The Laboratory Safety Institute
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SPEAKING OF SAFETY

Making health, safety and the environment an integral and important part of education, work, and life

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HOW TO MAKE YOUR LAB MORE DANGEROUS

In his 2003 biography, billionaire investor Charlie Munger revealed his favorite hack for getting his brain unstuck and finding out-of-the-box solutions: "Turn a situation or problem upside-down. Look at it backward," he said. "Where don't we want to go, and how do you get there?"

Applying Munger's inverted thinking model to lab safety produces an interesting question: How can we make our laboratory as *unsafe* as possible?

Of course, prohibiting protective equipment and encouraging new employees to mix unknown substances over an open flame is a good start, but we can do better than that. To really crank the danger meter into the red zone, we need a culture of danger — a lab where people couldn't care less about anyone's limbs or lives.

Wondering if peroxides have formed in that bottle? Slam it on the bench and find out. Researching a new bloodborne pathogen? Inject it into your nearest colleague and observe the effects.

Following this backwards thinking all the way back, we uncover a grim truth: fundamentally, what may lie at the core of a safety program is how much the people in that lab value life.

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IN THIS ISSUE

Speaking of Safety is published by the Laboratory Safety Institute (LSI). It is written and edited by James A. Kaufman and Connor Michael.

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The Laboratory Safety Institute
192 Worcester Street, Natick, MA 01760-2252
Phone: 1-508-647-1900 Fax: 1-508-647-0062
Email: Info@labsafety.org
http://www.LabSafety.org

Staff

Ana Adams, Institute Operations Manager
Ana@labsafety.org

Pasut Boontaweesakul, Operations Assistant,
pasut@labsafety.org

James A. Kaufman, Ph.D., LSI Founder and President Emeritus, Jim@labsafety.org

Connor Michael, Web & Advertising Manager
Connor@labsafety.org

Rajeev Santhappa, M.D., President
Raj@labsafety.org

Alie Schreck, Marketing and Sales,
Alie@labsafety.org

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HOW MUCH IS A LIFE WORTH?

The question is a thicket full of complex ethical challenges. Some would say life is so immeasurably valuable that the question itself is offensive. On the other hand, some economists contend that by the choices we make (such as accepting hazard pay for certain occupational risks), we unconsciously put a price on our own heads.

The Department of Transportation, the Centers for Disease Control and the Environmental Protection Agency all use an index called the value of a statistical life (VSL) in preparing government reports that shape public policy. Although proponents insist there's a difference between using a statistical index and placing an actual price tag on human life, the VSL clearly has impacts in the real world.

For example, in 1974 the Department of Transportation rejected a regulation to install bars at the rear of semi trailers to prevent passenger vehicles from sliding underneath them in a collision. The reasoning? The cost of installing the bars (almost $2 billion in today's dollars) exceeded the value of the lives it would have saved per year, based on a $1 million per life (the value the department was using at the time). The bars became mandatory in 1998 after the department's VSL had increased to $2.5 million.

Whether officials are looking at speed limits, mine safety rules or pandemic shutdowns, the VSL influences whether a government agency decides the deaths avoided by a particular policy are worth the cost — or not.

Such arbitrary valuation of human life may seem distasteful, especially when the government does it, but we have to admit the decisions we make every day reflect our own view of the value of life. Every time we don't wear a seat belt for a moment, stand on a chair to change a light bulb, or do other things we know are unsafe, we are effectively making a decision that the risk is "worth it" — an expression that implies value.

Interestingly, our willingness to take risks also changes with significant life events. According to a 2020 study by Katja Görlitz and Marcus Tamm, risk aversion significantly increases for both mothers and fathers around the time of their first childbirth.

Are Lab Safety and Productivity at Odds?

"There's this perception that the more safety requirements you put on a laboratory, the lower the research output is going to be," said Alberto Galasso, an economist at the University of Toronto, in the June 8 issue of *Science.*

Galasso wanted to put this perception to the test, but finding data to reliably measure the impact of lab safety requirements proved to be a challenge. The data Galasso and his fellow researchers were seeking finally came from an unexpected source: the tragic death of Sheharbano Sangji at a UCLA lab in 2009. Since the incident triggered massive safety reforms at labs across campus, Galasso only needed to compare the rate of papers published by UCLA wet labs in the years prior to Sangji's death with the rate afterward.

The team found no significant change in publication rates following the incident, suggesting that increased safety requirements do not affect research productivity as some believe. Galasso's research is part of a working paper published by the National Bureau of Economic Research and accepted for publication in *Research Policy*.

In a lab, the value assigned to life, even unconsciously, can influence individual willingness to take risks, and that can affect policies, attitudes, and organizational safety culture. On the low end of

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RADIOACTIVE 'TREASURES' IN THE LAB

The Soviet Union's launch of the earth's first artificial satellite in 1957 sent a shockwave through the U.S. government, and through the science education system. In the rush to produce future nuclear scientists, school labs began introducing activities involving ionizing radiation. Science kits including radioactive "treasures" from this era have been found on the back shelves of science storerooms, cabinets, and closets long after newer science curriculum programs were adopted in the 1980s.

More recently in 2016, a speaker visiting a high school in Salzburg, Austria, happened to bring a Geiger counter to show during his lecture. When the device began reporting extremely high levels of radiation, students had to be evacuated. A rock on display in the classroom turned out to be uranium, and the ensuing investigation unearthed 38 more chunks of radioactive ore in geology collections at 11 different schools in Austria. Last year, another radioactive "treasure" was discovered at a girls' high school in Sydney, Australia.

How do you know if radioactive material is lurking in your lab or chemical storeroom? An initial approach might be having the science teacher secure a Geiger counter and survey all science instructional spaces and associated areas like chemical storerooms.

If levels of radiation are detected by the Geiger counter, it would be prudent to contact a state radiation control officer. Given that there are a number of different radiation exposures even today in school laboratories, it is critical to assess those hazards and resulting health and safety risks, and then take appropriate safety actions.

RADIATION HAZARDS

Exposure to radiation can affect the body internally and externally. Internally, radiation can enter the body by inhalation, skin absorption or ingestion. External exposures are usually effected by X-rays and gamma rays. Radiation can damage the DNA in our cells and lead to cancer.

We are exposed to low doses of radiation in our daily lives through things like cosmic radiation, and even mercury vapor lighting (often found in stadiums and school gyms). As with many other toxins, radiation damage is dose-dependent.

HOW MUCH IS TOO MUCH?

The U.S. Nuclear Regulatory Commission has established base dose limits for exposure to radiation, found in 10 CFR 20. Limits include 5,000 mrem / year for whole body exposure and 30,000 mrem / year for skin of the whole body. Factors that can affect radiation exposure include:

Time

- Limiting or minimizing exposure time reduces the dose
- Exposure to a dose over a long period of time is less harmful than exposure to the same dose all at once

Distance
• The dose of radiation decreases as you move farther away from the source

How much of the body is exposed
• A dose to part of the body causes less harm than a dose to the entire body

Shielding
• Lead, concrete, or water barriers can provide protection from penetrating radiation and reduce or eliminate exposure

Age
• Children and young adults are more sensitive to the effects of radiation

HANDLING OF RADIATION

Safer handling of radiation starts with awareness through signage. A standard radiation caution sign has a yellow background and a black or magenta tri-foil symbol. This signage should be used in all radioactive materials storage areas such as cabinets, refrigerators, etc.

Consider adopting the following suggested protocols at the high school level if activities dealing with radioactive materials are under consideration:

1. To prevent accidental entry of radioactive materials into the body, high standards of cleanliness and good housekeeping must be maintained in all laboratories where radioactive materials are present and/or used.
2. Visitors are not allowed without approval of chemical hygiene officer or school system safety compliance officer.
3. Wash hands and arms thoroughly before handling any object which goes to the mouth, nose, or eyes (e.g. cosmetics, foods). Keep fingernails short and clean.
4. Eating or drinking in laboratories that deal with radioactive materials is unsafe and forbidden. Refrigerators will not be used jointly for foods and radioactive materials.
5. One or more trial runs beforehand with non-radioactive materials are recommended for new procedures and new personnel to test effectiveness of procedures and equipment.
6. Do not work with radioactive materials if there is a break in the skin below the wrist.
7. Always use gloves when handling more than a few hundred counts per minute. Wear protective clothing (lab coats, masks, shoe covers) as needed.
8. Table and bench tops should be of a non-porous, chemical resistant material. Working surfaces should be covered with absorbent paper regardless of the type of surface.
9. When work is completed, each person will clean up his own work area and arrange for disposal or proper storage of all radioactive materials and equipment.
10. Laboratories should provide special radioactive waste containers. These should bear the words "Caution, Radioactive Waste," and a warning to janitors against handling.

Radioactive sources used in high school science laboratories should be mounted in sealed discs. These discs must never be breached or damaged. If this does happen, they must be disposed of properly per state regulations. For relatively safe use by students, the activity should be rated at 1.0 µCi or less. Because these sources are low, they are license exempt by the U.S. Nuclear Regulatory Commission (also for licensing by states).

One final note: Although materials by regulation can be in non-sealed sources, it is inappropriate for high school level use, given the opportunity for contamination and exposure.

Idaho State University's Radiation Safety Manual is a great resource for all aspects of laboratory use of radiative sources.

SAFETY COUNTS!

If your science curriculum calls for investigations into radiation, it would be prudent to secure radiation sources designed for student or instructor use from a commercial science supplier. Alternative computer simulation programs are also available and worthy of consideration.

The bottom line is before initiating any activities or demonstrations using radioactive sources, be sure to conduct a potential hazards assessment and resulting health and safety risk analysis to determine what safety actions are required for a safer teaching and learning experience.

Ken Roy, Ph.D. is a past board chair of the Laboratory Safety Institute and a regular contributor with this column, "Safer Science: Be Protected!" He is also Director of Environmental Health & Safety for Glastonbury (CT) Public Schools, Chief Science Safety Compliance Adviser for NSTA and Safety Compliance Officer for NSELA. He can be reached on Twitter at drroysafersci.

THE HAZARD OF RISK ACCEPTANCE

By Howard Spencer

Risk is a part of life. In fact, it is risk that may be the source of enjoyment for our beloved leisure activities. Wikipedia defines risk as the potential of gaining or losing something of value. An example may be the thrill of the wind in your face versus the chance of crashing your motorcycle. Risk is also a consequence of action taken regardless of uncertainty.

Every day we make evaluations of risk. Ideally those decisions should be based on good, corroborated data. Sometimes, experience clouds our assessment of risk. (It hasn't happened yet, so it won't happen.)

For example, if you choose to stand on the top of a step ladder, one hazard is known — a possible fall and chance of serious injury. However, personal or environmental factors may be less understood — a windy day, working on a live electric fixture, fatigue.

Many times our past good luck in escaping from undesirable consequences lulls us into complacency that accidents only happen to the other guy. We are too smart or have reflexes too quick to ever fall prey to things that ensnare our less capable co-workers. The bottom line is we accept the risk associated with our "short-cut" method.

On the other hand, others do not know the likelihood of undesirable consequences — or their life-changing severity. To those folks I plead, heed the warnings offered by manufacturers, safety experts, and those unfortunate victims of similarly misguided thoughts. A second can change your life! Every regulation is "written in the blood" of the people whose risk-accepting decisions led to at-risk behaviors that led to unintended consequences and in some cases disfiguring injuries and even fatalities.

"Stinking thinking" beguiles us with the siren song and disillusionment that we will continue to escape the inevitable consequence of conducting at-risk behaviors. If we engage in questionable behavior repeatedly, we will get the bad outcome eventually. It is just a matter of when. Statistics show that with all games of chance, no one wins every time. Risk acceptance is taking a bet against yourself and hoping that you will beat the odds. That is a risk it is unwise to gamble on. Follow the best practices and avoid betting your life on an outcome fraught with uncertainty!

Howard W. Spencer, MS, CSP, CHCM, CPSI has worked for J.A. Montgomery Risk Control since March 2006. He is the senior risk control consultant for 25 New Jersey municipalities and 20 utility authorities.

MAKE YOUR OWN LAB SAFETY COURSE

With the bewildering array of regulations and the sheer number of things that could go tragically wrong, lab safety is a heavy responsibility — a responsibility inherited suddenly with little training at times.

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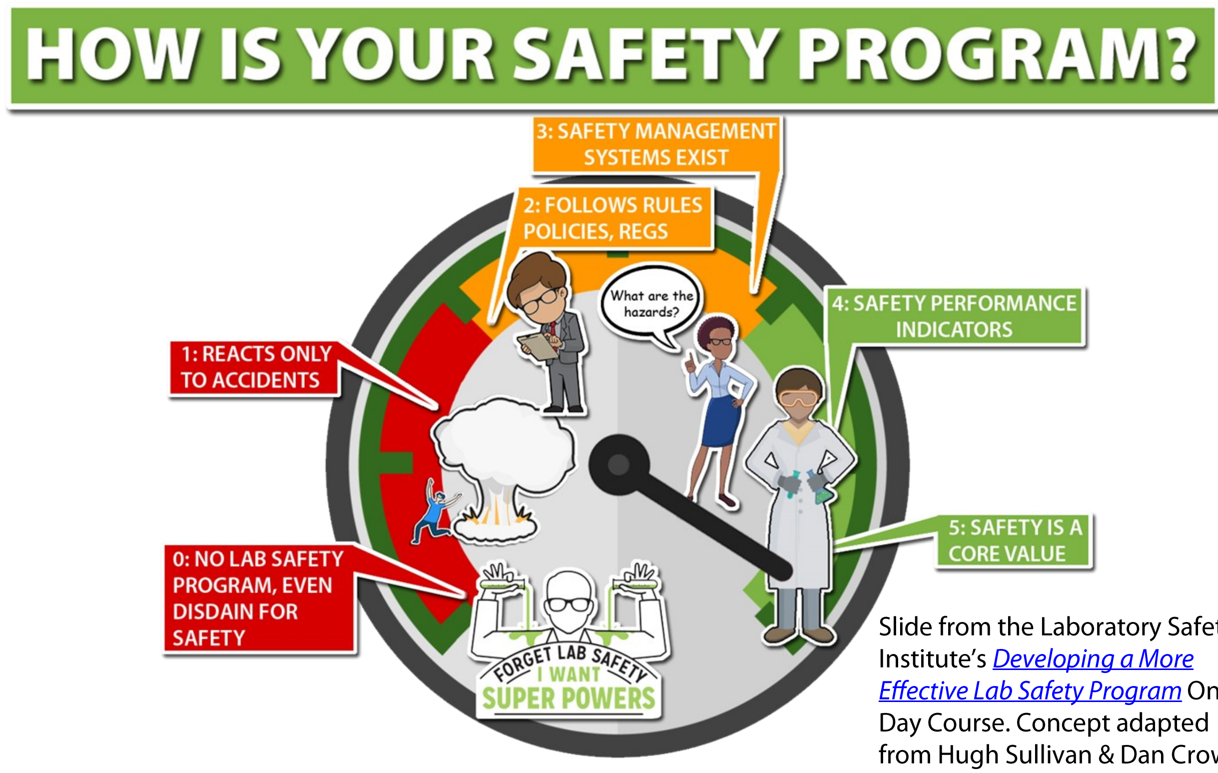


Slide from the Laboratory Safety Institute's *Developing a More Effective Lab Safety Program* One-Day Course. Concept adapted from Hugh Sullivan & Dan Crowl.

the spectrum, there is no safety program — even an outspoken disdain for safety. Safety may be seen as a waste of time, or as an impediment to productivity. (See box, page 3.)

Further along the spectrum, some organizations' safety culture focuses almost exclusively on the strict observance of rules and regulations. Employees may dutifully perform the required hazard analyses, but little more. While this is better than nothing, it does not meaningfully reflect a high value being placed on human life.

On the high end of the spectrum, there is an evident and active concern over the lives of everyone in the lab. If a serious safety violation occurs, the entire operation is immediately shuttered until the safety issues have been identified and corrected. Safety is a core value that permeates all aspects of employees' lives, including in the car and at home.

Whether human life is considered immeasurably valuable, or appraised at a mere $11.3 million (the Environmental Protection Agency's current mean VSL), considering each human life as essential and irreplaceable will necessarily affect the actions we take in the lab.

Think of it this way: a $100 piece of artwork may get thrown in the trunk with the groceries, but a $10 million piece of art would be stored in a climate-controlled container and transported with the greatest care. If human beings are worth at least that much, they should be treated accordingly.

Truly embracing safety at this level results in a culture in which each employee feels personally valued and protected. When each person clearly understands that coming home safely each night is immensely more important than the job itself, this has far-ranging effects on productivity, satisfaction and retention.

LABORATORY SAFETY GUIDELINE 10:

Schedule Regular Departmental Safety Meetings

Safety meetings are an integral part of a good safety program. You need to have a time when you and your colleagues can get together and focus on safety issues. Meetings that come as a follow-up on a regular safety inspection also provide a good basis for discussion of problems and needs.

Safety meetings provide an opportunity for employees and students to share their experiences, lessons learned, and best practices. By encouraging open dialogue, you can tap into the collective wisdom of your team and identify innovative solutions.

Interns, undergraduate and graduate students can especially benefit from participating in these discussions. It's an opportunity for them to become more familiar with safety problems and see that the organization is concerned about these issues. They often bring a fresh perspective because no one has been telling them for years that it can't be done, it's never happened before, it won't happen here, and it's not in the budget.

Safety meetings also provide an opportunity to reinforce safety training. Regular reminders ensure that safety practices become ingrained in daily routines and help prevent complacency.

Is a whole meeting too much for you to swallow? How about having safety as a regular agenda item on your normal department meeting? Set aside 10-15 minutes for a safety topic. Ask a member of the department to pick a safety topic related to his or her particular interests and present a five-minute review for the benefit of the rest of the group.

Use one of the whiteboard animations or safety videos at LabSafety.org/lab-safety-videos as part of your meeting.

By investing time and resources into regular safety meetings, you demonstrate a genuine commitment to the well-being of your colleagues and create a safer work environment for everyone. Remember, safety is an ongoing effort that requires active participation from everyone.

Jim Kaufman originally wrote Laboratory Safety Guidelines while he worked for the Dow Chemical company to share with schools, colleges and universities industry-tested lab safety principles.

Since then, Dow (1986), Fisher Science Education (1989), Carolina Biological Supply (1994), Fisher Safety (2012), Workrite (2017) and SCAT-Europe (2019) have produced co-branded editions of the guidelines in various poster formats. These guidelines have been translated into 22 languages, plus English Braille!

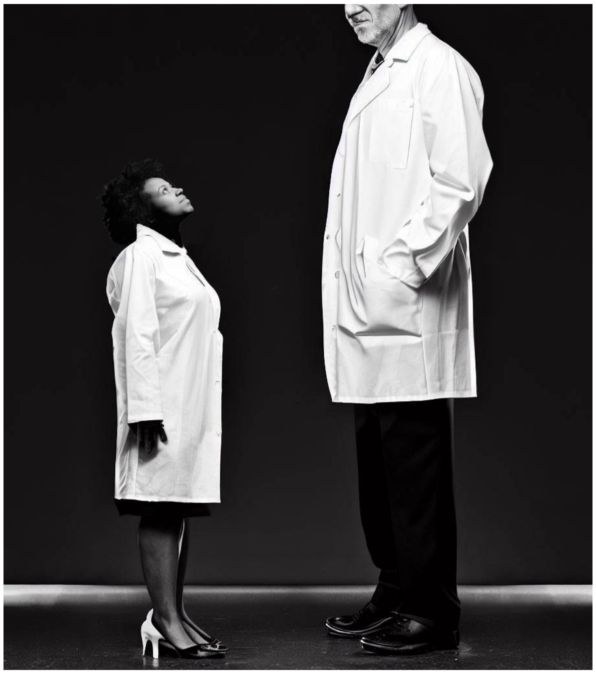
In each issue of *Speaking of Safety*, we publish an article expounding on one of the guidelines. The entire collection of revised and expanded guidelines is available in a 50-page booklet on labsafety.org.

Chemical Hygiene Plan

Wellness Check

Upload your chemical hygiene plan at labsafety.org/chp-help and we will send it back with our first 10 suggestions for making it even better.

Loose Threads



What Do You Mean 'Eye Level'?

"Store chemical containers below eye level." "Place directional signs at eye level." "Fix laser beams above or below eye level." Hundreds of safety regulations reference eye level, but what exactly does the term mean? We all think we know, but a standard definition is difficult to pin down.

Jessica Martin, Ph.D., a Laboratory Safety Institute board member, experienced the challenges of working in a lab that is arranged for someone else's eye level personally when she was in college. "I worked with a PI who was about 5 feet 5 inches in height. I am 5 feet 3 inches in height. Since he set the standard about what was 'eye level' in our lab, we actually had quite a bit of shelving we did not use at all because it was too high," she relates. "I really missed this lab after I moved on to my graduate school lab since the two men who set up my grad school lab were both over six feet tall!"

Architectural handbooks and standards manuals offer average eye height measurements based on population studies (see box), but averages vary by region, age, and sex, and different standards do not always agree with each other or with local building and fire codes. For Americans with Disabilities Act applications, "eye level" means 43-51 inches for someone sitting in a wheelchair.

What can be done when not everyone in the lab sees eye-to-eye about eye level? First, make sure you understand clearly the reason behind the rule and why it is important. For example, if policy requires chemicals to be stored below eye level, what could happen if they are not?

Second, create a solution that will protect the people actually using the lab. Among individuals who will access chemicals, what is the lowest eye height? Place containers below that level. Simple as that.

— Jim Kaufman, Ph.D. (six feet and shrinking)

These questions, answers, and comments are taken from the Laboratory Safety Institute's mail, email, phone calls, and internet discussion list.

Source	Male Standing Eye Height (in / mm) 95 Percentile	Female Standing Eye Height (in / mm) 95 Percentile
Architectural Graphic Standards (US)	65.4 / 1660	61.4 / 1560
ASTM F1166 (US)	69.2 / 1758	64.1 / 1628
BIFMA Ergonomics Guidelines (US)	61.4-69.8 / 1560-1773	56.9-65.0 / 1445 -1651
Human Dimension & Interior Space (US) (Referenced by NIOSH)	68.6 / 1742	64.1 / 1628
Metric Handbook: Planning & Design Data (UK)	68.7 / 1745	63.4 / 1610
DIN (Deutsches Institut für Normung) 33402-2 (Germany)	68.3 / 1735	63.2 / 1605
NOTE: Measurements do not include footwear. *Human Dimension & Interior Space* recommends adding one inch for shoes.		

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