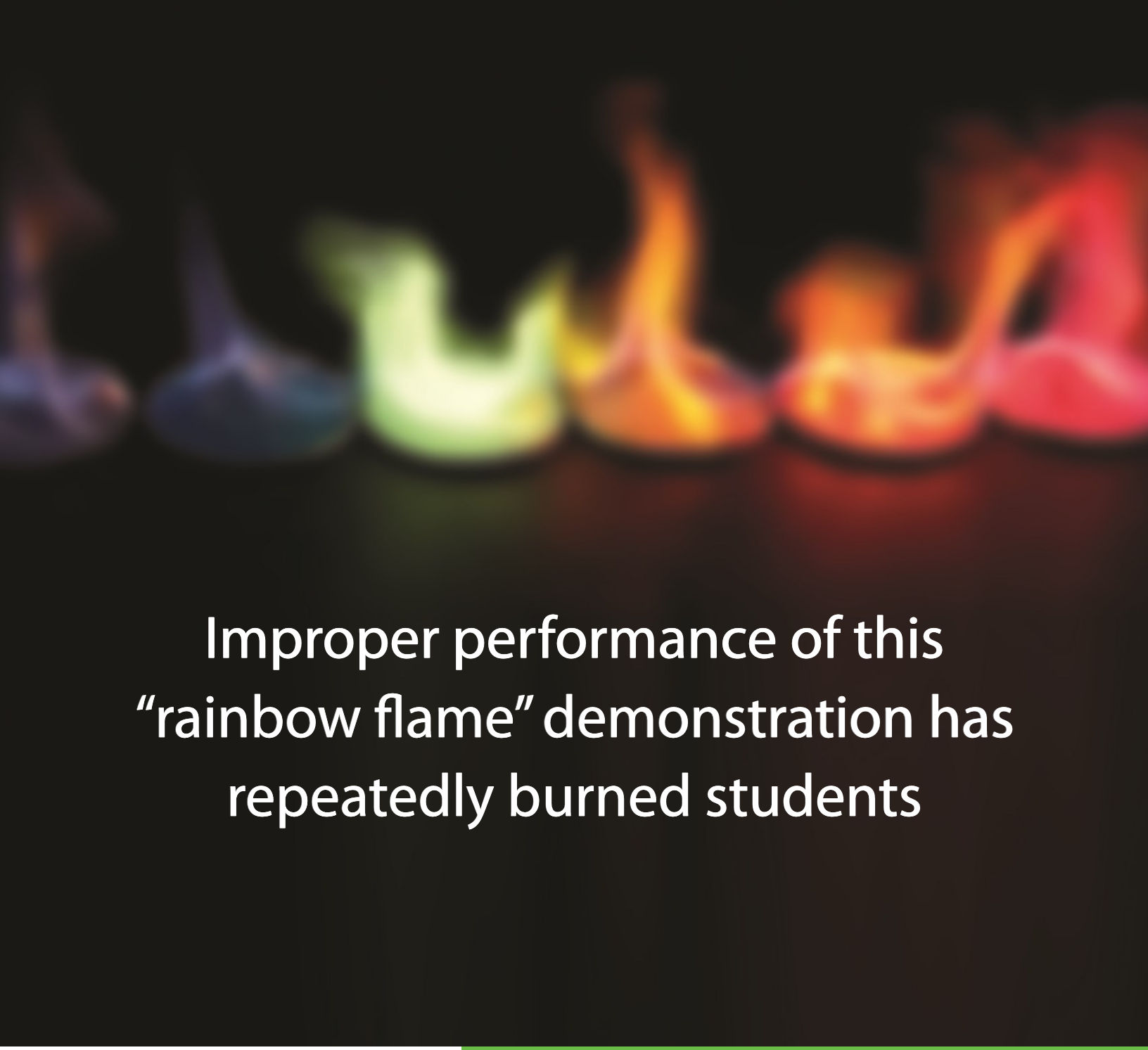

Improper performance of this "rainbow flame" demonstration has repeatedly burned students

The Laboratory Safety Institute

40 Years | 1978-2018

# RAINBOW FLAME SAFETY GUIDELINES

# DANGERS OF THE RAINBOW

Courtroom sketch: U.S. Chemical Safety Board

It's colorful, it's spectacular, and it teaches key concepts about the electromagnetic spectrum, atomic structure, and energy. No wonder the rainbow flame demonstration has long been a favorite of science teachers. Sadly, almost every year, failure to take appropriate safety precautions when performing this demonstration has resulted in fires, injuries, and costly lawsuits. (The Laboratory Safety Institute knows this all too well. We have provided expert witness testimony for plaintiffs and defendants in a dozen of these and other school injury cases.)

***How can this classic science demonstration be performed with less risk?*** The Laboratory Safety Institute has prepared this document to present some helpful safety guidelines.*

* These guidelines are intended to serve only as a supplement to instructions for performing rainbow flame or other experiments. They are not intended to be sufficient to safely perform these demonstrations.

**In May 2017,** a dozen kids sat on the floor in a Texas church school watching a teacher show them one of the "fun" science experiments designed to make kids think chemistry is cool. Because no flame was visible, the teacher decided to pour in some more methanol. Fire sprayed out of the canister and six students wound up in the hospital. This is not the first or the last time a rainbow flame demonstration has gone wrong — with the same terrible result:

- 2018 Nashville, TN. 17 injured.
- 2015 Fairfax, VA. 5 students injured.
- 2014 New York, NY. 2 students injured.
- 2014 Denver, CO. 4 students injured. Teacher charged with 3rd-degree assault.
- 2014 Reno, NV. 12 injured.
- 2013 Dallas, TX. 1 teacher, 2 students injured.
- 2011 Minneapolis, MN. 4 students injured.
- 2011 Oklahoma City, OK. 1 student injured.
- 2006 Cleveland, OH. 2 students injured. $18.9 million lawsuit.
- 2004 Seattle, WA. 2 students, 1 teacher injured.
- 2000 Washington, DC. 2 students injured.

## SPECTRUM OF SAFETY

No flame demo is 100% risk-free,
but there are less-risky variations.

### VIDEO: The Safer Choice

If you are even slightly unsure that you can perform any demonstration safely in front of students, simply take a video of yourself doing the demonstration with an assistant and play it in class.

### Wooden Splints

Colored flames can also be produced by dipping a wood splint in an aqueous solution of metallic salt and then holding it in a flame.

### Nichrome Wire Loop

Colored flames can also be produced by dipping a loop made of nichrome wire in an aqueous solution of metallic salt and then holding it in a flame.

# SAFETY GUIDELINES

## FOR ALL RAINBOW FLAME DEMONSTRATIONS

1. Always have a shield between the demo and your students when fire, flames, or reactive, flammable, toxic or corrosive chemicals are involved.
2. With all demonstrations, the teacher should master the procedure in the absence of students before allowing students to be present.
3. All persons preparing for, performing, or viewing this demonstration must wear proper personal protective equipment, including chemical splash goggles.
4. Some chemical salts, such as barium chloride, are highly toxic. Precautions must be taken to avoid ingestion of the salt or solution. Wear chemical splash goggles and avoid contact with solutions when performing this experiment. Wash hands after handling materials used to prepare for or perform this experiment.
5. Ensure that fire response equipment is available.
6. All science teachers should receive training as described in the OSHA Lab Standard, 29CFR1910.1450 (irrespective of whether their district is covered by state or federal OSHA regulations).

## VARIATIONS USING A BUNSEN BURNER / PROPANE TORCH

1. Always use caution around open flames. Keep flames away from flammable substances.
2. Always be aware of an open flame. Open flames can cause burns. Do not reach over the flame. Tie back hair and secure loose clothing.

## VARIATIONS USING PETRI DISHES / ALCOHOL

1. Never pour flammable liquid directly from the bottle. In the prep room, transfer to a small, sealable bottle or dropping bottle the minimum amount of methyl alcohol needed to perform the demonstration (not more than 25 ml). Leave the alcohol supply in the flammables cabinet. Bring only the smaller bottle into the lab or lab/classroom.
2. Use no more than 1 gram of salts per Petri dish and no more than 5 ml of alcohol per Petri dish.
3. Make sure the demonstration table / workbench is clear of anything flammable.
4. Add the alcohol to all of the Petri dishes before lighting any of them.
5. To reduce evaporation, place a Petri dish cover or watch glass over each dish as it is prepared.
6. Remove the cover just before lighting the alcohol.
7. Replace the cover over each dish to help ensure it is properly extinguished before lighting the next dish.
8. **Petri dishes should only be filled once. Do not try to refill if the dish does not ignite properly.**

The Laboratory Safety Institute will be happy to review written procedures on request and provide suggestions for creating safer and healthier demonstrations.

# THE LABORATORY SAFETY INSTITUTE

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## Disclaimer

These suggestions are intended to serve only as a supplement to instructions for performing the rainbow flame demonstration. They are not intended to be sufficient to safely perform these demonstrations.

**The Laboratory Safety Institute (LSI)** is committed to promoting a culture of safety at academic and nonacademic institutions throughout the world. Over 100,000 scientists and science educators have attended the Institute's courses and presentations. LSI is supported, in part, by grants from individuals, foundations, companies and professional societies. LSI conducts seminars, short courses, webinars, audits and inspections for schools, colleges, and companies. LSI also provides advice on regulatory compliance, safety program development, facilities design, editorial commentary on laboratory texts, and expert witness testimony.

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