While serious accidents causing catastrophic injury in high school science activities are very rare events, when they occur their human toll can be devastating. This post examines one potentially dangerous demo, its hazards and suggestions for safer alternatives.

The Rainbow Flame Demonstration:

Several of the most serious science accidents have resulted from the combustion of flammable liquids in teacher demonstrations like the rainbow flame demonstration. In this demo, metals salts are heated in a ceramic dish containing burning methanol. The flame colour observed is characteristic of the metal. Click on this link for an example of how this demo is sometimes done. Please note that the procedure used in this video is unsafe, inappropriate for students of any age and NOT recommended for teachers.

The Hazard:

Methanol vapours are extremely flammable. Furthermore, since the density of methanol is greater than that of air, methanol vapour can flow invisibly across surfaces like the demonstration desk and onto the floor towards unsuspecting observers. A flame, spark or even a hot surface can supply sufficient energy to ignite the vapour and create a sudden flash fire. The situation can be even more catastrophic if a nearby open container of methanol is present.

Published Accident Reports:

There have been several reported incidents of injury resulting from the Rainbow Flame Demonstration. For example, Rohrig[i] reports that 22 students were injured in four separate incidents involving this demonstration in the United States in 2014. In 2006, a 15-year-old science student in Ohio received burns to over 40% of her body due to an accident involving this demo. This link provides a YouTube video that summarizes the incident and its impact.

Lessons Learned:

Several safety concerns or deficiencies were identified in the accident reports including:

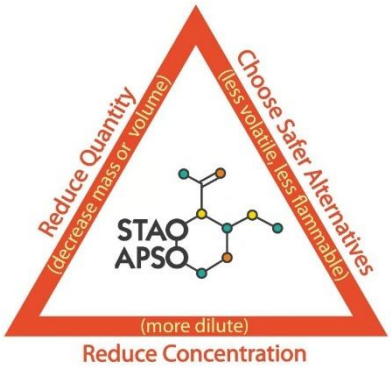
- Students were sitting too close to the demonstration apparatus
- There was limited or no personal protective equipment present
- No safety shield was present
- Stock bottles were sometimes used to refill hot ceramic dishes.
- Limited teacher training in the hazards and risks of using flammable liquids.

The Safer Alternative:

There is no question that the Rainbow Flame Demo has considerable "Wow!" factor. However, in our opinion, the hazards and risks of this demo far outweigh its educational value, particularly when there are safer alternatives. Click here for an example provided by the American Chemical Society. A similar result can be achieved by first dipping a loop of an inert metal, e.g., nichrome, into a sample of solid metal salt or its solution and then placing the loop into a Bunsen burner flame. Click here for an example.

Both alternatives achieve the same goal of showing the characteristic flames colours of metals but without using flammable solvents. Moreover, they can be easily adapted to become a student activity, allowing students to become more actively engaged in their learning.

Stress Safety:



"Safer alternatives" is one of the three general approaches to safety that are summarized in STAO's Science Safety Triangle. The others include "Reduce Quantity" and "Reduce Concentration". Together with well-maintained safety equipment and on-going training, these themes form the core of promoting a culture of safety mindedness in your school.

Let's continue to keep everyone safe

Dave Gervais

Safety Chair for STAO

References

Safety Alert: The Rainbow Demonstration

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[i] Safety Data Sheets: Information that Could Save Your Life

STAO Resources:

Safe ON Science (revised 2018): Provides practical information regarding the managing of a science department, appropriate for general science, biology, chemistry and physics. Available soon at the STAO online store at stao.ca

Safer Use of Chemicals in our Laboratories (revised 2018): Provides valuable information on restricted chemicals, designated substances, and has an improved

table of chemicals with STAO's recommendations as to their safe use. Available soon at the STAO online store at stao.ca

Safety Mindedness Online Training Modules (2018): These self-paced modules provide an excellent overview of typical science safety considerations for both elementary and secondary teachers. Click these links to access this resource:

Elementary Safety Mindedness Secondary Safety Mindedness

STAO Conference (Nov 2018): This three-day event is the largest science teachers conference in Canada. It is a "must be there" event for any Ontario Science teacher.