

Science/STEM Safety & the Science Teacher

NSTA Pre-Service Secondary Teachers of Science
28 February 2022



OSHA HazCom GHS Pictograms

Presenter!

Dr. Ken Roy

Safersci@gmail.com

ON STAFF AT Glastonbury Public Schools (CT)
-Director of Environmental Health & Safety
-Safety Compliance Officer
-Chemical Hygiene Officer

PRIVATE SAFETY PRACTICE

National Safety Consultants, LLC – General Manager
-Trained as Authorized OSHA Instructor;
-National Science Teaching Association (NSTA)
Chief Science Safety Compliance Adviser and Blogger
-National Science Education Leadership Association (NSELA)
Safety Compliance Officer
-International Council of Associations for Science Education (ICASE)
Safety Committee Member
-Author of over 12 safety books and over 800 Professional Journal Articles on Safety
-Safety Researcher at Pennsylvania State University



Getting Up-to-date Safety News

NSTA Safety Blogger – Ken Roy
<https://www.nsta.org/topics/safety#tab-safety-blog>

Tweet Dr. Ken
Twitter@drroysafersci



Presenter!

Dr. Kevin S Doyle @KSDoyle1

District Supervisor of Science Instruction –
Morris Hills Regional District

- ❖ Coordinator of the Math and Science Magnet Program at MHRD
- ❖ Coordinator of the Aviation and Aerospace Program at MHRD

Safety Advisory Board Member, National Science Teaching Association

Kevin Doyle Consulting

Science Safety Presenter

- ❖ NJ Science Convention
- ❖ New Jersey Science Education Leadership Association
- ❖ National Science Teaching Association



Agenda

- Why Safety?
- COVID Protocols
- Facilities
- Chemicals
- Fire Safety
- Demo/Activity Safety & PPE
- Duty of Supervision & Negligence
- Questions and Answers



COVID STEM Lab Protocols

Current CDC Recommends to Keep social/physical distance of at least 3+ feet.

- Think outside the box when doing labs
- Wear gloves when sharing materials
- Demonstrate how to take off gloves
- Have groups of two work at lab stations and other students working at their desks.
- Virtual Labs

Remember there is a learning loss associated with lab skills and techniques.

- Practice frequent hand washing for 20 seconds.
- Only use hand sanitizer/disinfectant if soap and water are not available.
- Clean first Disinfect second
- Avoid touching the eyes, nose, or mouth.
- Stay home if you are sick and avoid anyone who appear sick.
- Safety over Standards

For additional updated/current CDC protocols, see the following: Guidance for COVID-19 Prevention in K-12 Schools –

<https://www.cdc.gov/coronavirus/2019-ncov/community/schools-childcare/k-12-guidance.html>



Why Lab Safety?

Reason, History, and Implementation



BASIS OF SOPs: Legal Standards

- 29 CFR 1910.1450
Occupational Exposure to
Hazardous Chemicals in
Laboratories
- 29 CFR 1910.1200
OSHA's HazCom Standard
- NFPA Life Safety Code 101

OSHA Lab Standard



BASIS OF SOPs:

Better Professional Safety Practices



*Complacency about safety
leads to bad decisions
and accidents*

"Experts" can get the most complacent

Preventable Accidents

- 9/23/2016 - University of Hawaii fired over \$100,000 in safety and workplace violations after accident
- 5/9/2018 - Washington - 17 people were injured when a classroom science experiment caused a flash fire.
- 5/16/2017 - Houston - 12 preschoolers are injured in flash produced from "color changing flame experiment"
- 5/24/2017 - Perth Amboy - student is burned in outdoor experiment using alcohol in a bottle - student had tried to light bottle with matches on own
- 11/22/2017 - Bronx - "Whoosh Bottle" demo produced larger than expected flame - students were "singed"
- Since 1988 - 164 children and teachers have been hurt in science labs involving flammable liquids



KEEP
CALM
AND
BE
SAFE R!



FACILITIES

You are Responsible!!!

Security of Laboratories and Other Designated Areas

- All science/STEM laboratory areas are to remain locked in the absence of a designated employee – Secured areas given hazards and risks: Biological, Chemical & Physical.




Important Points

- Never conduct a lab in a room that is not properly outfitted to conduct an experiment!
 - Does the room have water, engineering controls, proper lab surfaces, proper ventilation, GFCI outlets, fire extinguisher.
 - The "coolness" of the lab is not worth the liability
 - The lab must be cleaned and organized. All trip hazards must be removed
 - Chemicals must be stored in a safer and secure area
 - Labs should be closed and locked whenever a teacher is not present. Students should never be in a laboratory unattended.

Engineering Controls & Safety Apparatus

Definition: Controls which remove or reduce exposure to a chemical or physical hazard by using or substituting engineered machinery or equipment.

- Eyewash Stations
- Safety Shower
- Fire Blanket
- Gas Shut-off Switch
- Goggle Sanitizer
- Chemical Clean-up kit
- Fire Extinguisher
- Broken Glass Container
- Running Water
- Fume Hood






Engineering Controls & Safety Apparatus

- Safety showers and eyewash stations need to be tested (for flow and cleanliness) weekly. These tests must be logged. Do not store stuff here
- Test running water, fume hoods, goggle sanitizing cabinet, and gas shut-off switch before each lab.
- Fire extinguishers need to be checked on a monthly basis and repressurized annually.
- If the school has been closed for an extended period (i.e. summer vacation, Superstorm Sandy, the Pandemic), run the water in your faucets until clear and then for an additional 3-5 minutes to make sure all of the bacteria and dirt is removed from the plumbing systems.



Housekeeping Practices

- Employees are expected to actively engage in prudent laboratory housekeeping practices. In addition to chemical and biological hazards, physical hazards such as trip/slip, fall, and electrical hazards are to be eliminated
- You are responsible

Housekeeping Practices



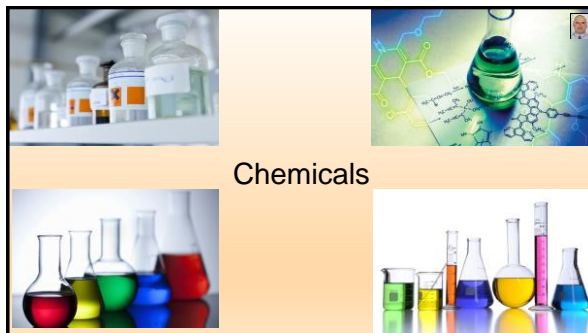
Maintain Proper Signs in Labs

- Goggles Must Be Worn
- Gas Shut-Off
- Evacuation Routes
- Safety Equipment
- Gas Lines must be labeled with CAS #



"Essential Laboratory Safety Signage" – NSTA's August Safety Blog commentary by Chief Safety Blogger Dr. Ken Roy focuses on classification of essential laboratory signage and requirements. Check it out at: <https://www.nsta.org/blog/essential-laboratory-safety-signage>

SOP# 10. Signage!



Chemicals

Ensure that all chemicals have proper labels

- Chemical name must be legible - replace old, stained labels
- All chemicals should be labeled with a **Chemical Abstracts Service** or CAS Number
- Provide hazard information
- Include proper storage information
- Flinn Chemventory can be used to print chemical labels



Know the List of Restricted Chemicals

These are the chemicals that are not allowed on school grounds. Do not purchase them, do not donate them, do not use them.

*These should be Board of Education approved and listed in your district's Chemical Hygiene Plan
Know your district's Chemical Hygiene Plan*

RESTRICTED

Pushback from other teachers:

"I've done this demo a million times and never had an accident."

**Disposal**

Think before you Purchase!!

Once a chemical enters your building, the school district is legally responsible for it FOREVER - even if it is disposed of properly through a waste management company.

Disposal of Chemicals

- Organic material:
 - Do you teach an organic chemistry class?
 - Ask your colleagues if they use a lot of organics (solvents, alcohols, etc.) or if they have substitute activities.
- Inorganic material:
 - Heavy metal solids (e.g. lead(II) iodide)
 - Transition metal cations/precipitates
 - Leftover solid metals
 - pH



Know What to DO!!!

NO!

Disposal

- Storage and removal
- Broken glassware
- Legal ramifications

Never accept donations of chemicals!

**Ensure Proper Storage of Chemicals**

Store Chemicals Properly by Chemical Class - Not Alphabetically

Some problems with alphabetizing chemicals:

- Magnesium and nitric acid - explosive reaction
- Sodium nitrate and sodium thiosulfate - even a dry mixture is explosive
- Hydrogen peroxide and lead(IV) oxide - possible explosive reaction
- Ammonium nitrate and (concentrated) acetic acid - mixture may result in ignition

Proper Storage of Chemicals

1. Need to restrict access to chemicals - only authorized personnel should have access - students should NEVER be allowed in chemical storage areas
2. Chemicals must be stored according to chemical class and proper storage guidelines
3. Science/STEM department should maintain SDS list separate from the rest of school to avoid getting written up for mistakes that other departments make



Acid cabinets

- Jointly storing bases in it is a problem (Ex: Ammonium hydroxide/hydrochloric acid)
- Nitric acid should be isolated from other acids (nitric acid is a strong oxidizer - can react with acetic acid and start a fire)

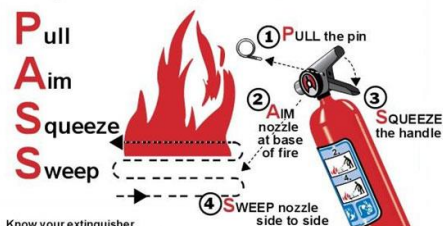


Fire Safety Training

- Must be done once a year if you are expected to use a fire extinguisher. Do not actually have to manipulate the device
- All science/STEM teachers should be trained prior to supervising labs providing BOE allows employees to use extinguishers

| Type | CLASS A Combustible materials (e.g. paper & wood) | CLASS B Flammable liquids (e.g. paint & petrol) | CLASS C Flammable gases (e.g. butane and methane) | CLASS D Flammable metals (e.g. lithium & potassium) | Electrical equipment (e.g. computers & generators) | CLASS F Deep fat fryers (e.g. chip pans) | Comments |
|--------------|---|---|---|---|--|--|--|
| Water | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | Do not use on liquid or electric fires |
| Foam | ✓ | ✓ | ✗ | ✗ | ✗ | ✗ | Not suited to domestic use |
| Dry Powder | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | Can be used safely up to 1000 volts |
| CO2 | ✗ | ✓ | ✗ | ✗ | ✓ | ✗ | Safe on both high and low voltage |
| Wet Chemical | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | Use on extremely high temperatures |

To operate an extinguisher:



Know your extinguisher
Use the correct extinguisher

(Check your own extinguisher's label for detailed instructions.)

Know the Chemical Hygiene Plan for District

- Principal, Science/STEM Dept Supervisor, CHO for each school
- Emergency & Accident procedures - chain of command
- Safety procedures for staff & students
- Maintenance of safety equipment in labs
- Proper Chemical Storage & Handling Procedures
- Restricted Chemical List
- Employee Training Procedures

Safety & PPE



Personal Protective Equipment (PPE)

- Indirectly Vented Chemical Splash goggles shall be worn when handling hazardous chemical liquid materials which have the potential to splash the eyes. Safety glasses with side shields can be worn with physical hazards; e.g. springs, glassware, power and hands tools.



Personal Protective Equipment (PPE)

- Non-latex gloves and aprons or laboratory coat appropriate for the material shall be worn when using chemicals. Consult SDS Section VIII for appropriate PPE use.
- Face shields along with safety goggles, shall be worn when preparing and/or transferring corrosive materials or where there is the possibility of chemical splash.



Demo Safety

- Balance risk vs. reward
- Make sure everyone (students AND teachers) are wearing goggles



Demo/Activity Safety

When attempting a new demo/activity, always research the chemicals and safety procedures for the demo

Practice the demo/activity prior to presenting it in class

You must review all safety protocols with your students prior to the activity, test the students to make sure that they understand the protocols, document the review in your lesson plans, and record the students' assessment results. Do not allow a student to conduct a lab activity who has not demonstrated proficiency on the safety assessment

Methane Bubbles Demo Gone Wrong



Demo Safety

- Always know where the heat sensors in your room are
- Don't allow students to videotape the demo



Lab Safety

- All students must receive safety training every year for every science/STEM class they are taking
- Signed safety agreements must be kept for each student - don't let students do a lab if they haven't returned a signed safety acknowledgement form!
NSTA Safety Portal: <https://www.nsta.org/topics/safety>

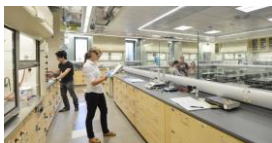


Lab Safety

- Students must be assessed on their safety training - it's not enough just to bring back a signed safety acknowledgement form.
- Teachers - Document all pertinent safety procedures in your lesson plans.
- Administrators - Document safety training/procedures that occurred during an observation of a lab

Lab Safety

- Never leave students alone in the lab
- Never allow students in the chemical storeroom
- Don't leave lab work as sub plans



Lab Safety

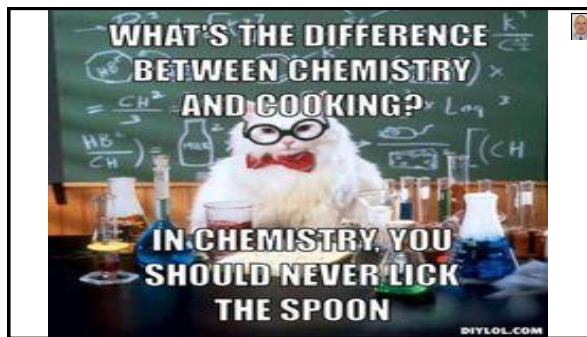
- Always research experiments and chemicals for safety
- Be careful if developing your own lab (Gunpowder Lab)

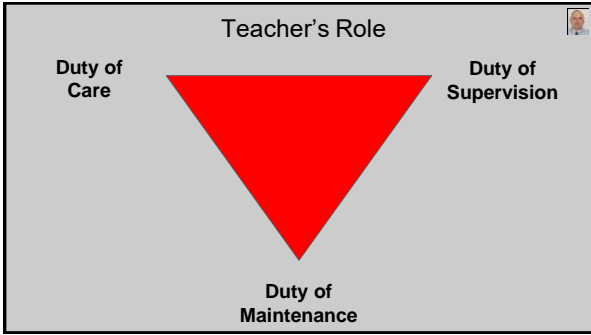


GHS Training

GHS PICTOGRAMS

| | | | | | |
|--|--|---|--|--|--|
| Health Hazard Carcinogens, respiratory sensitizers, reproductive toxicity, target organ toxicity, germ cell mutagens | | Flame Flammable gases, liquids & solids; self-reactives; pyrophorics; | | Exclamation Mark Irritant, dermal sensitizer, acute toxicity (harmful) | |
| Gas Cylinder Compressed gases; liquefied gases; dissolved gases | | Corrosion Skin corrosion; serious eye damage | | Exploding Bomb Explosives, self-reactives, organic peroxides | |
| Flame Over Circle Oxidizers gases, liquids and solids. | | Environment Aquatic toxicity | | Skull & Crossbones Acute toxicity (severe) | |





Duty of Care & Negligence vs. Recklessness

Negligence simply means that someone should have done something and failed to do so. Recklessness is when someone deliberately engages in dangerous behavior fully knowing that it is dangerous and may injure someone or damage property.

Duty of Care

High Duty or Standard of Care For Teaching Science/STEM:

- a. Duty of Instruction – adequate direction prior to activity
- b. Modeling of Safety – adequate “showing” of procedure
- c. Duty to warn – showing possible safety issues

Expectations

- d. Duty of Maintenance – ensuring a safe environment/equipment
- e. Inspection of Safety – ensure safety is being followed
- f. Duty of Supervision (Enforcement of Safety)
- g. Liability of Safety –
Negligence of Safety – conduct falling below a standard of care established by law or profession to protect from unreasonably risk of harm or failure to exercise due care.

If you say it... it never happened!

WRITE IT DOWN!!

**Be Intelligent
Be Vigilant
Use Common Sense**

Your risk is minimal if you exercise common sense and good judgment.

Let's pause for questions
from the audience



QR Code to Presentation Links

