your water to your lab table.
8. When your lab is complete, clean up your lab station. Clean all materials, dry the space, and return all materials to their original location. Also, push in your chair so there is a clear area for us to walk.
9. Complete every chemical lab by washing your hands with warm water and soap. Hand sanitizer is not soap!

First Aid

10. REPORT ALL ACCIDENTS TO ME IMMEDIATELY! It does not matter how small (or big).
11. Know where all of the safety equipment is in our classroom. Where is the eye wash? Lab shower? Phone? Lab safety goggles? Exit? Fire extinguisher? Fire blanket?

Chemical Safety

12. NEVER touch, taste, or smell a chemical. If you need to smell a chemical, then hold it six inches away from you and gently wave your hand over the substance towards your nose. This action will "waft" some of the fumes toward your nose without exposing you to a large dose.

Figure 1.1 (Continued)

13. NEVER MIX CHEMICALS FOR THE "FUN OF IT"! The result may be disastrous.
14. Keep lids closed on all containers when they are not being used. This will help you avoid accidental spills. Be sure all materials are kept at the back end of the lab table so they aren't easily knocked to the floor.
15. Rinse off any chemicals that have spilled or splashed onto your skin. DO THIS IMMEDIATELY! Do not come to me first. Take care of yourself first! I will come to you to help you with the spill.

I understand and agree to follow all of the safety rules discussed in class and within this contract. I accept the consequences for not following all of the safety rules discussed in class and within this contract.

Student Signature: _____ Date: _____

Parent/Guardian Signature: _____ Date: _____

Figure 1.1 (Continued)

Nombre del estudiante_____

Contracto De Seguridad para la Clase de Ciencias

La seguridad es la mayor prioridad en nuestra clase. Las siguientes reglas serán estrictamente aplicadas. Al violar algunas de estas normas de seguridad del laboratorio, usted será destituido del laboratorio y posiblemente de otros laboratorios en el futuro.

Código de Vestimenta

1. Utilice gafas de seguridad cuando use químicos o cuando algo se está calentando. Debe saber dónde está la estación de lavatorio de ojos. Si ocurre un accidente y tiene algo en el ojo, vaya inmediatamente al lavatorio de ojos y empiece a lavarse los ojos. Yo iré rápidamente al lavatorio de ojos para ayudarle.
2. El pelo largo debe ser atado para evitar un accidente con los químicos o el fuego. Para no contaminar, no se maquille, ni se peine el pelo en el laboratorio.
3. Quítese joyas colgantes y no use ropa suelta, si lo hace, asegúresela para evitar fuego, contaminación, o tumbar algo.

Las Reglas Generales

4. Llegue al salón de clase silenciosamente y vaya directamente a su escritorio. No toque los materiales del laboratorio hasta que reciba las instrucciones. Sería muy común llegar a clase y encontrar los materiales del laboratorio en las mesas y mostradores. Debe controlarse y evitar tocarlas.
5. Lea y siga todas las instrucciones. Empiece con el paso número 1 y cuando termine con el número 1 siga con el número 2. Si no entiende algo, pregúnteme. ¡Es mejor prevenir que lamentar!
6. El mal comportamiento NUNCA será permitido en el laboratorio. Si no mantiene las manos en su persona, usted tendrá que salir del laboratorio y no podrá participar en la clase y posiblemente en futuros laboratorios.
7. NUNCA coma en el salón de clase. En este salón hemos mezclado químicos, disecado especímenes y otros experimentos de ciencias. No quiero que usted consuma algo que lo enferme. Sí puede tomar agua, pero tiene que estar en una botella tapada. Su botella de agua tiene que quedarse en su escritorio. No lleve el agua a la mesa del laboratorio.
8. Cuando haya terminado con su trabajo, limpie su estación de laboratorio. Limpie, seque y regrese todos los materiales a su lugar. También empuje su silla para mantener espacio para caminar en el salón.

Figure 1.2 Science Safety Contract Spanish (Student Handout)

9. Termine cada experimento de química lavándose las manos con agua tibia y jabón. El gel antibacterial no es jabón.

Los Primeros Auxilios

10. ¡INFÓRMEME DE CUALQUIER ACCIDENTE INMEDIATAMENTE! No importa si sea un accidente pequeño o grande, yo necesito saber.
11. Aprenda dónde está localizado todo el equipo de seguridad. ¿Dónde está el lavatorio de ojos? ¿Dónde está el teléfono? ¿Dónde está la ducha del laboratorio? ¿Dónde están las gafas de seguridad? ¿Dónde está la salida de emergencia? ¿Dónde está el extinguidor de incendios? ¿Dónde está la manta del fuego?

La Seguridad de los Químicos

12. NUNCA toque, pruebe o huela un químico. Si necesita oler un químico, mantenga el químico por lo menos seis pulgadas de su persona y suavemente mueva la mano arriba de la substancia hacía la nariz. Esto dirigirá el humo hacía la nariz sin exponerlo a una dosis grande.
13. ¡NUNCA MEZCLE QUÍMICOS POR GUSTO! El resultado puede ser desastroso.
14. Mantenga los frascos cerrados cuando no los está usando. Esto ayuda evitar accidentes. Asegure que todos los materiales estén en el fondo de la mesa del laboratorio para evitar tumbarlos al piso.
15. Enjuague cualquier químico que ha tumbado o que ha tocado su piel. ¡HÁGALO INMEDIATAMENTE! No venga a informarme primero. ¡Cuídese primero! Yo iré a ayudarle con el derrame.

Yo entiendo y estoy de acuerdo en seguir todas las reglas de seguridad mencionadas en clase y en este contrato. Yo acepto las consecuencias al no seguir estas reglas de seguridad.

Firma del estudiante: _____ Fecha: _____

Firma del padre/guardián: _____ Fecha: _____

Figure 1.2 (Continued)

Name _____

Period _____ **Date** _____

Identifying Broken Lab Safety Rules

Directions: The following story includes many broken lab safety rules. Using the safety rules outlined in the Science Safety Contract, identify when someone breaks a lab safety rule in the story. Underline when a rule is broken and next to it, write the rule number that was broken. The first one was done for you.

Jalen, Mateo, Lily, and Emma were excited to begin their lab. Their teacher had been talking about burning rocks with acid since the first day of school. Lily and Emma placed a sample of the first acid in a test tube. Emma stuck her nose directly into the test tube *(rule number 12)* to smell the acid. Meanwhile, Jalen obtained 15 mL of the second acid. It seemed to have an unusual odor that made his nose feel funny, so he put a drop of it on his finger and tasted it.

Mateo mentioned to everyone that they should wear safety goggles but Lily made a good point that you look like a dork with lab goggles so they decided to bypass the goggles.

Emma and Jalen had a great time sword fighting with pipettes! What fun science lab can be!

By this time, Lily was growing bored, so she started to mix the two acids even though the lab's instructions didn't say anything about mixing them.

Emma was distracted by her friends who were in a different lab group. She never did any of the work but instead focused on getting ready for her next class. She brushed her hair, applied lipstick, and started eating a granola bar.

As Mateo performed his experiment, Lily followed directions. She started the lab by placing five drops of the first acid onto the first rock sample. While holding the pipette in one hand and the test tube in the other, she tripped! She caught herself so she didn't fall but she did splash some of the acid on her thumb, then splashed a little more on her shirt sleeve. Then, without putting the top back onto the bottle of acid, Lily went to test something else. When the group was finished working, they left the remaining acids in the test tubes and put the test tubes away in the rack.

As she was leaving the lab, Emma noticed she had a small cut on her hand. She decided it was not important because it didn't hurt. She chose not to mention it to her teacher.

Figure 1.3 Identifying Broken Lab Safety Rules (Student Handout)

Name Answer Key

Period _____

Identifying Broken Lab Safety Rules–Answer Key

Directions: The following story includes many broken lab safety rules. Using the safety rules outlined in the Science Safety Contract, identify when someone breaks a lab safety rule in the story. Underline when a rule is broken and next to it, write the rule number that was broken. The first one was done for you.

Jalen, Mateo, Lily, and Emma were excited to begin their lab. Their teacher had been talking about burning rocks with acid since the first day of school. Lily and Emma placed a sample of the first acid in a test tube. Emma stuck her nose directly into the test tube *(rule number 12)* to smell the acid. Meanwhile, Jalen obtained 15 mL of the second acid. It seemed to have an unusual odor that made his nose feel funny, so he put a drop of it on his finger and tasted it. *(rule number 12)*

Mateo mentioned to everyone that they should wear safety goggles but Lily made a good point that you look like a dork with lab goggles so the students decided to bypass the goggles. *(rule number 1)*

Emma and Jalen had a great time sword fighting with pipettes! What fun science lab can be! *(rule number 6)*

By this time, Lily was growing bored, so she started to mix the two acids even though the lab's instructions didn't say anything about mixing them. *(rule numbers 5 and 13)*

Emma was distracted by her friends who were in a different lab group. She never did any of the work but instead focused on getting ready for her next class. She brushed her hair, applied lipstick, and started eating a granola bar. *(rule numbers 2 and 7)*

As Mateo performed his experiment, Lily followed directions. She started to observe the lab by placing five drops of the first acid onto the first rock sample. While holding the pipette in one hand and the test tube in the other, she tripped! She caught herself so she didn't fall but she did splash some of the acid on her thumb, then splashed a little more on her shirt sleeve. Then, without putting the top back onto the bottle of acid *(rule number 14)*, Lily went to test something else. When the group was finished working, they left the remaining acids in the test tubes and put the test tubes away in the rack. *(rule number 8)*

As she was leaving the lab, Emma noticed she had a small cut on her hand. She decided it was not important because it didn't hurt. She chose not to mention it to her teacher. *(rule number 10)*

(And the students didn't wash their hands with soap and water so they also violated rule number 9).

Figure 1.4 Identifying Broken Lab Safety Rules—Answer Key

Name: _____

Period: _____ **Date:** _____

Science Lab Safety Quiz

Directions: Indicate if the following statements are true or false. You must receive an A before you can participate in a lab. Retakes will be offered for anyone who receives less than 90%.

_____ 1. In a lab setting, it is appropriate to wear loose-fitting clothing.

_____ 2. When you sit down at your lab station, make sure you start the lab immediately so there is enough time to complete it.

_____ 3. If you have questions, or are not sure how to handle a particular chemical, procedure, or part of an activity, you should always ask for help.

_____ 4. Be sure to clean up your lab area when you are instructed to do so.

_____ 5. Always use goggles, tie back your hair, and cover clothing when working with candles and burners.

_____ 6. Point test tubes and other containers that are being heated toward you.

_____ 7. Don't tell the teacher if you are hurt, but instead report directly to the nurse.

_____ 8. Notify your teacher immediately if a chemical is spilled.

_____ 9. You should wash your hands only after investigations involving chemicals.

_____ 10. Clean up your lab area completely before you leave.

Figure 1.5 Science Lab Safety Quiz (Student Handout)