



Council of State Science Supervisors

CSSS HIGH SCHOOL CTE SAFETY REFERENCE MANUAL

Council of State Science Supervisors

**Safer Practices for Career and Technical Education
(Grades 9–12)**

CTE Career Clusters covered include: Agriculture; Food; Natural Resources; Architecture & Construction; Engineering; Health Science; Manufacturing; STEM; Transportation; Distribution & Logistics

A nationally aligned safety manual supporting professional judgment, risk reduction, and safer hands-on instruction in U.S. high school CTE programs

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In Partnership With

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This manual was created to support rigorous, inquiry-based CTE instruction while aligning with applicable legal safety standards and accepted professional practices in secondary instructional settings. It reflects contributions from educators, safety professionals, and organizational partners who work daily to make school CTE safer and more effective.

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About CSSS

The Council of State Science Supervisors is a national organization made up of the people who oversee science education at the state level. Its members are responsible for guiding how science is taught across K–12 systems, from setting policy and supporting standards implementation to shaping professional learning and statewide initiatives.

CSSS provides a space for states to learn from one another, share emerging challenges, and exchange practical solutions grounded in classroom reality. Through collaboration, research-informed guidance, and partnerships with national organizations, CSSS helps states strengthen science, STEM, and CTE education so that it remains rigorous, inclusive, and connected to real-world learning, while supporting educators in meeting their professional responsibilities, including student safety.

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EXECUTIVE SUMMARY

Hands-on Career and Technical Education (CTE) instruction prepares students for real work in real environments, but it also introduces predictable hazards. The purpose of this manual is not to restrict authentic learning. It is to ensure that hands-on learning occurs under conditions that protect students, educators, and institutions.

The CSSS High School CTE Safety Reference Manual provides clear, standards-aligned guidance for safer instruction across major CTE Career Clusters, including: Agriculture; Food; Natural Resources; Architecture & Construction; Health Science; Manufacturing; STEM; Transportation; Distribution & Logistics. It reflects the professional reality that safety failures rarely occur because educators do not care.

They occur when hazards and corresponding risks are not identified early, when responsibility is unclear, when supervision is compromised, or when conditions change without instructional decisions changing with them.

This manual emphasizes that CTE safety is a form of professional practice. It integrates recognized legal safety standards and accepted professional practices as benchmarks for reasonable care in secondary CTE environments. It also recognizes that state and district requirements vary and must be applied alongside this guidance.

Key themes include:

- ▶ CTE as an industrial learning environment with employer-level duty of care
- ▶ Legal foreseeability of risk and the expectation of documented controls
- ▶ Regulatory and professional standards as the baseline for defensible practice
- ▶ Facility design, occupancy limits, ventilation, and shutoffs as frontline controls
- ▶ Machine guarding, authorization systems, and maintenance as core prevention strategies
- ▶ Chemical, biological, and environmental hazard management across CTE Career Clusters and Sub-clusters
- ▶ PPE selection and enforcement based on hazard, not preference
- ▶ Emergency preparedness, incident reporting, and corrective action as professional obligations
- ▶ Training, documentation, and continuous improvement as the foundation of program credibility
- ▶ Manufacturer instructions as the most specific, tool-level safety standard for daily practice

This manual is written for educators and leaders who understand that safety is not a checklist.



I CTE SAFETY FOUNDATIONS

CTE safety must be managed at the same level as industry safety, because the risks are the same.

— James Palcik, CHO, Safer STEM

Career and Technical Education (CTE) programs offer industry-aligned learning environments that may not always appear like traditional classrooms. These spaces routinely contain powered equipment, hazardous materials, vehicles, electrical systems, biological agents, live animals, and active processes. The potential hazards and resulting risks are real, predictable, and well documented (OSHA; NIOSH). Like most STEM programs, there are inherent hazards and risks associated with having a hands-on, technical, and engineering course that incorporates design challenges, tools, machinery, and other potential safety hazards and resulting risks.

CTE safety cannot be managed casually or informally. It must be addressed deliberately, systematically, and at an employer level of responsibility. Students are learners, not employees; however, courts, investigators, and families evaluate injuries based on the hazards and the safety risks present, not the intent of instruction (OSHA). Remember that students are considered ‘employees’ by extension and are provided with the necessary CTE safety items including PPE that you would provide to an employee conducting work.

A safer CTE program is not measured by luck or by the absence of reported injuries. It is measured by whether hazards were anticipated, acceptable controls were in place, supervision was appropriate, and recognized legal safety standards were followed (ITEEA, ACTE, NCCER NFPA, NSTA).

1.1 Purpose, Scope, and Legal Context

The Council of State Science Supervisors High School CTE Safety Reference Manual establishes a nationally aligned, legally defensible framework for safer CTE instruction. It defines minimum professional expectations for teachers, administrators, and state science supervisors responsible for student safety in high-risk instructional environments (CSSS). CTE programs are these STEM instructional spaces and must be treated as such for the safety of all stakeholders in the students' forward progression towards post-secondary and the workplace.

This CSSS safety reference CTE manual exists to prevent foreseeable injuries, not to justify practices after an incident. It is to be used in conjunction with the local safety manuals, safer procedures, and established and approved CTE activities used in each school district.

Scope

This guidance applies to all secondary CTE Career Clusters and SubClusters, including but not limited to:

- ▶ Manufacturing and Industrial Technology
- ▶ Architecture & Construction
- ▶ Transportation, Distribution & Logistics
- ▶ Health Sciences and Biomedical
- ▶ Information Technology and Networking
- ▶ Agriculture, Food, and Natural Resources
- ▶ STEM

Legal and Regulatory Context

Students are not employees, yet they are considered occupants of the CTE lab and provided safety protections under the law. However, when injuries occur, school-based CTE programs are routinely evaluated against recognized industry and legal safety standards. The potential absence of direct OSHA enforcement authority in K–12 settings does not eliminate potential liability from the school district, school administrator, or CTE educator (OSHA).

Relevant authorities include:

- ▶ OSHA
- ▶ NIOSH
- ▶ NFPA
- ▶ ASHRAE & AIHA
- ▶ ANSI/ISEA
- ▶ State and local building, fire, and health codes
- ▶ Established professional standards (ACTE)
- ▶ High Quality CTE Framework, NCCER, NSTA, ACS, AAPT, ACTE, ITEEA-STEL)

Failure to align instruction with recognized standards is routinely cited as evidence of negligence.

If a standard exists and you ignore it, that choice will be used against you legally.

Instructional Context

- ▶ **Manufacturing:** Machine guarding; lockout/tagout awareness
- ▶ **Construction:** Fall protection; tool and material handling
- ▶ **Automotive:** Vehicle lifts; compressed air and coil systems; fuels
- ▶ **Health Sciences:** Bloodborne pathogens; sharps; microorganisms
- ▶ **IT:** Electrical safety; ergonomics; ESD controls (electrostatic discharge)
- ▶ **Agriculture:** Equipment operation; animals; chemicals; pesticides; vehicles

Annex A explains the role of consensus standards in defining professional Career and Technical Education practice, with a focus on how NFPA and ANSI/ISEA standards establish expectations for hazard and risk control, equipment use, facility design, and duty of care in CTE instructional environments.

Figure 1

This figure illustrates how regulatory agencies and professional organizations collectively shape safety expectations in CTE programs.

It helps teachers recognize that safer instruction is grounded in aligning classroom practice with established industry standards.



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1.2 CTE as an Industrial Learning Environment

High school CTE facilities must be managed as industry aligned instructional spaces, not modified classrooms. Industry-grade tools, equipment, and processes require formal hazard analysis, risk assessment, layered controls, and enforced operating procedures (OSHA; NIOSH).

CTE teachers function as worksite supervisors. Student age, enthusiasm, or inexperience does not reduce hazard severity or professional responsibility. Remember that most students are having their first experience with tools, machinery and other materials in the CTE program and it is the responsibility of the teacher to provide appropriate safety training and consistently modeling and enforcing safer behaviors benefit of the class.

What This Means for High School CTE

Safer CTE environments require:

- ▶ Documented hazard analysis and risk assessment for each lab, shop, or work area
- ▶ Written standard operating procedures (SOPs) for tools and equipment
- ▶ Supervision ratios adjusted for task-specific
- ▶ Restricted access to high-risk equipment and storage areas
- ▶ Clear separation between instruction, setup, and operation
- ▶ Enforced start-up and shut-down procedures and clean up expectations

Hands-on instruction does not justify uncontrolled exposure. Access is earned through training, supervision, and demonstrated readiness. CTE participation is competency-based through demonstrated readiness, and consistent application of safer practices. This is an access course, meaning that students must be accountable for their actions and use of safer strategies.

If industry requires training, authorization, and PPE, so does the CTE course at school.

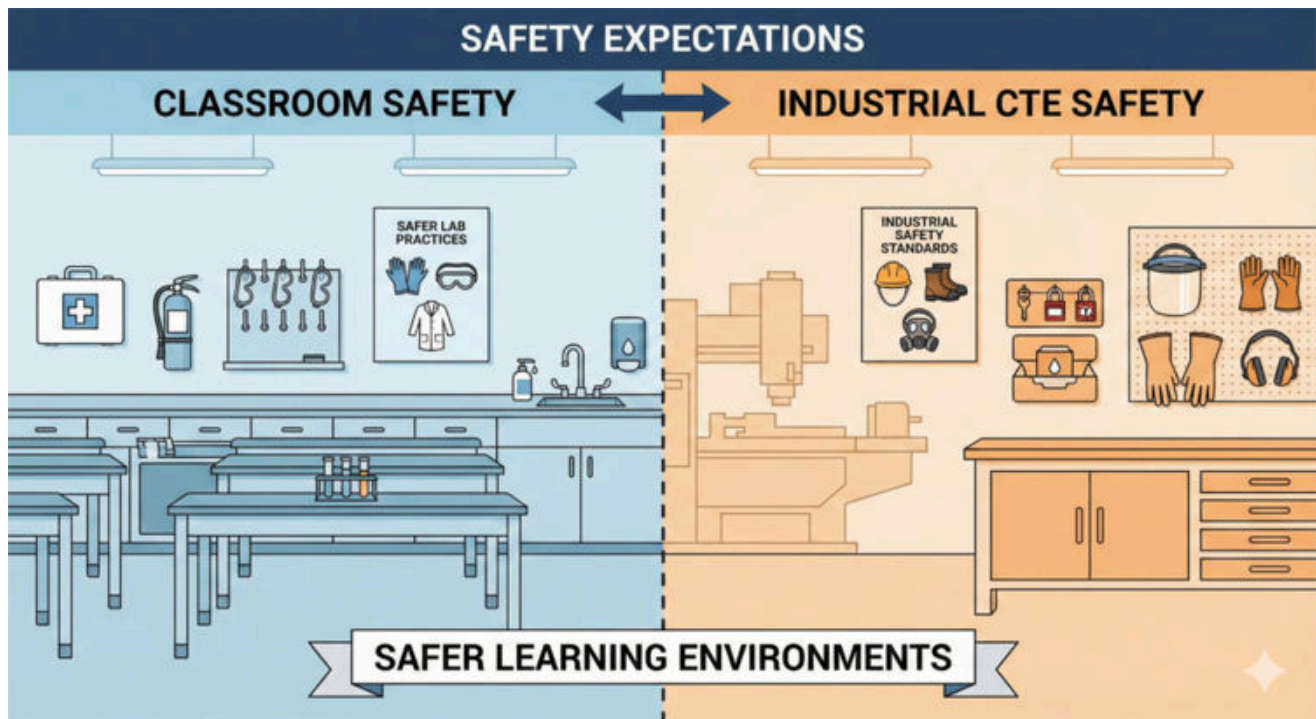
Instructional Context

- ▶ **Manufacturing:** CNC machines; mills; lathes; robotics
- ▶ **Construction:** Power saws; scaffolding; pneumatic tools
- ▶ **Automotive:** Vehicle lifts; engines; 12V battery systems
- ▶ **Health Sciences:** Simulation labs; medical devices
- ▶ **IT:** Server racks; wiring; ESD controls
- ▶ **Agriculture:** Tractors; livestock facilities; pesticides
- ▶ **Engineering:** Design / construction / testing / modification; using tools and materials

Figure 2

Supporting Students with Additional Needs in CTE: A Duty-of-Care Extension

In high school CTE environments, employer-level duty of care must explicitly include students with additional needs. This aligns with the Universal Design for Learning (UDL) framework to account for student variability and anticipate additional needs. This elevated focus includes learners identified through an Individualized Education Program (IEP), Section 504 Plan, or a formally documented medical condition. Legal obligations under the Individuals with Disabilities Education Act (IDEA) and the Americans with Disabilities Act (ADA) require that these students are provided equitable and safer access to instructional experiences, including those involving tools, equipment, and hazardous materials in CTE (U.S. Department of Education, 2020; ADA National Network, 2023).



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| 1.3 Employer-Level Duty of Care

School districts operating CTE programs assume an employer-level duty of care. This duty includes anticipating potential hazards and resulting safety risks, providing training and protective equipment, enforcing safety rules, and correcting observed unsafe conditions before injuries occur (OSHA; NIOSH).

Courts do not accept “students should have known better.” Responsibility rests with the adults and the safety systems they operate.

Key Elements of Duty of Care in CTE

Effective duty-of-care systems include:

- ▶ Facilities designed and maintained for intended hazards
- ▶ Accessible engineering controls like eyewash stations and spray booths
- ▶ Equipment continuously inspected, maintained, and removed from service when unsafe
- ▶ Documented ongoing safety training for teachers and students
- ▶ Consistent enforcement of CTE safety rules
- ▶ Immediate response to injuries and near-misses in the instructional space(s)
- ▶ Ongoing program review and corrective action documented

Predictable injuries result from unmanaged hazards and risks, not bad luck.

Most incidents are foreseeable. Prevention is a professional obligation.

Instructional Context

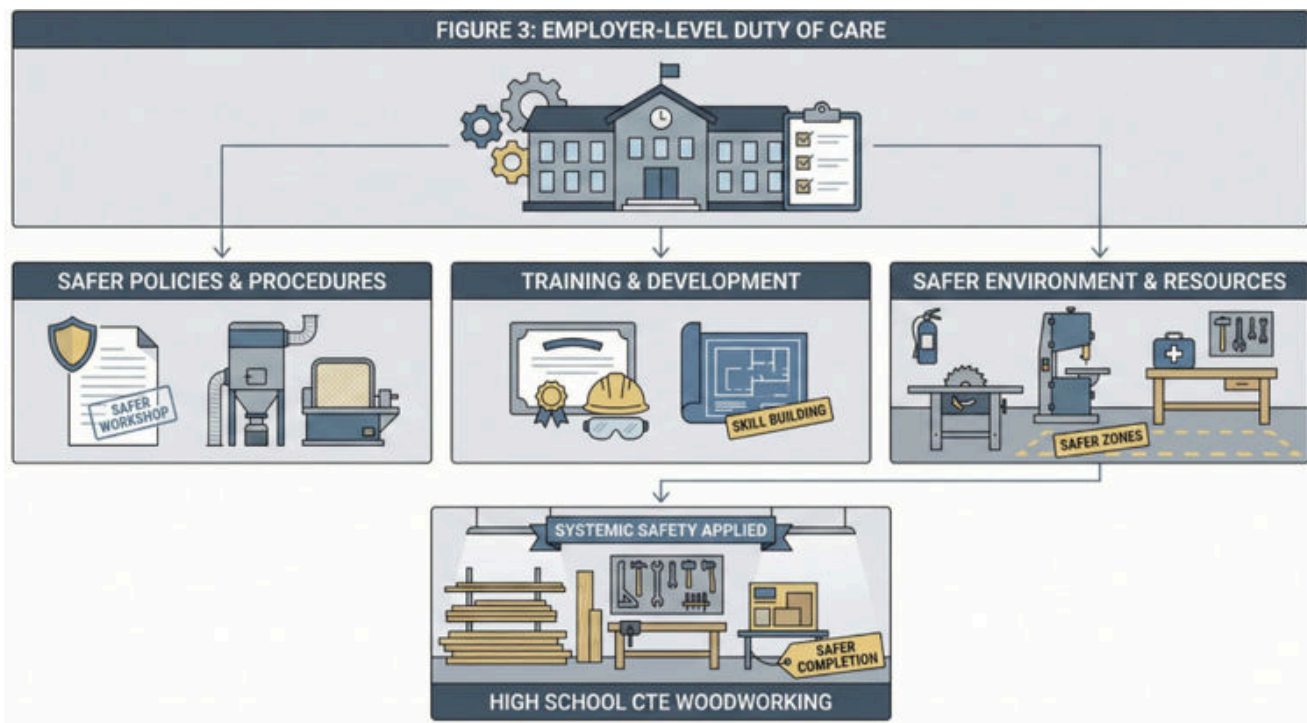
- ▶ Manufacturing: Machine authorization; energy-control awareness
- ▶ Construction: Jobsite safety briefings; hazard communication
- ▶ **Automotive:** Vehicle movement and lift protocols
- ▶ **Health Sciences:** Infection control systems
- ▶ **IT:** Electrical lockout; cable management
- ▶ **Agriculture:** Controlled access to equipment, crops and animals

Instructors must maintain active, continuous visual supervision during all hands-on CTE activities, particularly when students are using tools, machinery, or hazardous materials.

CTE programs are often described as classrooms with better tools. In practice, they function more like small industrial sites nested inside schools. In practice, they reflect instructional spaces that aim to mimic what students will encounter in the workplace. When we focus primarily on engagement and workforce alignment, we can overlook a central truth: the potential hazards and corresponding safety risks do not scale down just because the learners are adolescents. Calling it instruction does not reduce duty and standard of care any more than calling a factory a workshop reduces its risks.

Figure 3

This figure shows how schools assume an employer-level duty and standard of care when operating CTE programs. It helps educators understand that supervision, training, and hazard control must meet professional expectations, not informal classroom norms.



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Closing Note from the Safety Desk

Equitable access in CTE is achieved through safety, not in spite of it. Students with additional needs must be provided structured, supported pathways to participate in high-skill, hands-on learning environments. This may require adjustments to equipment, instructional pacing, supervision, or facility design, but these are not compromises. They are indicators of a professionally managed program. When safety systems are inclusive by design, they do more than prevent injury. They expand opportunity.

II REGULATORY & COMPLIANCE FRAMEWORK

Compliance is not about paperwork. It is about preventing foreseeable harm.
— James Palcik, CHO, Safer STEM

CTE programs operating in school settings should align with applicable OSHA frameworks, including 29 CFR 1910 Subpart I (Personal Protective Equipment), 29 CFR 1910.1200 (Hazard Communication), and, where applicable, 29 CFR 1910.1450 (Laboratory Standard).

As a result, regulatory standards developed for industry are routinely used to define reasonable practice, due diligence, and negligence in school-based CTE programs, including OSHA 29 CFR 1910 Subpart I (Personal Protective Equipment), 29 CFR 1910.1200 (Hazard Communication), and, where applicable, 29 CFR 1910.1450 (Laboratory Standard) and the associated NFPA fire safety standards.



2.1 OSHA Standards as the Safety Baseline

OSHA standards (or state equivalents) establish the nationally recognized baseline for occupational safety and health. Although OSHA does not directly regulate students, its standards are consistently referenced in investigations, litigation, and expert testimony involving CTE injuries (OSHA).

Students are considered employees by extension and must be provided the same safety items and access as employees while in a CTE program in a school.

CTE programs that ignore OSHA standards do so at significant professional and legal risk.

Implications for High School CTE

OSHA standards inform:

- ▶ Machine guarding and safer equipment operation
- ▶ Electrical safety and energy-control awareness
- ▶ Hazard communication and chemical management
- ▶ PPE selection, use, and enforcement
- ▶ Bloodborne pathogen and microorganism controls in health science programs

When a hazard is present in a CTE lab, the corresponding OSHA standard defines what “reasonable protection” looks like, and it must mirror this expectation at a minimum before any work or activities are carried out in the CTE instructional space.



If OSHA would require it in industry, you must justify not requiring it in CTE.

Program-Specific Context

- ▶ **Manufacturing:** 29 CFR 1910 Subpart O (Machinery and Machine Guarding)
- ▶ **Construction:** Tool and fall-hazard principles drawn from 29 CFR 1926
- ▶ **Automotive:** Electrical, chemical, and compressed-system hazards and risks
- ▶ **Health Sciences:** 29 CFR 1910.1030 (Bloodborne Pathogens)
- ▶ **IT:** Electrical and ergonomic standards
- ▶ **Agriculture:** 29 CFR 1910.1200 Equipment and chemical / pesticide exposure guidance

Figure 4

This visual connects OSHA standards directly to CTE instructional practices across program areas. It supports teachers in identifying which regulations inform safer procedures, equipment use, and student protection.



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2.2 NFPA Codes and Life Safety Requirements

NFPA codes address fire prevention, life safety, overcrowding, electrical systems, and hazardous materials storage. These codes apply directly to CTE facilities and define minimum conditions for occupancy and emergency response (NFPA).

NFPA standards are enforceable through state and local fire codes and are routinely cited following school-based incidents.

Implications for High School CTE

NFPA guidance informs:

- ▶ Egress, exit access, and occupancy load limits
- ▶ Electrical systems and equipment placement
- ▶ Flammable and combustible material storage
- ▶ Fire extinguisher selection and placement
- ▶ Hot work and ignition source control
- ▶ Conducting a hazard analysis and risk assessment prior to instruction

Life safety requirements apply every day, not just during inspections.

NFPA 101 Occupancy Load states that in CTE instructional spaces, there must be 50 NET Square Feet / Person. This is arrived at by calculating the area of the room and subtracting the Furniture, Fixtures, and Equipment, and then dividing that number by 50 to determine the legal maximum number of people allowed.

(Area-FFE=Net Sq. Ft / 50 = total occupants)

If an exit is blocked or a system is nonfunctional, instruction stops.

Program-Specific Context

- ▶ **Manufacturing:** Electrical and hot-work considerations
- ▶ **Construction:** Temporary structures and material storage / sawdust combustion
- ▶ **Automotive:** Fuel systems and ignition sources
- ▶ **Health Sciences:** Emergency power and alarm systems
- ▶ **IT:** Server rooms and electrical load management
- ▶ **Agriculture:** Fuel, grain dust, pesticides, and equipment hazards

Annex B clarifies when hands-on instructional activities in CTE cross into OSHA Construction (29 CFR 1926) coverage, and when General Industry (29 CFR 1910) remains the correct benchmark. It helps educators match safer practices to the work being simulated, especially for structural work, height exposure, demolition, masonry, and electrical installation.

Maximum allowable quantities of flammable liquids must not be exceeded. Fire extinguishers must be inspected monthly and serviced annually. Open flames must not be used beneath active sprinkler systems. Different clearance heights exist based on distance from the ceilings for locations with installed fire suppression systems including sprinkler systems and those that do not have these installed. (NFPA)

| 2.3 EPA and Environmental Compliance

CTE programs generate waste streams that may be regulated under environmental law. Improper disposal procedures expose districts to potential fines, cleanup costs, and potential liability (EPA).

Environmental compliance is a safety issue, not just a facilities concern.

Implications for High School CTE

EPA guidance affects:

- ▶ Chemical waste handling, neutralization and disposal
- ▶ Used oil, batteries, and solvents handling and storage concerns
- ▶ Agricultural chemicals and fertilizers
- ▶ Air quality and emissions from equipment and vehicles
- ▶ Spill prevention and reporting documentation

If you do not know how to dispose of it, you should not be using it.

Program-Specific Context

- ▶ **Automotive:** Oils, fuels, and 12V batteries
- ▶ **Manufacturing:** Solvents and metal residues
- ▶ **Health Sciences:** Biohazardous waste
- ▶ **Agriculture:** Pesticides and fertilizers
- ▶ **IT:** Electronic waste

CTE teachers must follow district-approved disposal procedures and never improvise. CTE instructors must always be aligned with federal and state level pollution-control regulations and adhere to the municipal / county waste management protocols enforced for environmental protections.

Figure 5

This figure categorizes the types of waste generated in CTE settings, including chemical, biological, and mechanical sources. It helps teachers plan for proper handling, storage, and disposal to reduce environmental and safety risks.



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2.4 Professional and Programmatic Standards

Professional organizations establish expectations that define quality, safety, and alignment with workforce practice. These standards are frequently referenced to evaluate program credibility and safety culture in Career and Technical Education (ACTE; NASDTEC).

Implications for High School CTE

Professional guidance supports:

- ▶ Alignment with workforce expectations without transferring workforce risk
- ▶ Clear documentation of training and authorization
- ▶ Integration of safety into curriculum and assessment
- ▶ Program review and continuous improvement plans
- ▶ Earning industry recognized credentials (IRCs) such as OSHA 10 certification, which are recognized by industry where students demonstrate a certain level of competency on par with industry expectations.

Alignment without documentation is exposure.

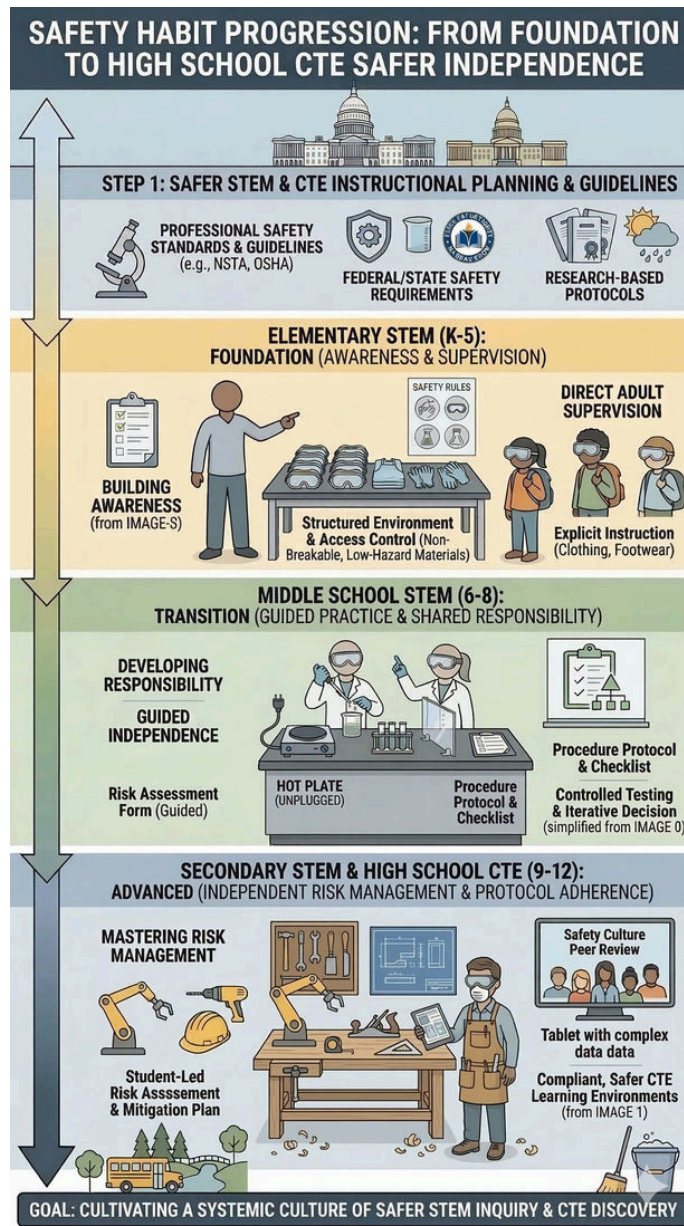
If it cannot be defended on paper, it cannot be defended after an incident.

Program-Specific Context

- ▶ **Manufacturing:** Industry certification safety requirements
- ▶ **Construction:** Trade safety competencies
- ▶ **Automotive:** ASE-aligned safety practices
- ▶ **Health Sciences:** Clinical safety protocols
- ▶ **IT:** Industry electrical and data-center norms
- ▶ **Agriculture:** Equipment and chemical safety standards

Figure 6

This illustration demonstrates how multiple safety frameworks align to define acceptable professional practice in CTE. It reinforces that consistency across standards strengthens both safety outcomes and legal defensibility.



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2.5 Understanding the Globally Harmonized System (GHS) for Chemical Safety

The Globally Harmonized System of Classification and Labeling of Chemicals (GHS) is an internationally adopted framework developed by the United Nations to ensure that chemical hazards are classified consistently and communicated clearly.

GHS establishes a shared structure for chemical labels and Safety Data Sheets (SDS), allowing potential hazards and corresponding chemical risks to be recognized and understood regardless of location, industry, or instructional setting (UNECE).

In secondary science and CTE instructional spaces, GHS serves as the foundation of chemical hazard communication. It supports informed professional judgment by educators and enables students to recognize, interpret, and respond appropriately to chemical hazards encountered during instruction. GHS is not an abstract regulatory concept. It is the system students encounter on compliant chemical containers, secondary labels, and SDS used in school laboratories (OSHA).

Implications for High School CTE Courses

When hazardous chemicals are present, educators are responsible for ensuring that hazards are clearly identified, communicated, and addressed before instruction begins. GHS provides the standardized language and symbols that make this possible.

Most industry onboarding safety programs include explicit GHS training. Introducing these concepts in high school science and CTE courses strengthens continuity between instructional practice and professional laboratory environments (OSHA; NSTA).

Effective application of GHS in secondary science laboratories supports:

- ▶ Consistent interpretation of chemical hazards and resulting risks
- ▶ Safer handling, storage, and disposal practices
- ▶ Alignment with the OSHA Hazard Communication Standard
- ▶ Preparation for postsecondary laboratories and workforce safety expectations

If students cannot identify the hazard, the safety system has failed.








GHS Pictograms and Visual Hazard Communication



GHS uses standardized pictograms to communicate chemical hazards visually. Each pictogram consists of a black symbol on a white background framed by a red diamond.

These pictograms appear on chemical container labels and SDS and provide immediate, nonverbal hazard recognition (UNECE).

Figure 7

This figure presents standardized GHS pictograms used to communicate chemical hazards visually. It helps teachers guide students in quickly recognizing and interpreting hazard information before working with substances.

GHS Pictogram	GHS Pictogram Name	Hazard Type	Hazards Communicated (Plain Language)
	Flame	Fire hazard	Flammable gases, liquids, or solids; self-reactive substances; materials that ignite easily
	Flame Over Circle	Oxidizer	Chemicals that can cause or intensify fires even without an ignition source
	Exploding Bomb	Explosion hazard	Explosives, self-reactive substances, organic peroxides that may detonate
	Gas Cylinder	Gas under pressure	Compressed, liquefied, or dissolved gases that may rupture or explode if heated
	Corrosion	Corrosive	Causes severe skin burns and eye damage; corrodes metals
	Skull and Crossbones	Acute toxicity	Highly toxic substances that can cause serious harm or death after short exposure
	Health Hazard (Silhouette)	Chronic health hazard	Carcinogenicity, respiratory sensitization, reproductive toxicity, organ damage

GHS Pictogram	GHS Pictogram Name	Hazard Type	Hazards Communicated (Plain Language)
	Exclamation Mark	Irritant or harmful	Skin or eye irritation, allergic reactions, drowsiness, respiratory irritation
	Environment	Environmental hazard	Toxic to aquatic life; included in GHS though not required in all regulatory systems

Note: The environmental hazard pictogram is part of GHS but may not be required under all regulatory systems.

Pictograms never stand alone. They must be interpreted together with the signal word, hazard statements, and precautionary statements on the label and SDS.

Safety Data Sheets (SDS)

Safety Data Sheets are standardized documents supplied for hazardous chemicals and are required to follow a 16-section format.

This consistency allows educators and students to locate critical safety information efficiently and supports hazard analysis before instruction (OSHA).

SDS provide information on:

- ▶ Hazard identification
- ▶ Composition and ingredients
- ▶ Handling and storage
- ▶ First aid and emergency measures
- ▶ Exposure controls and required personal protective equipment
- ▶ Physical, chemical, and toxicological properties

GHS classification elements appear prominently in Section 2 of every SDS and are reinforced throughout the document (UNECE).

Figure 8

This figure focuses on the most critical section of a Safety Data Sheet (SDS), where hazard identification is clearly presented. It supports teachers in guiding students to locate and use safety information effectively before working with chemicals.

SDS No.: IX0230 SAFETY DATA SHEET FLAMMABLE STORAGE CODE RED

Section 1 Chemical Product and Company Identification Page E1 of E2

ward's science
5100 West Henrietta Rd
PO Box 92912
Rochester, NY 14692-9012
Tel: (800) 962-2660


Boreal Science
399 Vansickle Road
St. Catharines, Ontario
L2S 3T4 Canada
Tel: (800) 387-9393

CHEMTREC 24 Hour Emergency USA
Phone Number (800) 424-9300
For laboratory and industrial use only.
Not for drug, food or household use.

Product	ISOPROPYL ALCOHOL, 70% SOLUTION
Synonyms	2-Propanol 70%; Isopropanol, Water Solution

Section 2 Hazards Identification

Signal word: DANGER
Pictograms: GHS02 / GHS07
Target organs: Central nervous system, Liver, Kidneys.



GHS Classification:
Flammable liquid (Category 2)
Eye irritation (Category 2)
STOT-SE (Category 3)

GHS Label information: Hazard statement(s):
H225: Highly flammable liquid and vapour.
H319: Causes serious eye irritation.
H336: May cause drowsiness or dizziness.

Precautionary statement(s):
P210: Keep away from heat/sparks/open flames/hot surfaces. No smoking.
P233: Keep container tightly closed.
P240: Ground/bond container and receiving equipment.
P241: Use explosion-proof electrical/ventilating/lighting equipment.
P242: Use only non-sparking tools.
P243: Take precautionary measures against static discharge.
P261: Avoid breathing mist/vapours/spray.
P264: Wash hands thoroughly after handling.
P271: Use only outdoors or in a well-ventilated area.
P280: Wear protective gloves/protective clothing/eye protection/face protection.
P303+P361+P353: IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/shower.
P304+P340: IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P305+P351+P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P312: Call a POISON CENTER or doctor if you feel unwell.
P337+P313: If eye irritation persists: Get medical attention.
P370+P378: In case of fire: Use dry chemical, alcohol foam, carbon dioxide or water spray to extinguish.
P403+P235: Store in a well-ventilated place. Keep cool.
P405: Store locked up.
P501: Dispose of contents/container to a licensed chemical disposal agency in accordance with local/regional/national regulations.

Hazards not otherwise classified:
Health hazards not otherwise classified (HHNOC) - Not Known
Physical hazards not otherwise classified (PHNOC) - Not Known

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Signal Words

Signal words provide a rapid indication of hazard severity. GHS uses two signal words:

- ▶ **Danger** for more severe hazards
- ▶ **Warning** for less severe hazards

Hazard Statements

Hazard statements are standardized phrases assigned specific H-codes that describe the nature of a chemical hazard. These statements communicate the physical or health risks associated with a substance (UNECE).

Only one signal word appears on a label, corresponding to the most severe applicable hazard. If no signal word applies, none is used (UNECE).

Example:

▶ **H314** Causes severe skin burns and eye damage

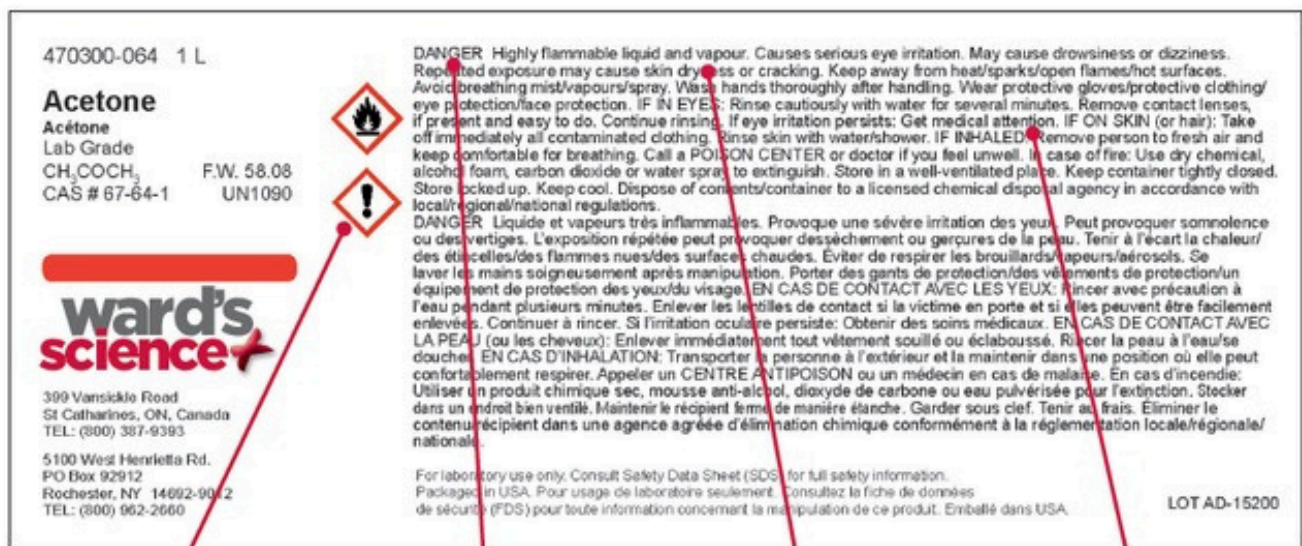
If students cannot interpret a label, they cannot make an informed decision. Hazard communication is literacy.8.1

Using hazard statements during instruction supports accurate interpretation of labels and SDS and reinforces professional laboratory practice (NSTA).

Figure 9

This example demonstrates how hazard communication elements (e.g., signal words, pictograms, and statements) appear on a chemical label. It reinforces for educators that students must be able to interpret labels to make informed and safer decisions during lab work.

GHS Compliant Label
Color-coded labels make safe storage simple



Pictograms:
Conveys specific information about the hazard(s) of a chemical

Signal Word:
Level of severity of hazard.

Hazard Statements:
Describe the nature of hazard(s) associated with a chemical.

Precautionary Statements:
Recommended measures to take to prevent adverse effects

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Precautionary Statements

Precautionary statements describe measures required to minimize or prevent harm.

They are organized into four categories:

- ▶ Prevention
- ▶ Response
- ▶ Storage
- ▶ Disposal

Example:

- ▶ **P280** Wear protective gloves, protective clothing, and eye protection

Precautionary statements translate hazard recognition into specific protective action and should be reinforced verbally and in writing during instruction (OSHA).

Figure 10

This figure emphasizes the role of safety manuals as foundational tools for guiding safer practices and compliance. For teachers, it underscores that safety documentation is not optional but essential for preparing students to work responsibly in STEM environments.



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Closing Note from the Safety Desk

Compliance in CTE is not optional and not theoretical. Regulatory and professional standards exist because injuries have already occurred. Programs that align instruction with these established and accepted standards reduce risk, protect students, and protect themselves. Additionally, this elevated safety awareness allows for the protection and preservation of expensive CTE equipment and tools for these Career Cluster instructional areas.



III CTE FACILITY DESIGN & INFRASTRUCTURE SAFETY

Facilities either control risk or they transfer it to people.

— James Palcik, CHO, Safer STEM

CTE facilities are not neutral spaces. The design, layout, and infrastructure of a shop, lab, barn, greenhouse, or simulation space determine how much risk is present before instruction begins.

Well-designed facilities reduce reliance on behavioral controls; poorly designed spaces amplify hazards and supervision challenges (NFPA; OSHA).

3.1 Facility Design Aligned to Instructional Hazards

CTE facilities must be designed and maintained to support the specific hazards present in each program area. Generic classrooms or repurposed spaces are not acceptable substitutes for purpose-designed CTE environments when industrial hazards are present (OSHA; NFPA)

Implications for High School CTE

Safer facility design includes:

- ▶ Separation of incompatible activities and hazards
- ▶ Adequate clearance around equipment for operation and supervision
- ▶ Fixed locations for high-risk equipment
- ▶ Surfaces and materials appropriate for heat, impact, chemicals, or biological exposure
- ▶ Dedicated preparation, storage, and cleanup areas
- ▶ 24/7 accessible engineering controls like eye wash stations and spray booths

CTE instruction must align with what the facility can safely support. When the CTE space cannot support the hazard, the activity must change. You cannot have students working in a CTE lab without fully functional and accessible eye wash stations in case of an emergency.

If the room cannot support the hazard safely, instruction stops.

Program-Specific Context

- ▶ **Manufacturing:** Fixed machines, guarding zones, and material flow
- ▶ **Construction:** Tool staging areas and clear work zones and model construction projects take up significant amounts of floorspace
- ▶ **Automotive:** Vehicle movement lanes and lift clearances
- ▶ **Health Sciences:** Clean zones and contamination control
- ▶ **IT:** Equipment racks and cable management
- ▶ **Agriculture:** Animal flow, equipment access, and chemical storage

Annex C explains how CTE spaces must be designed around hazard type, not course title, so facilities, engineering controls, and PPE align with foreseeable risks. It supports defensible planning by linking common CTE hazards (chemical, mechanical, thermal, electrical, biological, dust, noise, mixed hazards) to required room features and safer controls.

Chemicals must be segregated by compatibility class. Acids must be separated from bases. Oxidizers must be segregated from organics and flammables. Nitric acid must be isolated from other acids. Corrosives should not be stored above eye level. Flammable liquids must be stored in approved flammable storage cabinets consistent with NFPA 45 and applicable fire codes.

| 3.2 Occupancy, Supervision, and Sightlines

Occupancy limits and sightlines must allow continuous supervision of all CTE students engaged in hazardous activities. Overcrowding undermines supervision and is a predictable contributor to injury (NFPA; NSTA).

Figure 11

Freestanding Woodshop Drill Press (reduced size, right side)



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Implications for High School CTE

Safer infrastructure supports:

- ▶ Posted occupancy limits based on recognized hazard and existing room design
- ▶ Clear sightlines to all workstations and equipment
- ▶ Teacher circulation paths that allow immediate intervention
- ▶ Separation of observation areas from active work zones
- ▶ Accessible engineering controls at all times, meaning no obstructions allowed

When supervision is compromised, hazards must be reduced or access restricted since the safety risks will escalate immediately.

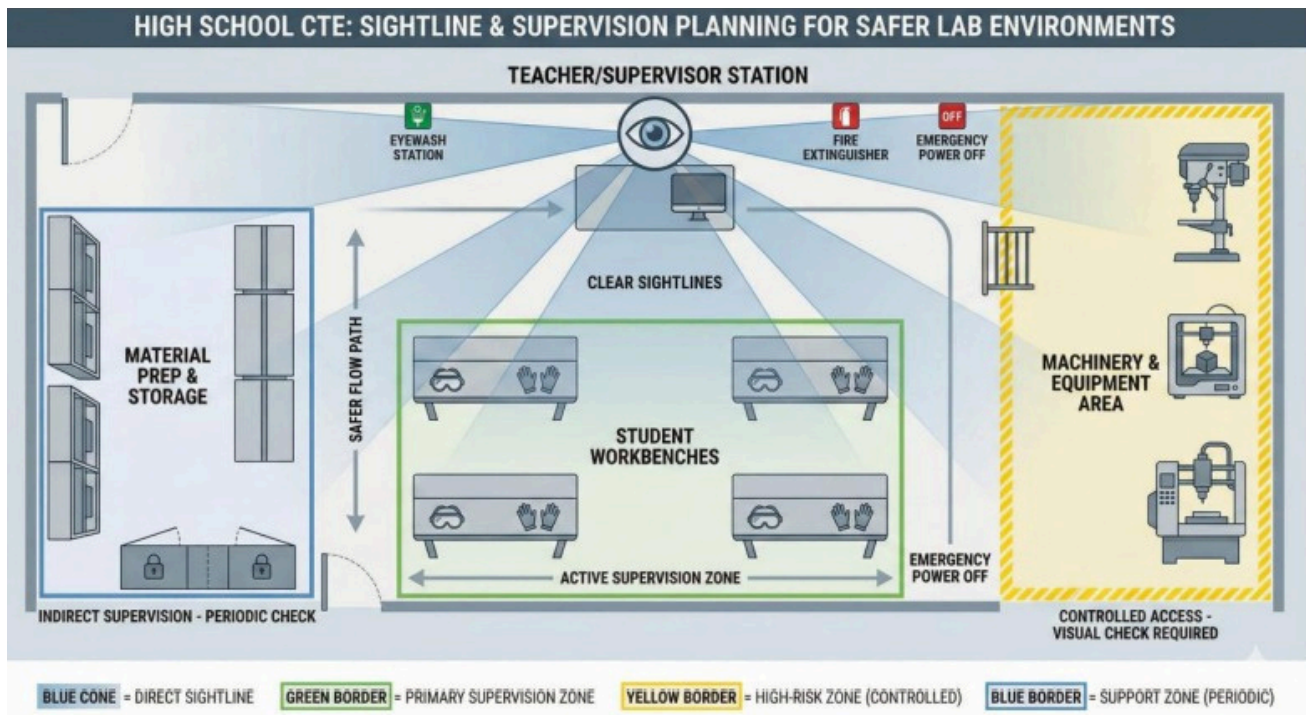
If you cannot see it, you cannot control it.

Program-Specific Context

- ▶ **Manufacturing:** One-student-per-machine zones
- ▶ **Construction:** Clear perimeter control for cutting and fastening
- ▶ **Automotive:** Controlled access around lifts and vehicles
- ▶ **Health Sciences:** Supervision of sharps and procedures
- ▶ **IT:** Visibility of electrical and networking work
- ▶ **Agriculture:** Line-of-sight control in barns and shops

Figure 12

Sightline and supervision planning in CTE spaces



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3.3 Ventilation, Air Quality, and Environmental Controls

Ventilation and air-quality controls are engineering controls, not optional amenities. When processes generate fumes, vapors, dusts, or aerosols, mechanical ventilation must control the possible exposure (OSHA; NIOSH).

Implications for High School CTE

Safer environmental controls include:

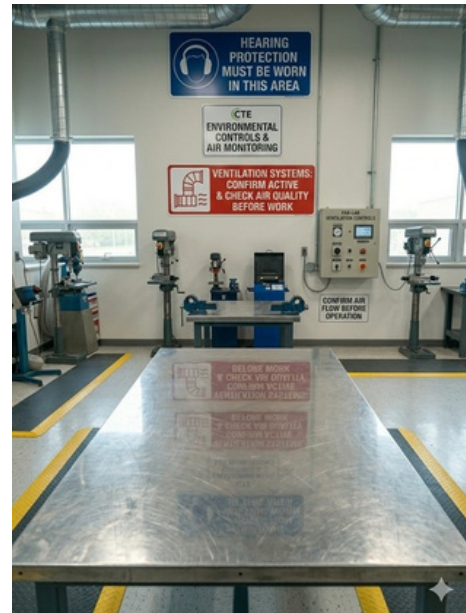
- ▶ Local specific and independent exhaust ventilation systems for welding, painting, sanding, and chemical use in the various CTE rooms designed for these purposes
- ▶ General ventilation appropriate to equipment load and occupancy
- ▶ Prohibition of respirator use as a substitute for ventilation
- ▶ Routine inspection and maintenance of ventilation systems
- ▶ Use of sawdust collection system in woodworking CTE rooms

General CTE instructional space ventilation must maintain adequate air exchange and must not be obstructed or disabled during instruction.

If air quality cannot be controlled, the activity cannot continue.

Figure 13

This figure illustrates how ventilation systems control airborne hazards in CTE environments. It helps teachers evaluate whether instructional activities can be conducted safely based on air quality conditions.



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Discipline-Specific Context

- ▶ **Manufacturing:** Welding fumes and particulates
- ▶ **Construction:** Dusts and adhesives
- ▶ **Automotive:** Exhaust and solvent vapors
- ▶ **Health Sciences:** Aerosol-generating procedures
- ▶ **IT:** Heat management in server spaces
- ▶ **Agriculture:** Dust, gases, and pesticide vapors

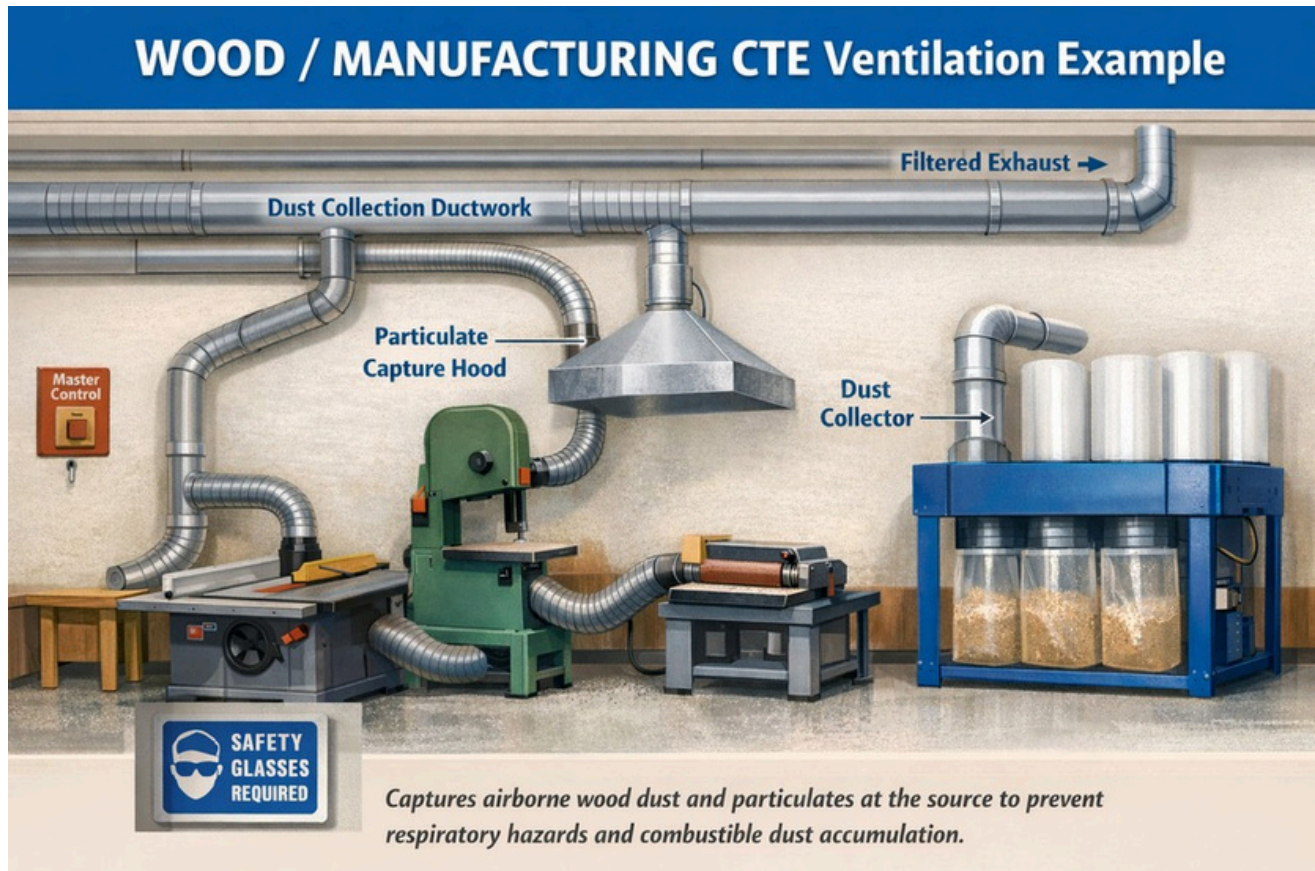
Ventilation

Chemical fume hoods must be inspected and certified at least annually.

Typical face velocity ranges from approximately 80 to 120 feet per minute, depending on institutional guidance. Chemical storage inside fume hoods is prohibited. (ASHRAE)

Figure 14

This example shows how localized ventilation reduces exposure to dust, fumes, and particulates. It reinforces that engineering controls are essential for maintaining safer working conditions.



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3.4 Electrical, Gas, and Emergency Shutoff Systems

CTE facilities must allow rapid shutdown of utilities during emergencies. Teachers must know the location and operation of emergency shutoffs and must be able to access them immediately (NFPA; OSHA).

Implications for High School CTE

Safer infrastructure includes:

- ▶ Clearly labeled electrical, gas, air, and water shutoffs (master control switches)
- ▶ Unobstructed access to shutoff controls
- ▶ Training for staff on emergency shutdown procedures
- ▶ Clear prohibition on student operation of emergency controls unless directed

If a shutoff is blocked or unknown, the space is not ready for instruction

If you cannot shut it off quickly, you cannot run it safely.

We often ask teachers to compensate for the limitations of their space. But supervision cannot substitute for design. Expecting a teacher to manage obstructed sightlines or inadequate ventilation is like asking a pilot to navigate with a partially covered windshield. Skill matters. Systems and controls matter more. Facilities either absorb risk quietly, or they transfer it to people.

Program-Specific Context

- ▶ **Manufacturing:** Electrical disconnects for machines
- ▶ **Construction:** Air and power shutoffs
- ▶ **Automotive:** Fuel and electrical isolation
- ▶ **Health Sciences:** Medical gas controls
- ▶ **IT:** Power and cooling systems
- ▶ **Agriculture:** Equipment and fuel shutoffs

Figure 15

CTE first Aid Kit and Master Shut Off Controls



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| 3.5 Emergency Eyewash and Drench Shower Systems

Emergency eyewash and drench shower systems are critical engineering controls designed to reduce the severity of chemical exposure injuries. In CTE and laboratory environments where corrosive, toxic, or irritant substances are used or stored, these systems must comply with ANSI/ISEA Z358.1.

Where applicable, OSHA regulations require that suitable facilities for quick drenching or flushing of the eyes and body be provided within the work area for immediate emergency use (29 CFR 1910.151(c)). In states without direct OSHA jurisdiction over public employees, these requirements remain the nationally recognized benchmark for professional practice.

Emergency equipment does not prevent exposure. It reduces injury severity when exposure occurs. Proper placement, inspection, training, and enforcement are essential.

Location and Accessibility Requirements

Emergency eyewash and drench shower units must:

- ▶ Must meet ANSI/ISEA Z358.1 regulations from the potential hazard.
- ▶ Be located within 10 seconds travel time from the potential hazard.
- ▶ Be installed on the same level as the potential hazard.
- ▶ Have a clear, unobstructed path of travel at all times.
- ▶ Be highly visible and properly identified with signage.
- ▶ Use of a retractable eyewash / shower meets ADA requirements
- ▶ Not require passage through doors with locks or obstructions.

Portable units may supplement but do not replace plumbed installations where corrosive chemicals are present. *Portable saline eyewash bottles must be exchanged every 2 years or upon usage; whichever occurs first.*

Performance Standards

Eyewash and shower systems must meet the performance specifications outlined in ANSI/ISEA Z358.1, including:

- ▶ Continuous flow for a minimum of 15 minutes.
- ▶ Tepid water delivery (generally 60–100°F or 16–38°C).
- ▶ Hands-free operation once activated.
- ▶ Simultaneous flushing of both eyes for eyewash units.

Combination units must allow simultaneous body drenching and eye flushing when required by hazardous conditions.

Inspection, Testing, and Documentation

To maintain operational readiness:

- ▶ Eyewash units must be activated weekly to verify flow and clear sediment from lines.
- ▶ Showers must be visually inspected weekly and pressure tested at least annually.
- ▶ Annual inspections must be conducted and documented in accordance with ANSI/ISEA Z358.1.
- ▶ Inspection logs must be maintained and available for administrative review.

Non-functioning or obstructed units must be removed from service immediately and repaired before laboratory activities resume.

An untested eyewash is a guess. Weekly activation isn't bureaucracy; it's rehearsal. We don't discover equipment failure during an emergency; we prevent it before one.

Training and Instructional Integration

Students must receive instruction on:

- ▶ Location of emergency equipment.
- ▶ Activation procedures.
- ▶ The importance of immediate flushing following exposure.
- ▶ The requirement to flush for the full 15-minute duration unless directed otherwise by emergency responders.

Demonstration of equipment operation (without full activation unless appropriate) should occur at the start of each course or when new students enter the CTE Instructional space.

Common Compliance Failures to Avoid

The following conditions represent preventable compliance failures:

- ▶ Storing equipment, carts, or materials in front of units prevents access
- ▶ Installing units beyond 10 seconds travel time or 55 feet.
- ▶ Failing to document weekly activation.
- ▶ Using tempering valves that deliver water outside the tepid range.
- ▶ Treating portable gravity units as permanent substitutes where corrosives are present.

Emergency equipment must be accessible, functional, and verified, not merely present.

Administrative Responsibility

Site administrators and program directors are responsible for:

- ▶ Ensuring installation meets ANSI/ISEA Z358.1 and ADA requirements.
- ▶ Allocating budget for maintenance and inspection.
- ▶ Verifying documentation.
- ▶ Aligning local practice with state and national regulatory expectations.

Availability alone is not compliance. Operational readiness, documentation, and training demonstrate professional duty of care.

Closing Note from the Safety Desk

CTE facility design is a frontline safety control. When infrastructure supports appropriate supervision, ventilation, emergency response, and hazard separation, instruction becomes more predictable and safer. When facilities fall short, instruction must be adjusted until potential hazards and resulting safety risks are controlled in your CTE instructional spaces (OSHA; NFPA).

Figure 16

This image shows proper placement and accessibility of emergency eyewash and shower equipment. It helps teachers evaluate whether their instructional spaces meet required response-time standards and ensures students can access emergency equipment quickly.



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IV EQUIPMENT, TOOLS, AND MACHINE SAFETY

Machines do not forgive mistakes. Systems and controls must prevent them.
— James Palcik, CHO, Safer STEM

CTE instruction frequently involves industrial-grade tools and machines capable of causing severe injury in seconds. Most serious CTE injuries occur when equipment is used without adequate training, guarding, authorization, or supervision. Teachers have reported CTE accidents due to students not following directions/SOPs (Love & Roy, 2022, p. 87 – ITEEA), even after completing safety training, having the right equipment and controls in place, and having a qualified instructor present. Having 1:1 supervision would help, but students ultimately do some work on their own and have to make quick decisions even with a teacher observing. Safer CTE instruction requires structured access, formal authorization, and strict adherence to standardized operating procedures (OSHA; NIOSH).

Chemical storage must align with compatibility and hazard class to prevent dangerous reactions. Acids should be separated from bases, oxidizers from organic materials, and flammables stored in approved cabinets.



4.1 Machine Guarding and Fixed Equipment

All fixed machines in CTE programs must be properly guarded and maintained according to manufacturer specifications and recognized safety standards. Guards must never be removed, bypassed, or disabled for instructional convenience (OSHA; ANSI/ISEA).

All equipment on tabletops must be secured or bolted down to prevent accidental tipping when in use.

Implications for High School CTE

Safer machine practices include:

- ▶ Using only equipment with required point-of-operation guards in place
- ▶ Verifying that interlocks and emergency stops function correctly
- ▶ Prohibiting operation when guards are missing, modified or damaged
- ▶ Maintaining written operating procedures accessible at each machine
- ▶ Removing unsafe equipment from service immediately
- ▶ Having safer work zones clearly delineated around equipment and machinery

Instruction stops when a guard is missing or damaged. Exceptions must be explicitly defined in written safety procedures and aligned with manufacturer guidance.

For example, some table saw operations don't allow for a guard to be on, since it just simply will not operate unless the guard is removed in very specific cases. These exceptions must be limited, clearly defined, and restricted to instructor-directed activities.

If the guard is off, the machine is off.

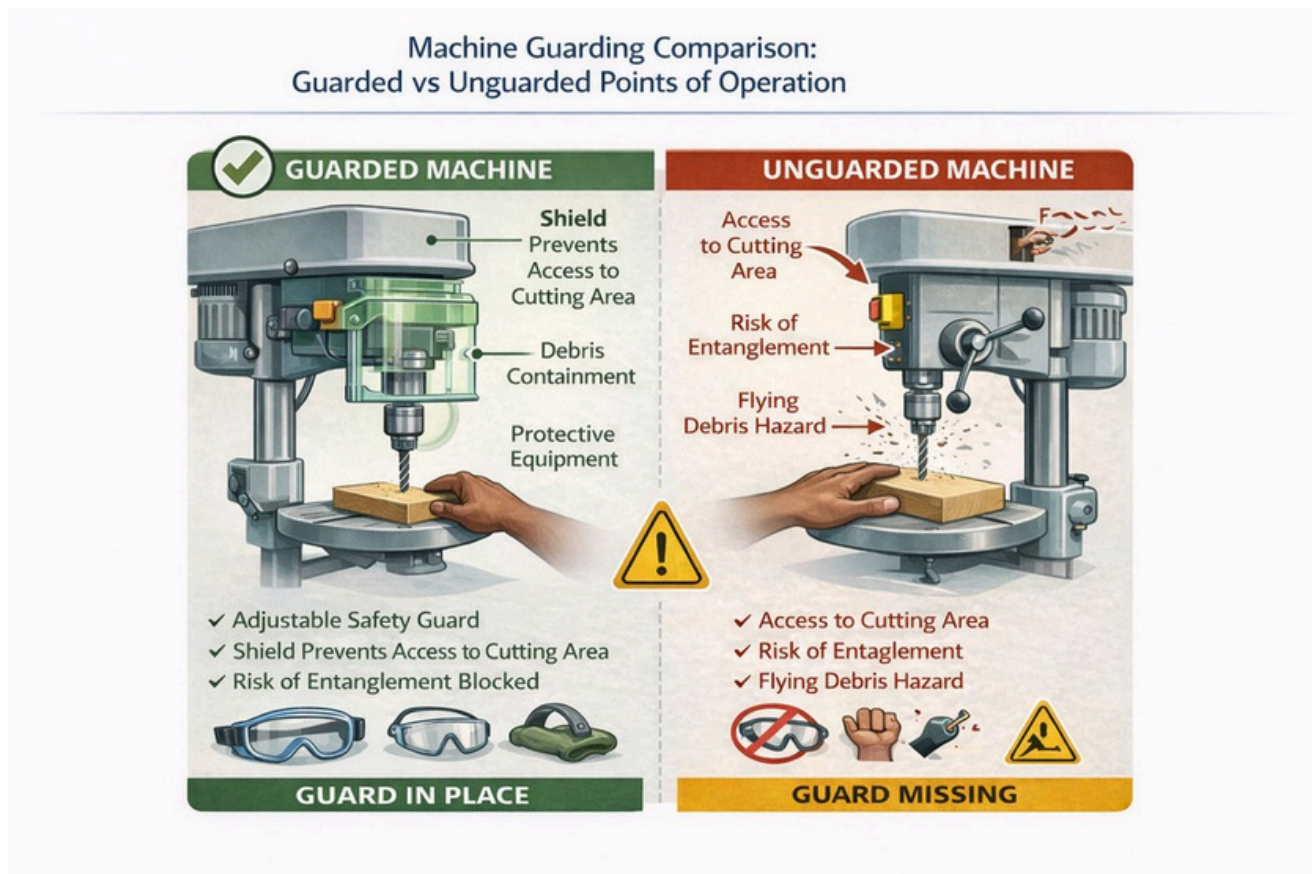
Discipline-Specific Considerations

- ▶ **Manufacturing:** Lathes, mills, saws, presses
- ▶ **Construction:** Table saws, miter saws, planers
- ▶ **Automotive:** Tire machines, lifts, presses
- ▶ **Agriculture:** PTO-driven equipment
- ▶ **Health Sciences:** Powered medical simulation devices

Figure 17

This comparison shows the difference between guarded and unguarded machinery, highlighting risks such as entanglement and flying debris.

For science teachers, it illustrates why engineering controls like guards are essential and why equipment should never be used when safeguards are missing.



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| 4.2 Portable Power Tools and Hand Tools

Portable power tools introduce mobility, torque, and potential energy hazards that require strict controls. Only approved tools appropriate to the instructional level may be used, and access must be supervised at all times (OSHA).

Implications for High School CTE

Safer tool practices include:

- ▶ Inspecting tools before each use
- ▶ Using tools only for their intended purpose
- ▶ Requiring appropriate PPE for each planned task
- ▶ Establishing tool check-out and return procedures
- ▶ Prohibiting horseplay, modification, or misuse

Hand tools must be maintained and replaced when damaged. These are unsafe and sources of potential risk if not removed from service or access to students. Procedures should be set up to allow students to report issues with damaged tools/equipment without fear of being penalized.

If you would not hand it to an apprentice, do not hand it to a student. Many states provide apprenticeship courses and hours in school as part of the CTE Career Clusters.

Figure 18

CTE Wall of Tools



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Program-Specific Context

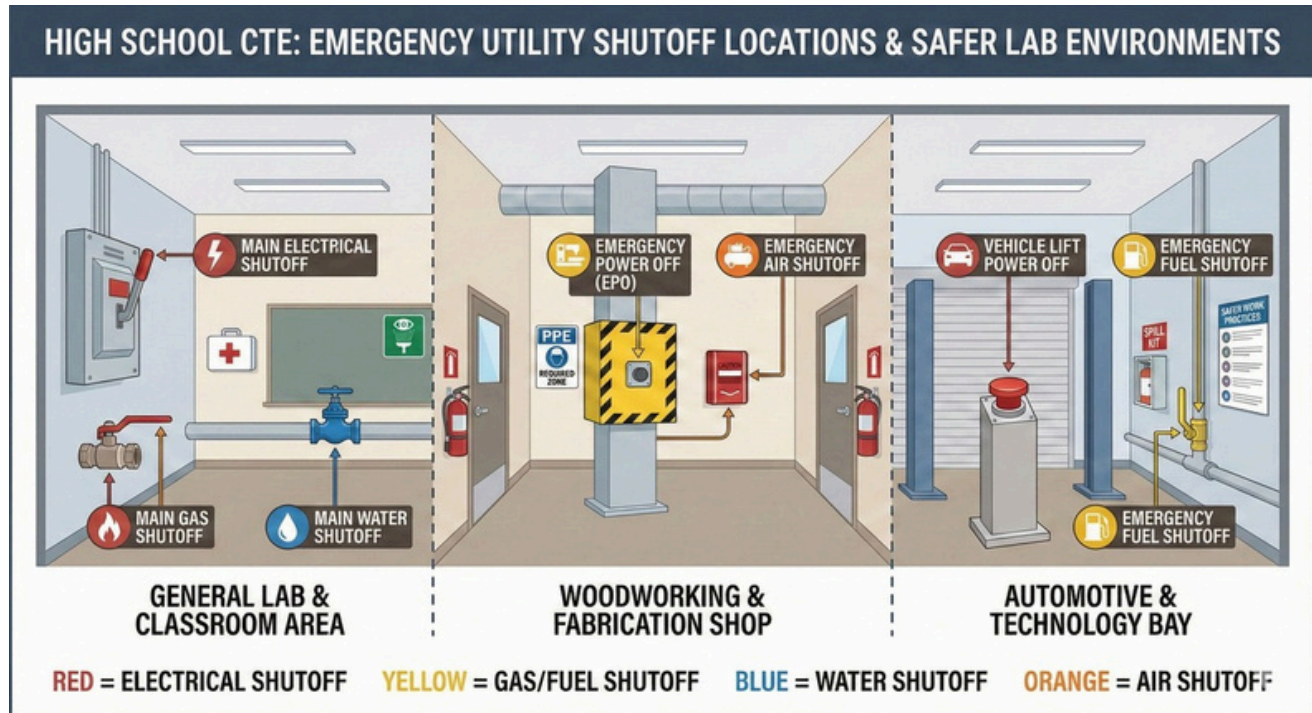
- ▶ **Manufacturing:** Grinders, drills, and cutting tools
- ▶ **Construction:** Pneumatic nailers, saws, and fastening tools
- ▶ **Automotive:** Grinders, buffers, impact tools, and diagnostic equipment
- ▶ **IT:** Crimpers and cable tools, soldering irons
- ▶ **Agriculture:** Handheld powered equipment (gas & electric), hydraulic equipment V tools

Chemical Handling / Disposal

Chemical waste disposal must follow district hazardous waste procedures and applicable environmental regulations, including coordination with approved disposal vendors.

Figure 19

This figure outlines safety practices for using portable power tools. It reinforces the importance of inspection, supervision, and appropriate PPE for each task.



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4.3 Authorization, Training, and Lockout Awareness

Students must not operate machines or high-risk tools without documented training and explicit authorization. Lockout/tagout concepts must be taught as awareness, not practiced operationally by students (OSHA).

Implications for High School CTE

Safer authorization systems include:

- ▶ Documented safety training prior to equipment use
- ▶ Skill authorization records for specific machines for each student
- ▶ Visible authorization systems (badges, tags, rosters)
- ▶ Teacher-controlled startup and shutdown procedures

Lockout/tagout (LOTO) procedures remain the responsibility of trained adults.

Students should not independently access tool rooms, chemical storage areas, or equipment storage without direct instructor supervision.

Materials and tools should be issued and controlled by the instructor.

Students should not independently access tool rooms, chemical storage areas, or equipment storage without direct instructor supervision. Materials and tools should be issued and controlled by the instructor.

Program-Specific Context

- ▶ **Manufacturing:** Machine-specific authorization
- ▶ **Construction:** Tool-specific authorization
- ▶ **Automotive:** Lift and equipment authorization
- ▶ **Health Sciences:** Equipment competency verification
- ▶ **IT:** Electrical system access control
- ▶ **Agriculture:** Use of pesticides or vaccines/medicines

Annex D provides a student-facing safety assessment and instructor key to document baseline safety knowledge before tool, machine, or lab participation.

It reinforces industry-aligned expectations for PPE, guarding, reporting, authorization, and professional conduct as a prerequisite for access.

4.4 Maintenance, Inspection, and Equipment Removal

Equipment condition directly affects safety. Preventive maintenance and regular inspection are required to identify signs of wear, damage, or malfunction before injuries occur (NIOSH).

Implications for High School CTE

Safer equipment management includes:

- ▶ Scheduled inspections documented in writing
- ▶ Immediate tagging and removal of defective equipment (Lock Out Tag Out)
- ▶ Prohibition on temporary fixes or workarounds
- ▶ Coordination with maintenance staff and manufacturer service technicians for repairs
- ▶ Verification of repair before returning equipment to service
- ▶ Dated receipt or documentation of repair/maintenance completed.

Improvised repairs create uncontrolled risk.

Broken equipment is not a teaching tool.

Program-Specific Context

- ▶ **Manufacturing:** Machine calibration and lubrication
- ▶ **Construction:** Tool inspection and replacement
- ▶ **Automotive:** Lift inspection and certification
- ▶ **Agriculture:** Equipment wear and seasonal hazards
- ▶ **Health Sciences:** Device calibration and cleaning

Experience can breed confidence. Occasionally, it also breeds shortcuts. Machines, however, remain indifferent to both. Guards, authorization systems, and maintenance protocols are not signs of mistrust; they are expressions of foresight. They function much like guardrails on a steep mountain road. Most of the time, you do not notice them. On the day you need them, they are everything.

Figure 20

A student works on a car engine with a diagnostic tablet displaying waveforms nearby.



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Closing Note from the Safety Desk

Machines, tools, and equipment are central to CTE instruction, and they demand professional safety management. When access is controlled, authorization is documented, and equipment is maintained, CTE programs protect students while preparing them for real-world work (OSHA; NIOSH).



V CHEMICAL, BIOLOGICAL, AND ENVIRONMENTAL HAZARDS

If a substance can harm workers, it can harm students.

— James Palcik, CHO, Safer STEM

CTE programs routinely expose students to chemicals, biological agents, and environmental hazards that can cause acute injury or long-term health effects if improperly managed.

These potential hazards and resulting risks are well documented in industry and must be addressed with the same rigor in educational settings (OSHA; EPA).

5.1 Chemical Hazard Identification and Management

All chemicals used in CTE programs must be clearly identified, labeled, stored, and managed in accordance with hazard communication principles. Teachers must know what chemicals are present, what hazards they pose, and how to control potential exposure and risks present (OSHA).

Implications for High School CTE

Safer chemical management includes:

- ▶ Maintaining an up-to-date chemical inventory of on-hand materials
- ▶ Using GHS-compliant labeling for all containers regardless of volume
- ▶ Providing immediate access to Safety Data Sheets (SDS)
- ▶ Storing chemicals by compatibility and hazard class
- ▶ Prohibiting use of unidentified or unlabeled substances

If a chemical cannot be identified, it cannot be used. Period. Donations are not acceptable from industry partners or community organizations, as these can become expensive disposal costs.

Chemical waste disposal must follow district hazardous waste procedures and applicable environmental regulations, including coordination with approved disposal vendors.

Discipline-Specific Considerations

- ▶ **Manufacturing:** Solvents, cutting fluids, coatings
- ▶ **Construction:** Adhesives, sealants, finishes
- ▶ **Automotive:** Fuels, oils, coolants, cleaners, paints, sealers
- ▶ **Health Sciences:** Disinfectants and reagents
- ▶ **Agriculture:** Pesticides and fertilizers

Chemical waste disposal must follow district hazardous waste procedures and applicable environmental regulations, including coordination with approved disposal vendors.

Figure 21

Ward's Science Color-coded Chemical Storage System and Chart



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| 5.2 Biological Hazards and Exposure Control

Biological hazards in CTE programs require strict controls to prevent exposure, infection, or contamination. Students must not be exposed to potential biological hazards without appropriate training, PPE, and supervision (CDC; OSHA).

Implications for High School CTE

Safer biological hazard controls include:

- ▶ Limiting exposure to simulated or non-infectious materials when possible
- ▶ Implementing bloodborne pathogen training for applicable programs
- ▶ Using approved sharps containers and disposal methods
- ▶ Enforcing hand hygiene and surface disinfection protocols
- ▶ Prohibiting eating, drinking, or cosmetic use in exposure areas
- ▶ Follow local protocols on the use of micro-organisms, bodily fluids, bacteria & virus investigations and related biohazardous activities in CTE
- ▶ Prohibit the use of bodily fluids and locally sourced specimens from camping, hunting, fishing, or road kill for use in CTE programs

Biological hazards and resulting safety risks demand zero tolerance for shortcuts.

If exposure is possible, controls must already be in place.

Discipline-Specific Context

- ▶ **Health Sciences:** Bloodborne pathogen precautions
- ▶ **Agriculture:** Animal handling and zoonotic disease awareness, and irrigation and drain water management systems present potential biohazards
- ▶ **Manufacturing:** Mold or biofilm in fluid systems
- ▶ **Construction:** Mold in crawlspaces, attics, and structures

Bloodborne Pathogens and Sharps Safety

When instruction or injury response may reasonably involve exposure to blood or other potentially infectious materials, procedures must align with OSHA's Bloodborne Pathogens Standard (29 CFR 1910.1030) where applicable. Universal precautions must be followed.

Sharps must be disposed of immediately in approved, puncture-resistant, closable, leak-resistant, labeled or color-coded sharps containers. Exposure incidents must be documented and managed according to district exposure control procedures.

Figure 22

Ward's Science sharps container. This container is for the safe disposal of various sharps including blood lancets. Meets OSHA Bloodborne Pathogens Rule, 29 CFS 1910.1030.



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5.3 Environmental Hazards: Noise, Dust, and Airborne Contaminants

Environmental hazards such as noise, dust, fumes, and vapors must be controlled to prevent hearing loss, respiratory injury, and potential chronic exposure. Engineering controls take precedence over PPE (NIOSH).

Implications for High School CTE

Safer environmental controls include:

- ▶ Monitoring noise levels and providing hearing protection when required
- ▶ Using local exhaust ventilation for dust and fumes (dust and fumes separate from paint, chemical, and metal exhaust systems due to potential combustion)
- ▶ Preventing accumulation of combustible dusts and ensuring ventilation and air exchange are not obstructed or disabled during CTE instruction
- ▶ Limiting duration of exposure through task design and substitutions
- ▶ Prohibiting respiratory protection without a formal program and facilities

Students must never be placed in environments that exceed safer exposure limits found in the TLV and PEL tables from OSHA and ASHRAE for ventilation standards

If you cannot control exposure, you must stop the task.

Figure 23

Dust Pick Up Vacuum



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Discipline-Specific Context

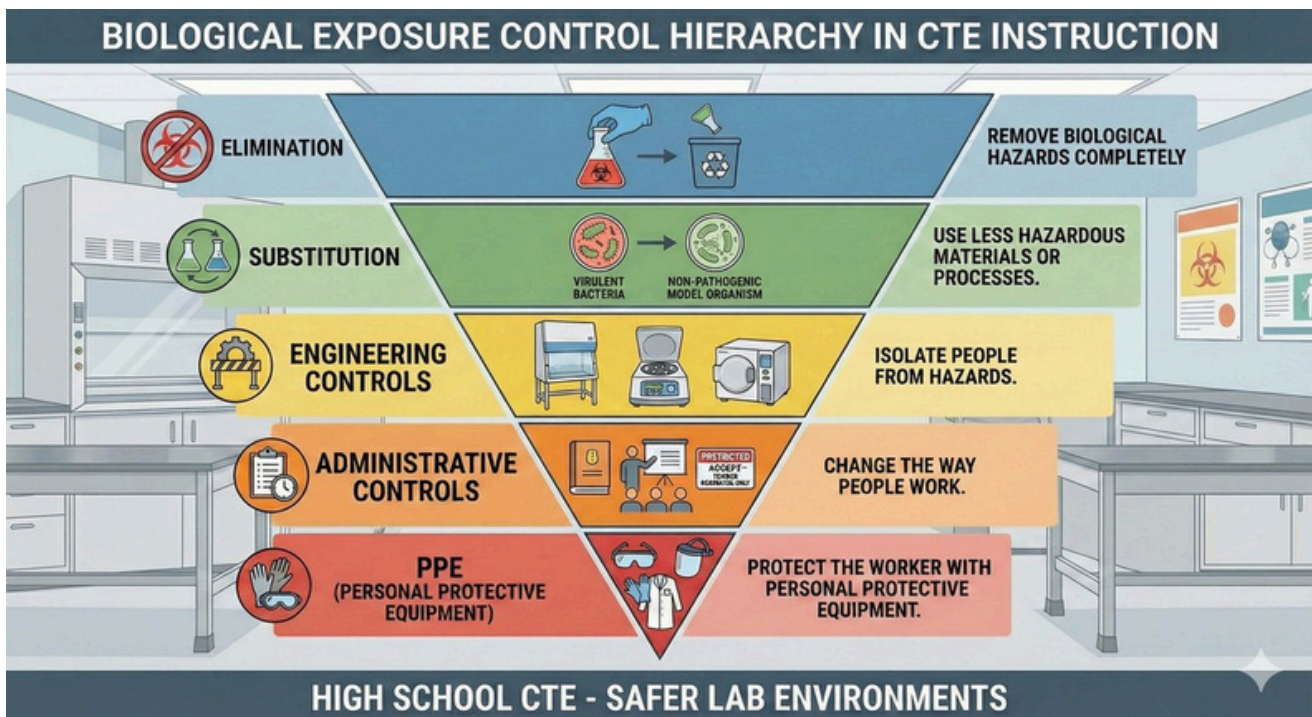
- ▶ **Manufacturing:** Grinding, sanding, welding
- ▶ **Construction:** Cutting, drilling, demolition
- ▶ **Automotive:** Exhaust and solvent vapors
- ▶ **Agriculture:** Dust, gases, and particulates

All CTE programs must keep dust and fumes separate from paint, chemical, and metal exhaust systems due to potential combustion in the ventilation and exhaust system.

Lithium-ion batteries used in tools and robotics equipment should be charged only with manufacturer-approved chargers, monitored during charging, and kept away from heat sources to reduce fire risk.

Figure 24

This figure outlines layered controls used to reduce biological exposure risks. It helps teachers prioritize engineering and procedural controls over reliance on PPE alone.



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5.4 Chemical Handling / Disposal

Chemical waste disposal must follow district hazardous waste procedures and applicable environmental regulations, including coordination with approved disposal vendors.

If disposal is unclear, the activity should not proceed.

Implications for High School CTE

Safer waste practices include:

- ▶ Identifying waste streams before activities begin
- ▶ Using approved containers and labels
- ▶ Following approved district and state disposal procedures
- ▶ Never disposing of chemicals or biohazards in sinks or trash unless permitted
- ▶ Training students on proper waste segregation

Discipline-Specific Context

- ▶ **Automotive:** Oils, solvents, batteries, paint, epoxy, Bondo, resins
- ▶ **Health Sciences:** Sharps and biohazard waste
- ▶ **Agriculture:** Chemical residues, pesticides, hydraulic oils
- ▶ **Manufacturing:** Metal shavings and residues, oils, lubricants

Waste decisions must be planned, not improvised.

In educational settings, substances can appear less threatening because they are used for learning. Yet chemicals, biological agents, and airborne contaminants follow the same laws of exposure in schools as they do in industry. Hazard communication is not about compliance language; it is about recognition before exposure. When labeling, ventilation, or disposal is improvised, risk accumulates quietly, often long before hazardous symptoms appear.

Figure 25

Environmental waste example



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Closing Note from the Safety Desk

Chemical, biological, and environmental hazards and risks demand professional respect and disciplined control. When hazards are identified, controls are layered, and waste is managed responsibly, CTE programs protect students while modeling industry-recognized safety practice (OSHA; EPA).

VI PERSONAL PROTECTIVE EQUIPMENT (PPE)

PPE is not optional when hazards and resulting CTE risks are present.

— James Palcik, CHO, Safer STEM

Personal protective equipment (PPE) is a critical control measure in CTE environments where potential hazards and recognized risks cannot be eliminated through engineering or administrative controls alone. Because students are learning in environments designed for professional work, PPE expectations must reflect industry standards and be enforced consistently (OSHA). PPE is the last line of defense or safety controls in this CTE instructional space, yet it is a necessity for safer operation of the tools, equipment, machinery and materials found in these programs.



6.1 Hazard-Based PPE Selection

PPE must be selected based on identified hazards, not convenience, tradition, or student preference. When potential hazards are present, appropriate PPE is mandatory for all participants and observers within the hazard and safety risk zone (OSHA; NIOSH). CTE instructional spaces are high risk areas, and PPE is a non-negotiable aspect of participating in these programs. Students with additional needs may require special modifications and accommodations, including specialized PPE that meet the legal safety standards when in the CTE program.

Implications for High School CTE

Safer PPE selection includes:

- ▶ Conducting task-specific hazard analysis and risk assessments
- ▶ Selecting PPE that meets applicable ANSI/ISEA certification standards
- ▶ Ensuring PPE fits correctly and functions as designed
- ▶ Requiring PPE during setup, operation, and cleanup
- ▶ Prohibiting participation when required PPE is not worn correctly
- ▶ Having ample supply on hand for damage or loss, as well as visitors in CTE rooms, and removing any non-compliant PPE from service immediately

PPE decisions are made before instruction begins, not during the activity. Students with additional needs may require specialized PPE or additional time to put on and take off their PPE.

If PPE is required in industry, it is required in CTE instructional areas.

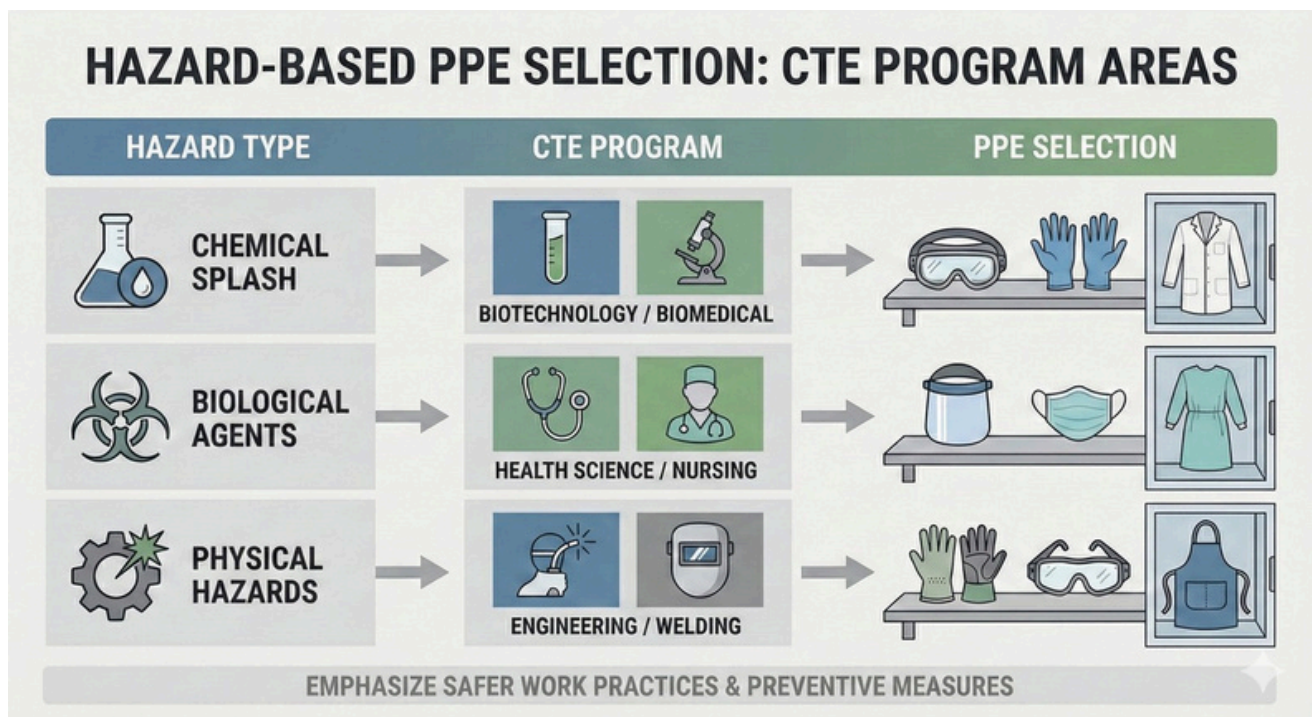
Discipline-Specific Considerations

- ▶ **Manufacturing:** Eye, face, hearing, and hand protection
- ▶ **Construction:** Head, eye, hand, and foot protection
- ▶ **Automotive:** Eye, hand, face, feet and protective clothing
- ▶ **Health Sciences:** Gloves, gowns, masks, and eye protection
- ▶ **IT:** Eye protection and ESD controls
- ▶ **Agriculture:** Eye, hand, respiratory, feet and body protection

Annex E summarizes minimum PPE requirements by machine, process, and hazard profile, grounded in documented hazard analysis and risk assessment principles. It supports consistent enforcement by specifying when PPE is required, when to add protection, and where glove use may increase entanglement risk.

Figure 26

Hazard-based PPE selection across CTE program areas



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| 6.2 Eye and Face Protection

Eye and face protection must be worn whenever there is risk of impact, splash, flying debris, radiant energy, or chemical exposure. Safety glasses or goggles must meet ANSI/ISEA Z87.1 standards (ANSI/ISEA; OSHA).

Any activity that has liquids, chemicals, glassware or heat requires ANSI/ISEA Z87.1 D3 2020 indirectly vented chemical splash goggles for all occupants, and the certified safety glasses for dry lab situations MUST have side shields in order to provide protection to the person wearing them. Choose appropriately.

Implications for High School CTE

Safer eye and face protection practices include:

- ▶ Requiring ANSI/ISEA Z87.1–compliant protective eyewear in CTE work areas
- ▶ Using chemical splash goggles when liquid or chemical hazards exist
- ▶ Adding face shields when there is risk of high-energy impact or splashes
- ▶ Ensuring eye protection is worn correctly and continuously while in the CTE space, including light protective lenses and helmets with face shields for welding and laser use
- ▶ Maintaining cleaning and sanitation procedures for shared PPE involving cleaning and disinfection procedures

If eyes are exposed, protection stays on.

Lab Coats, Aprons, and Clothing

Minimum expectations include:

- ▶ **Manufacturing:** Grinding, cutting, machining plasma cutter
- ▶ **Construction:** Cutting, fastening, demolition
- ▶ **Automotive:** Fluid handling, pressurized systems
- ▶ **Health Sciences:** Splashes and aerosols
- ▶ **Agriculture:** Equipment operation and chemical / pesticide handling

Eye protection worn on the forehead or removed between steps is not acceptable or safe. All occupants of the CTE instructional space must wear approved, certified, and sanitary eye protection at all times during instruction or demonstration. Choosing not to wear protective eyewear can result in an immediate removal from the CTE room since this action is a recognized safety risk to themselves and others. Appropriate eye protection must be worn at all times.

Figure 27

Eye and face protection appropriate for CTE hazards with indirect venting.



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6.3 Hand, Body, and Foot Protection

Hand, body, and foot protection must prevent contact with mechanical, chemical, thermal, or biological hazards and resulting safety risks.

PPE must be appropriate to the task and removed when it creates additional risk (NIOSH). Follow established safer CTE practices and procedures for PPE usage.

Implications for High School CTE

Safer practices include:

- ▶ Selecting safety gloves compatible with the potential hazard and task
- ▶ Prohibiting glove use near rotating equipment
- ▶ Requiring protective clothing to prevent skin exposure
- ▶ Enforcing closed-toe, slip-resistant footwear (e.g., Casting molten metal requires leather covers over shoes/boots. Also, steel toe and shank for construction areas)
- ▶ Securing hair, jewelry, and loose clothing at all times in the CTE space

Improper and uncertified PPE can increase risks rather than reduce it.

The wrong PPE can be more dangerous than none.

Program-Specific Context

- ▶ **Manufacturing:** Cut-resistant gloves where appropriate
- ▶ **Construction:** Steel-toe or protective footwear
- ▶ **Automotive:** Chemical-resistant gloves
- ▶ **Health Sciences:** Barrier protection
- ▶ **Agriculture:** Protective clothing for chemicals and animals

Figure 28

PPE and CTE



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6.4 Hearing and Respiratory Protection

Hearing and respiratory protection must be used when engineering controls cannot reduce exposure to safer noise or airborne exposure levels. Respirators must not be used without a formal respiratory protection program (OSHA; NIOSH).

Implications for High School CTE

Safer practices include:

- ▶ Monitoring noise levels and providing hearing protection when required
- ▶ Training students on proper use and care of hearing protection
- ▶ Prohibiting voluntary respirator use without program approval
- ▶ Using ventilation and process controls before considering respiratory PPE
- ▶ Instructors will be impacted most by this. They are exposed to the noise for a full-day; students are there for one class period

Respirators are not substitutes for appropriate ventilation.

Respiratory protection programs must align with OSHA 29 CFR 1910.134. The use of respirators requires medical evaluation, fit testing, and a written respiratory protection program. In most school settings, substitution and ventilation controls should be prioritized over respirator use.

Program-Specific Context

- ▶ **Manufacturing:** Grinding and machining noise
- ▶ **Construction:** Power tools and demolition
- ▶ **Automotive:** Engine operation & pneumatic tools
- ▶ **Agriculture:** Equipment noise and dust

Respiratory protection programs must align with OSHA 29 CFR 1910.134. The use of respirators requires medical evaluation, fit testing, and a written respiratory protection program. In most school settings, substitution and ventilation controls should be prioritized over respirator use.

Hearing protection must be provided when noise exposure meets or exceeds action levels established under OSHA 29 CFR 1910.95 (Occupational Noise Exposure). Engineering and administrative controls should be implemented to reduce noise exposure before relying on personal protective equipment.

Figure 29

Hearing Protection



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| 6.5 PPE Enforcement and Accountability

PPE requirements must be enforced consistently and without exception. Allowing noncompliance undermines safety culture and increases potential liability (OSHA).

Implications for High School CTE

Effective enforcement includes:

- ▶ Clear communication of PPE expectations
- ▶ Immediate correction of noncompliance
- ▶ Removal from activity when PPE is not worn correctly
- ▶ Documentation of repeated violations
- ▶ Administrative support for enforcement

If PPE rules are negotiable, injuries are inevitable.

Program-Specific Context

- ▶ **All CTE areas:** Consistency across instructors and programs

PPE rules are safety rules, not classroom preferences.

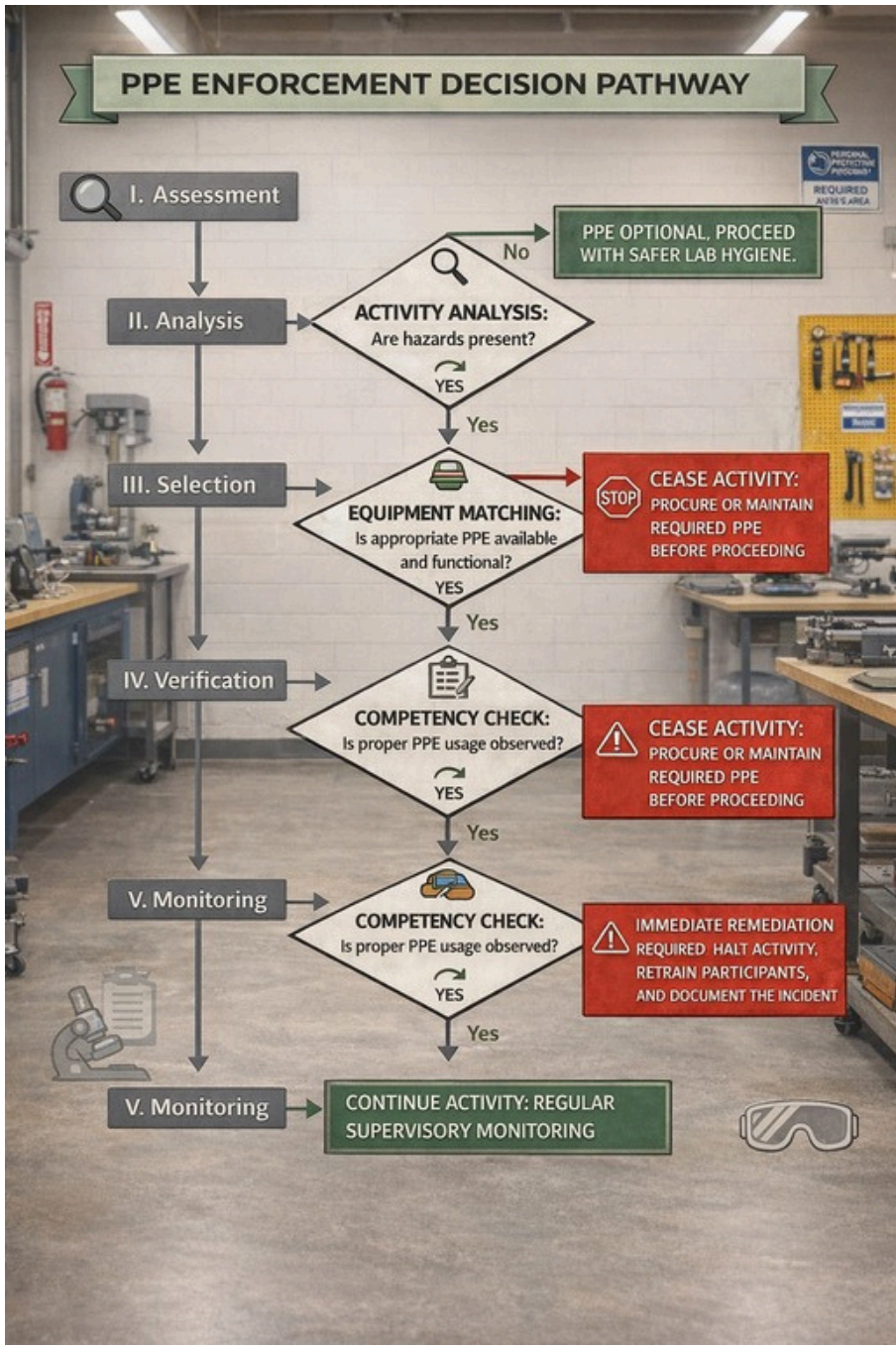
PPE enforcement is sometimes framed as a discipline issue. It is not. It is a culture signal. When protective equipment is optional in practice, even if mandatory in policy, students internalize that safety is negotiable. Seatbelts only work when everyone wears them, every time. Consistency is what transforms a rule into a norm.

Closing Note from the Safety Desk

Personal protective equipment protects students only when it is selected correctly, worn properly, and enforced consistently. In CTE programs, PPE use models professional behavior and prepares students for safer participation in the workforce (OSHA; NIOSH).

Figure 30

This figure outlines how decisions about PPE use should be based on hazard analysis rather than routine or preference. It helps educators understand that PPE is the last line of defense and must be selected intentionally based on identified risks.



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VII INSTRUCTIONAL RISK MANAGEMENT & SUPERVISION

Risk management begins before students enter the CTE instructional space.
— James Palcik, CHO, Safer STEM

Instructional risk in CTE programs is predictable and manageable when potential hazards and resulting risks are identified, controls are layered, and supervision is intentional.

Most serious CTE injuries occur during routine tasks when risk management breaks down, not during rare or complex operations (OSHA).

7.1 Hazard Analysis & Risk Assessment in CTE

Each instructional task must be preceded by a documented hazard analysis and resulting risk assessment resulting in safer actions prior to the demonstration or student activity. Teachers must understand how injuries occur in industry and prevent those conditions from existing in school-based CTE instructional settings (NIOSH).

This is a duty of care obligation for CTE educators in addition to a legal requirement to recognize hazards and risks and mitigate these ahead of time. (NSTA, Roy)

Implications for High School CTE

Effective hazard analysis and risk assessment includes:

- ▶ Identifying mechanical, chemical, electrical, biological, and environmental hazards and the corresponding safety risks
- ▶ Breaking tasks into discrete, individual steps
- ▶ Identifying points where loss of control is most likely to occur
- ▶ Selecting controls before instruction begins that mitigate recognized hazards and resulting risks

Hazards that are not identified cannot be controlled. Consider biological, chemical, physical and electrical hazards and their corresponding risks in your CTE instructional space and select appropriate safer actions prior to conducting the activity. Also consider equipment and tool maintenance, familiarity, safety training and formal documentation in your overall analysis and assessment strategy.

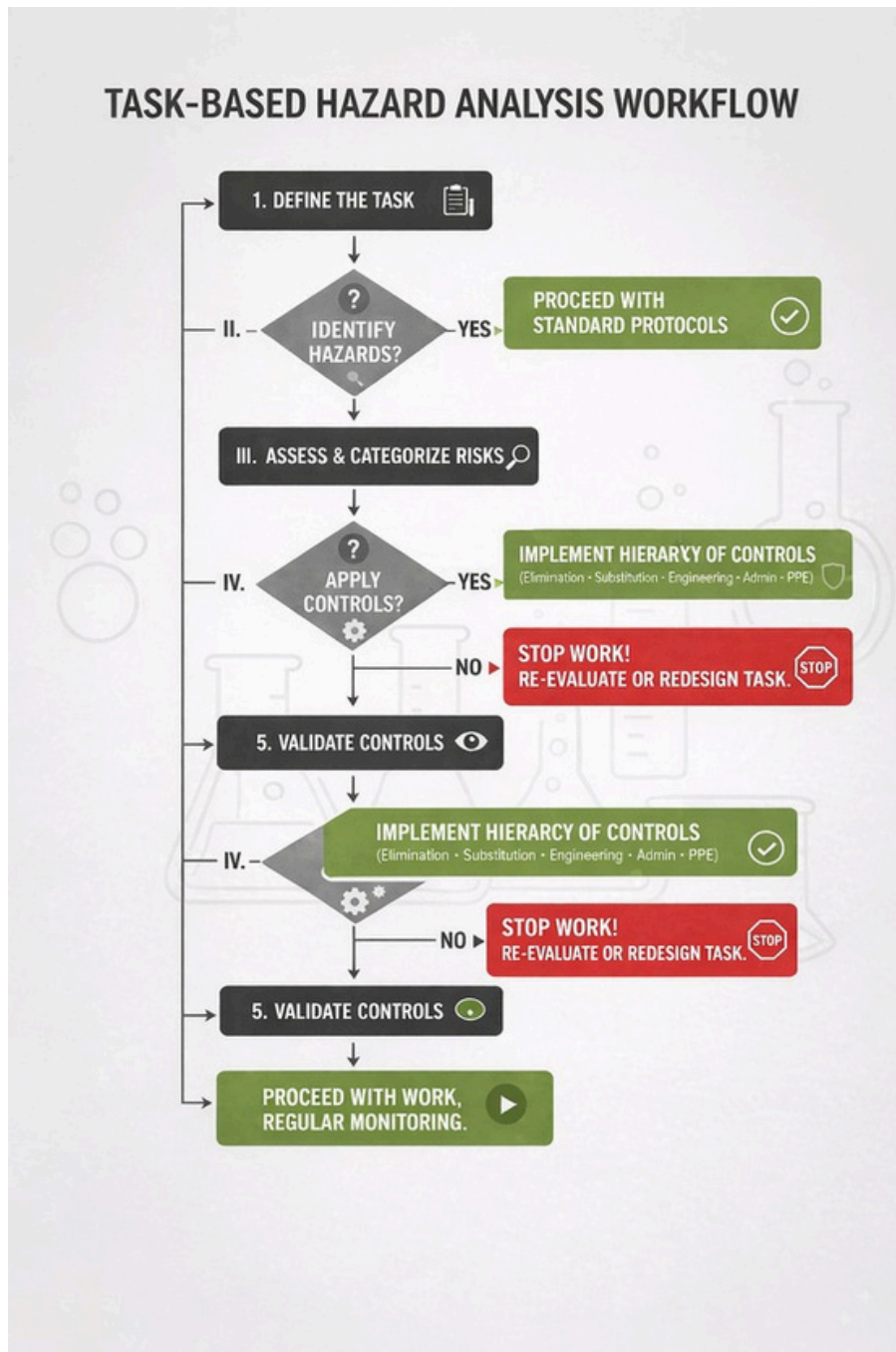
If you did not identify the potential hazard and resulting risk, you cannot defend the decision.

Program-Specific Context

- ▶ **Manufacturing:** Machine startup and shutdown procedures
- ▶ **Construction:** Cutting, lifting, and fastening tasks
- ▶ **Automotive:** Vehicle movement and pressurized systems
- ▶ **Health Sciences:** Patient simulation procedures
- ▶ **IT:** Electrical and ergonomic tasks
- ▶ **Agriculture:** Equipment operation and animal handling

Figure 31

This diagram breaks down how to analyze a task step-by-step to identify hazards and apply appropriate controls. It supports teachers in planning safer investigations by emphasizing proactive thinking before students begin hands-on work.



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| 7.2 Layered Controls and the Hierarchy of Safety

CTE instruction must follow the hierarchy of controls: elimination, substitution, engineering controls, administrative controls, and PPE.

PPE alone is never sufficient (NIOSH).

Implications for High School CTE

Safer instructional design includes:

- ▶ Eliminating recognized safety hazards where possible
- ▶ Substituting safer materials or processes to make planned CTE activity safer
- ▶ Using guards, barriers, and ventilation
- ▶ Establishing procedures and authorization systems
- ▶ Requiring PPE only when higher-level controls cannot fully protect user

Reliance on PPE as the primary control indicates system failure.

If PPE is the only control, redesign the task.

Program-Specific Context

- ▶ **Manufacturing:** Guarded equipment and automation
- ▶ **Construction:** Tool selection and sequencing
- ▶ **Automotive:** Engine-off procedures
- ▶ **Health Sciences:** Simulated exposures
- ▶ **IT:** De-energized systems
- ▶ **Agriculture:** Remote operation and barriers

Student-Specific Risk Assessment in CTE Instruction

Hazard analysis in CTE programs must also be student-centered. In addition to identifying task-based hazards, educators must evaluate how those hazards and resulting risks are experienced by individual learners, particularly those with additional needs.

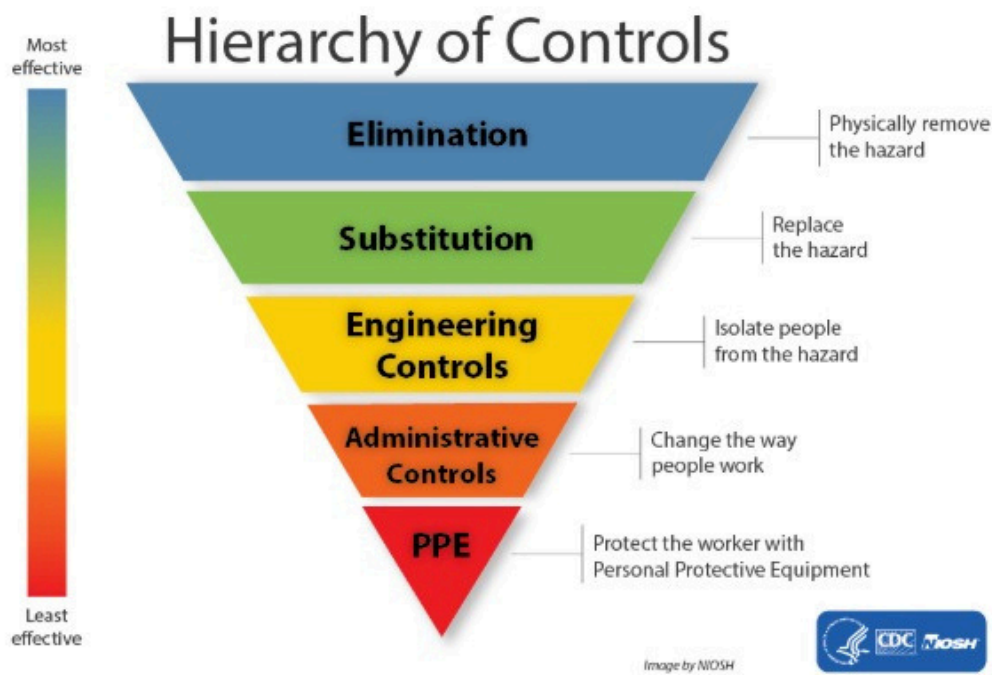
A Student-Specific Risk Assessment includes:

- ▶ Reviewing relevant IEPs, 504 Plans, or medical documentation
- ▶ Identifying how physical layout, tools, materials, or procedures may introduce elevated risk for the student
- ▶ Adjusting instructional methods, equipment, or supervision accordingly
- ▶ Documenting all safety-related decisions and controls

For example, a task involving rotating machinery may present increased entanglement risk for a student with limited motor control, while a high-noise environment may limit hazard awareness for a student who is deaf or hard of hearing. These differences do not eliminate participation, they require intentional planning and layered controls. (NIOSH; ADA)

Figure 32

This figure illustrates the hierarchy of controls, prioritizing elimination and engineering controls over PPE. It helps educators understand that safer instructional design reduces reliance on student behavior alone to prevent injury.



Source: CDC

7.3 Supervision Ratios and Teacher Positioning

Supervision must be matched to task risk. Higher-risk activities require lower student-to-teacher ratios and closer physical proximity (ITEEA, ACTE, NSTA).

Implications for High School CTE

Safer supervision includes:

- ▶ Adjusting class size or activity scope based on recognized safety hazard(s). (24 students should be the max enrollment)
- ▶ Positioning teachers to observe critical operations with line-of-sight
- ▶ Stopping work immediately when supervision is compromised
- ▶ Avoiding simultaneous high-risk tasks reducing supervision capabilities

Teachers cannot supervise effectively from behind desks.

If you cannot intervene immediately, supervision is inadequate.

Program-Specific Context

- ▶ **Manufacturing:** One-on-one supervision for certain equipment / machine use
- ▶ **Construction:** Close monitoring during cutting and lifting
- ▶ **Automotive:** Control during vehicle movement
- ▶ **Health Sciences:** Oversight during medical simulations and procedures
- ▶ **Agriculture:** Supervision near animals and Ag equipment

Appropriate spacing of CTE activities to avoid accidents across areas where large or heavy equipment is used

Figure 33

Occupancy Load and Accidents in STEM Classes. Risks increase when class size is over 25. (Love, 2025)

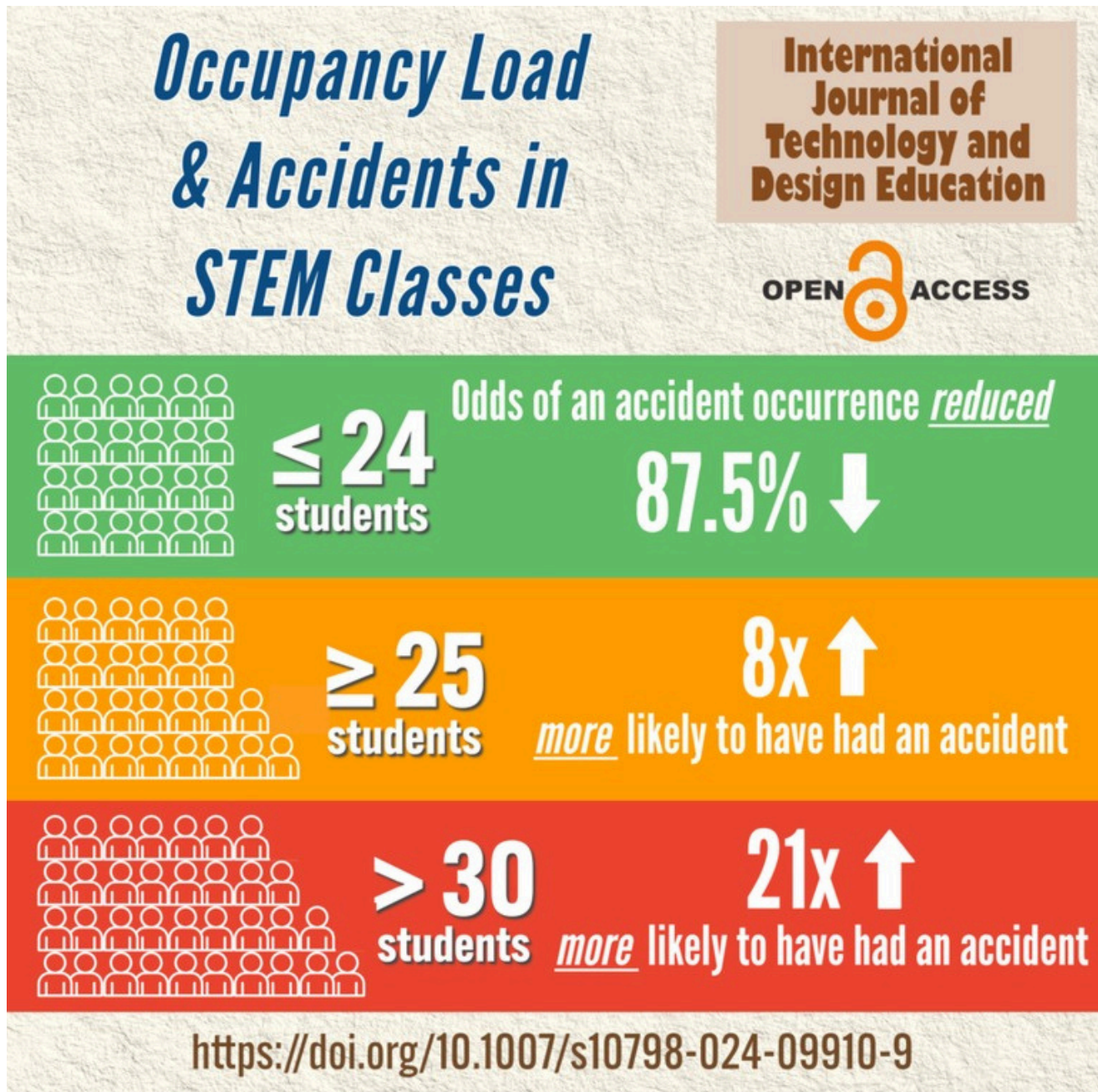


Figure 34

Close monitoring during cutting and lifting.



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7.4 Student Behavior, Authorization, and Removal from Activity

Unsafe behavior must result in immediate removal from the activity. Continued access to recognized potential hazards and resulting risks is contingent on safer conduct, not academic progress (OSHA).

Unsafe behavior ends the activity immediately

Implications for High School CTE

Effective behavior management includes:

- ▶ Clear, written safety rules and use of student safety acknowledgment forms
- ▶ Progressive discipline aligned with district policy
- ▶ Immediate removal from hazard exposure
- ▶ Documentation of unsafe behavior
- ▶ Reauthorization only after corrective action

Safety rules are conditions of participation.

Program-Specific Context

- ▶ **All CTE areas:** Consistent enforcement across programs (Gill, 2019)

Most serious injuries occur during routine activities when planning assumptions go unexamined. Hazard analysis is not pessimism; it is preparation. Installing layered controls before instruction begins is similar to rehearsing a complex performance before opening night. The audience sees fluency. What makes it possible is deliberate practice behind the scenes. In CTE performing a hazard analysis and risk assessment are critically important to prevent possible accidents.

Instructional risk management in CTE is not an add-on; it is the foundation of credible, defensible instruction. When recognized and potential hazards are anticipated, controls are layered, and supervision is active, students learn safely and professionally (OSHA; NIOSH).

VIII EMERGENCY RESPONSE & INCIDENT MANAGEMENT

Preparedness determines outcomes.

— James Palcik, CHO, Safer STEM

Emergencies in CTE environments are rarely unpredictable. They are the result of unmanaged hazards and risks, equipment failure, or breakdowns in supervision. Effective emergency response limits harm, protects lives, and preserves the integrity of instructional programs (OSHA).



8.1 Immediate Response to Injuries

All injuries must be addressed immediately and according to district emergency procedures. Students are not responders; they are protected individuals under adult direction (OSHA).

Implications for High School CTE

Effective response includes:

- ▶ Stopping all activity immediately in case of an injury or emergency
- ▶ Securing potential hazards to prevent additional injury
- ▶ Providing first aid within the scope of training and accepted procedures in your school district
- ▶ Contacting emergency services when required
- ▶ Notifying administration promptly and documenting the incident

Delays increase severity.

Instruction stops when someone is hurt.

Program-Specific Context

- ▶ **Manufacturing:** Crush or laceration injuries
- ▶ **Construction:** Falls or tool-related injuries
- ▶ **Automotive:** Vehicle movement incidents
- ▶ **Health Sciences:** Exposure incidents
- ▶ **Agriculture:** Equipment or animal injuries

Emergency response procedures must account for the needs of all students, including those who may not be able to respond quickly or independently due to physical, sensory, or cognitive factors.

Educators must evaluate:

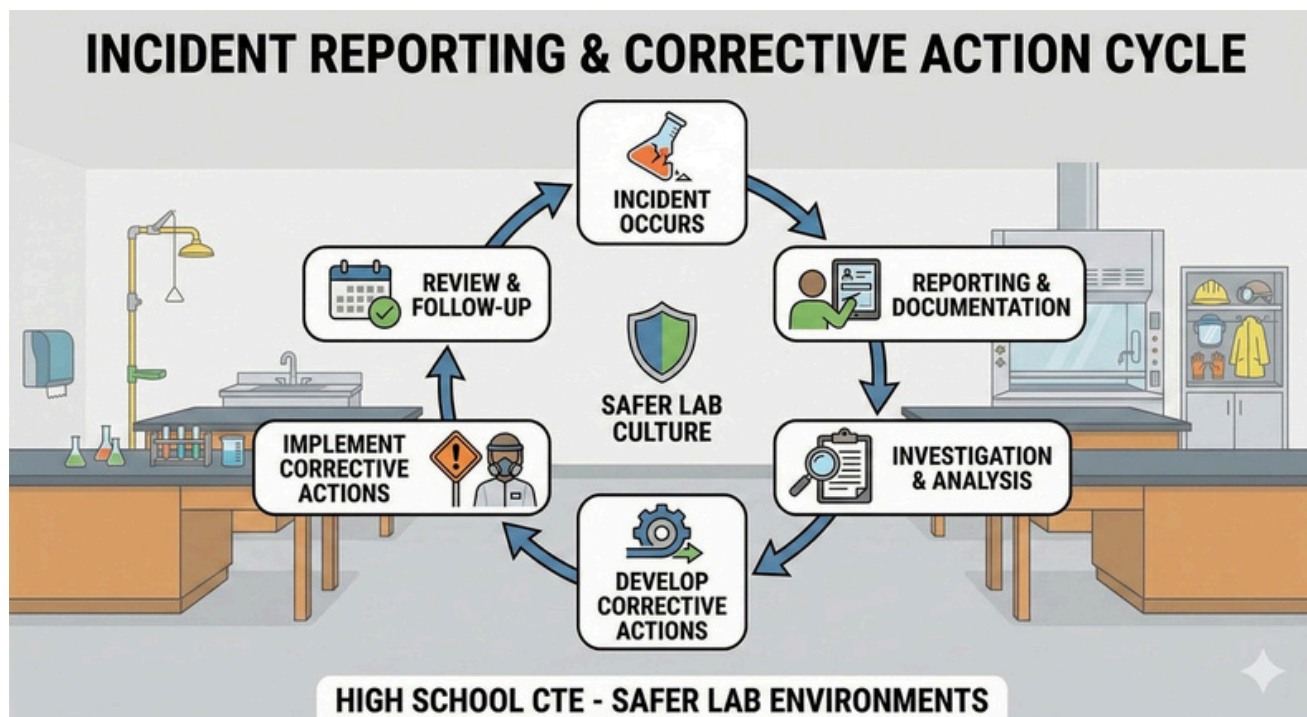
- ▶ Whether each student can independently access emergency equipment (e.g., eyewash, shutoffs)
- ▶ Whether evacuation routes are navigable, given mobility or sensory limitations
- ▶ Whether assistance is required during emergency response conditions

Best practices for students with additional needs include:

- ▶ Pre-identifying students requiring additional support
- ▶ Assigning trained peer or adult assistance when appropriate
- ▶ Practicing modified emergency procedures in advance
- ▶ Positioning students strategically within the instructional space

Figure 35

This flowchart outlines the steps educators should take immediately following an injury. It reinforces for teachers that rapid, structured response minimizes harm and ensures compliance with emergency procedures.



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| 8.2 Fire, Explosion, and Energy Release Incidents

Fire, explosion, or uncontrolled energy release requires immediate evacuation unless the potential safety hazard can be safely controlled by appropriately trained personnel (NFPA).

Implications for High School CTE

Safer response includes:

- ▶ Activating fire alarms when required
- ▶ Directing students to evacuate CTE space immediately
- ▶ Using fire extinguishers only if trained and conditions permit
- ▶ Accounting for all students at the assembly point

Property is replaceable. Lives are not.

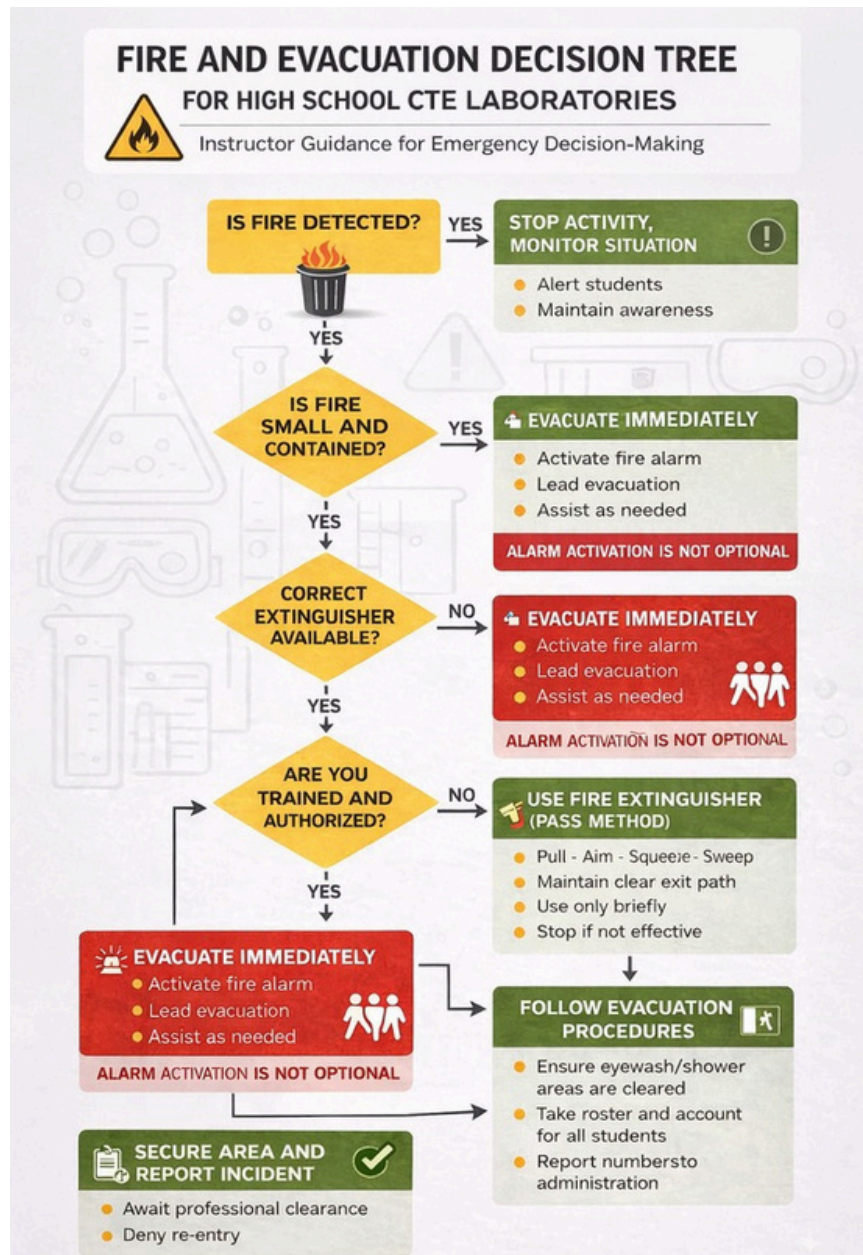
| When in doubt, evacuate.

Program-Specific Context

- ▶ **Manufacturing:** Welding or electrical fires
- ▶ **Construction:** Combustible materials
- ▶ **Automotive:** Fuel or battery fires
- ▶ **Health Sciences:** Electrical equipment failures
- ▶ **Agriculture:** Grain dust or fuel fires

Figure 36

This diagram guides decision-making during fire or explosion scenarios, including when to evacuate. It helps teachers prepare students to respond appropriately under pressure and reinforces that safety decisions must prioritize life over property.



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8.3 Chemical, Biological, and Environmental Releases

Spills, releases, or exposures involving hazardous materials must be managed according to written procedures. Improvised responses increase possible harm and potential liability (EPA; CDC).

Implications for High School CTE

Effective response includes:

- ▶ Isolating the affected area(s)
- ▶ Preventing student involvement in cleanup
- ▶ Using spill kits only in appropriate situations if trained on safer use
- ▶ Notifying appropriate authorities when escalation is required
- ▶ Documenting the incident fully (do the same for near miss or close call)

Students must never clean hazardous spills.

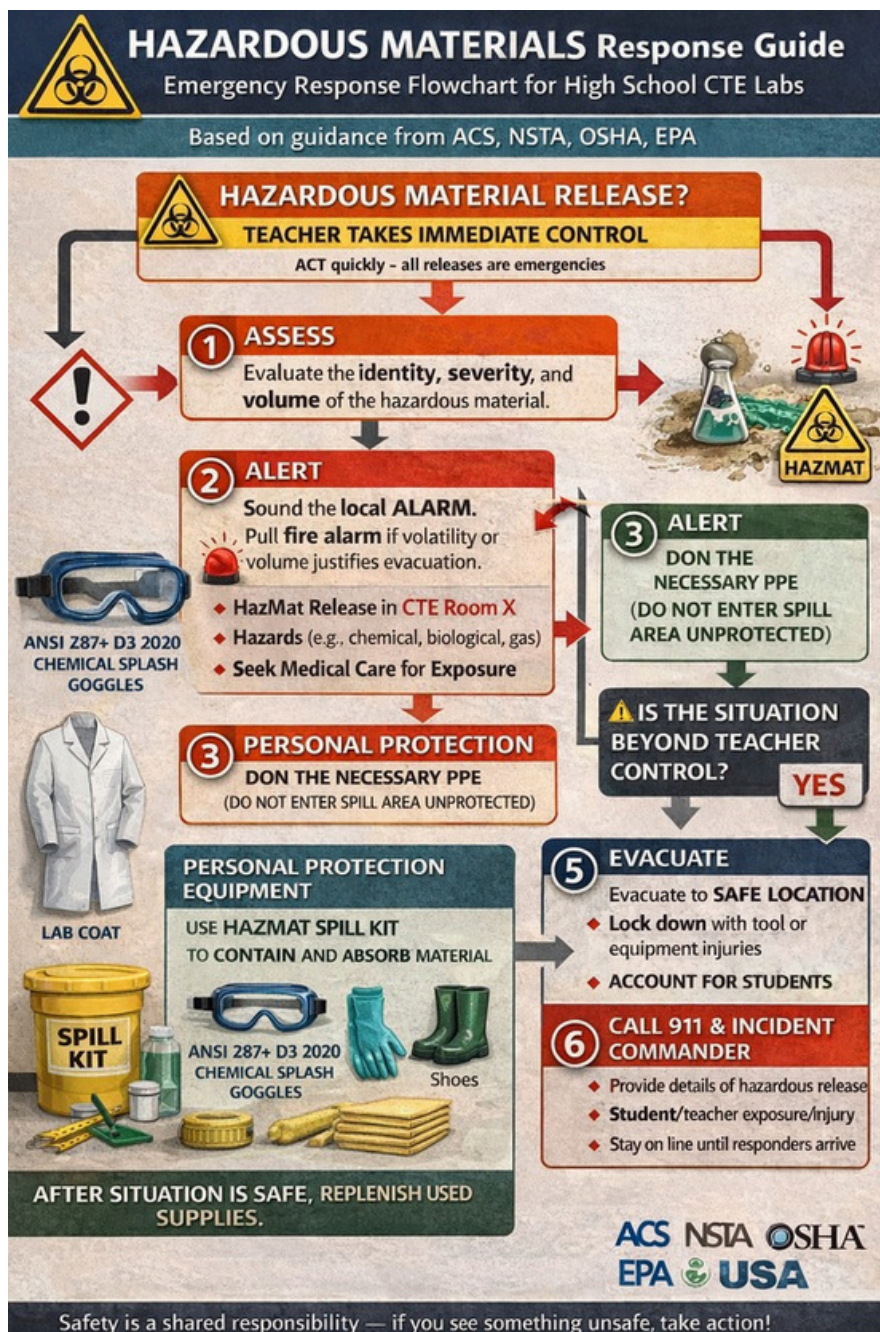
If the response is unclear, stop and escalate.

Discipline-Specific Context

- ▶ **Manufacturing:** Solvent or chemical spills
- ▶ **Construction:** Leaking hydraulic fluids
- ▶ **Automotive:** Fuel or oil releases
- ▶ **Health Sciences:** Biohazard exposure
- ▶ **Agriculture:** Pesticide releases

Figure 37

This figure provides a structured approach to managing chemical or biological spills and exposures. It supports teachers in reinforcing that students should not handle hazardous cleanup and that escalation procedures must be followed.



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8.4 Biological and Bloodborne Pathogen Response

Exposure to blood or other potentially infectious materials requires immediate protective action and adherence to established bloodborne pathogen procedures. Assumptions about risk must not delay response (OSHA).

Implications for High School CTE

Safer response includes:

- ▶ Use of appropriate PPE during cleanup and containment
- ▶ Isolation of affected areas and control of student movement
- ▶ Disinfection using approved agents and procedures
- ▶ Disposal of contaminated materials according to district protocols
- ▶ Reporting and documentation consistent with district policy

If blood is present, stop, protect, isolate, and follow procedure every time.

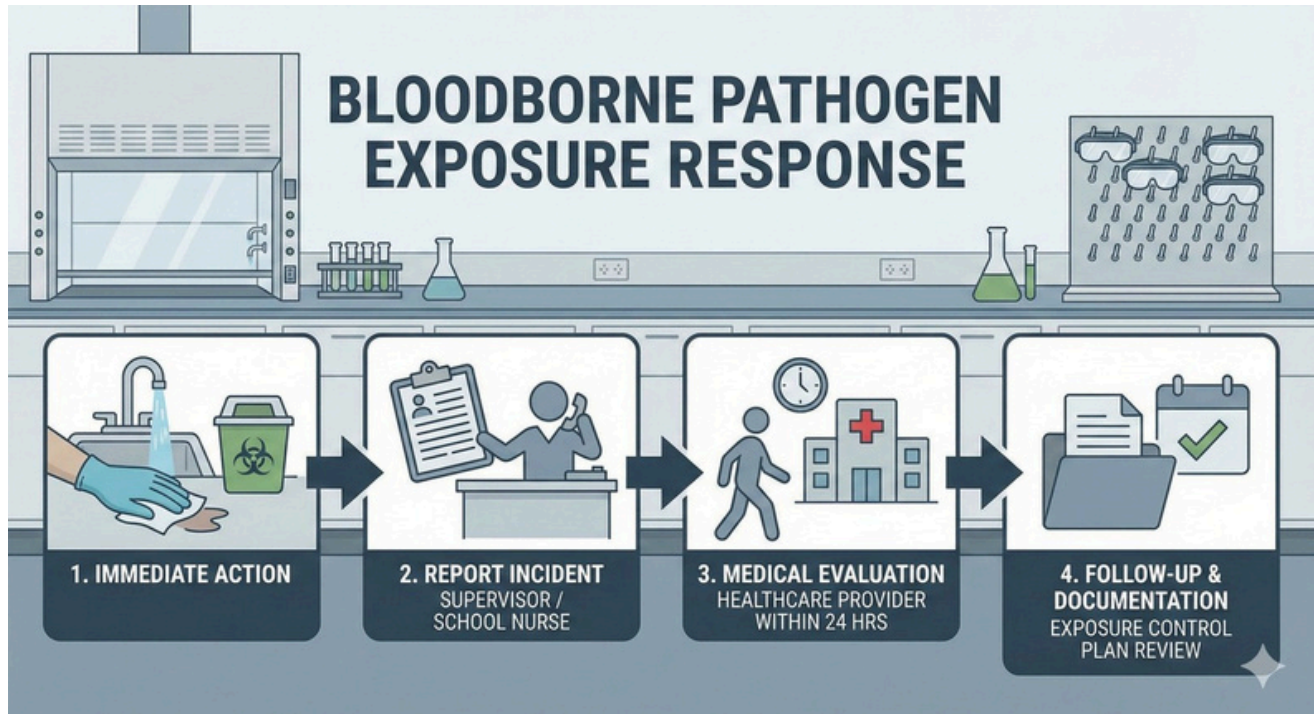
Discipline-Specific Considerations

- ▶ **Biology:** Specimens and sharps increase exposure risk
- ▶ **Chemistry:** Mixed biological and chemical hazards require dual controls
- ▶ **Physics & Earth & Environmental Science:** Field injuries may involve delayed access to supplies

Blood or bodily fluid presence always triggers formal response procedures. Prohibit the use of bodily fluids and local specimens from camping, fishing, hunting, or roadkill in your CTE program due to the potential for bloodborne pathogens and other unknown risks associated with this practice.

Figure 38

Bloodborne pathogen response steps for school laboratories



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8.5 Reporting, Investigation, and Corrective Action

All incidents, injuries, and near misses must be reported, investigated, and used to improve safety systems. Documentation protects students and institutions (OSHA). There should not be a fear of reporting these near miss incidents as these are valuable teaching and learning systems which are beneficial to the overall CTE program locally and nationally.

Near-miss events, situations where potential hazards and resulting safety risks were present, but injury did not occur, should be documented and reviewed. These events provide early indicators of system weaknesses and help prevent potential future accidents or injuries.

Implications for High School CTE

Effective incident management includes:

- ▶ Completing incident reports promptly
- ▶ Preserving evidence when required
- ▶ Conducting root cause analysis
- ▶ Implementing corrective actions
- ▶ Communicating lessons learned

If it is not documented, it did not happen.

Program-Specific Context

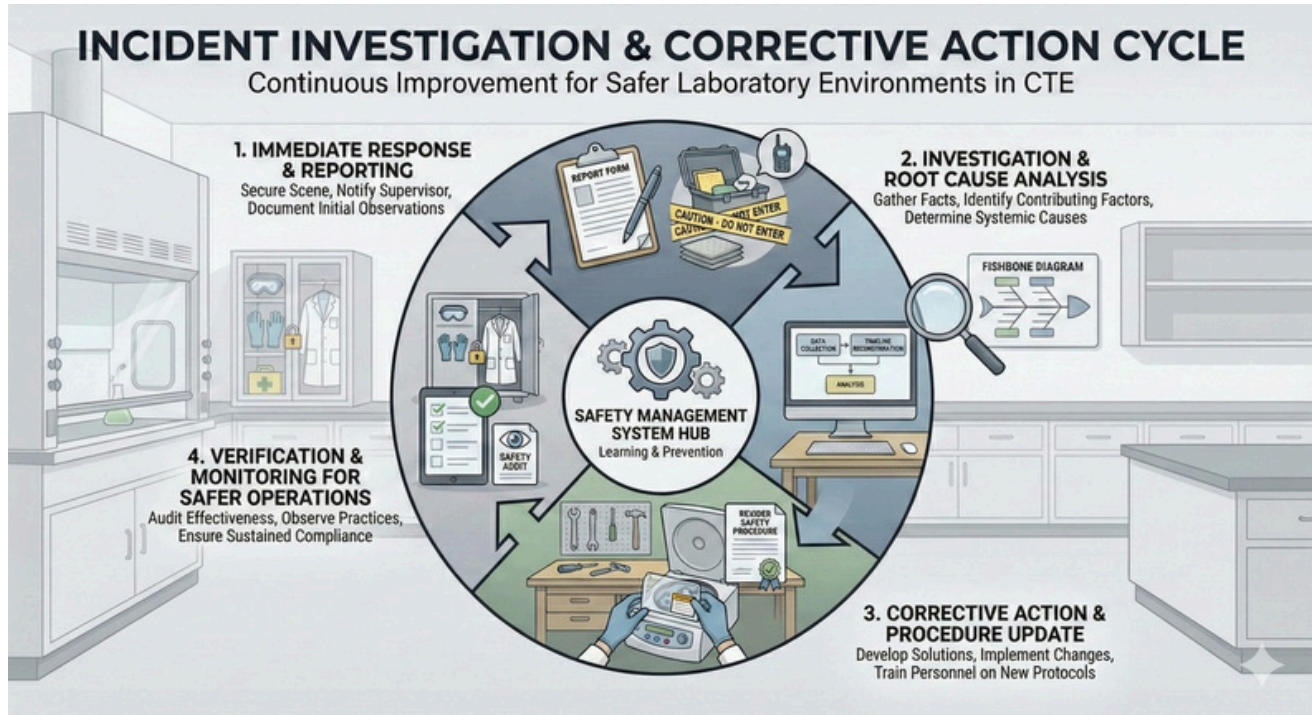
- ▶ **All CTE programs:** Systemic issues often cross program lines. Safer CTE practice is founded on following established procedures and routines.

Near-misses are warnings, not successes.

Emergencies rarely introduce entirely new problems. They expose existing weaknesses. Preparedness is less about dramatic response and more about disciplined rehearsal. Near misses deserve attention not because they caused harm, but because they reveal where harm almost occurred. Smoke is useful information. Ignoring it does not make the building safer.

Figure 39

This diagram illustrates how incidents are analyzed and used to improve safety systems. It reinforces that continuous improvement is built on reviewing both incidents and near misses.



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Closing Note from the Safety Desk

Emergency response in CTE is not about heroics; it is about preparation, clarity, and disciplined action. Programs that plan for emergencies respond faster, reduce harm, and strengthen their safety culture (OSHA; NFPA).



IX TRAINING, DOCUMENTATION, AND PROGRAM OVERSIGHT

Alignment without documentation is exposure.

— James Palcik, CHO, Safer STEM

High-quality CTE programs align instruction with workforce expectations without transferring workforce risk to students. Alignment does not reduce duty of care.

It increases the need for documentation, oversight, and verification. Training systems and records are the backbone of defensible CTE safety programs (OSHA).

9.1 Educator Safety Training

All CTE instructors and support staff must receive regular, documented safety training appropriate to the recognized safety hazards and corresponding risks present in their instructional spaces. Training is a professional obligation and an institutional responsibility, not a one-time event (OSHA; ACTE)

Implications for High School CTE

Effective training systems include:

- ▶ Initial safety orientation for new CTE teachers and aides
- ▶ Annual refresher training focused on program-specific hazards
- ▶ Targeted training before introducing new equipment or processes
- ▶ Documentation of training dates, topics, and participants
- ▶ Verification that training aligns with actual instructional practice
- ▶ Specific training is required for the safer use and maintenance of equipment, tools, apparatus, and instrumentation when new additions to the CTE program arrive, including software
- ▶ Safety checklists used as needed for inspecting equipment, apparatus, materials, as well as engineering controls, PPE, and fire safety items, as required by OSHA and NFPA

Training that is not recorded is assumed not to have occurred.

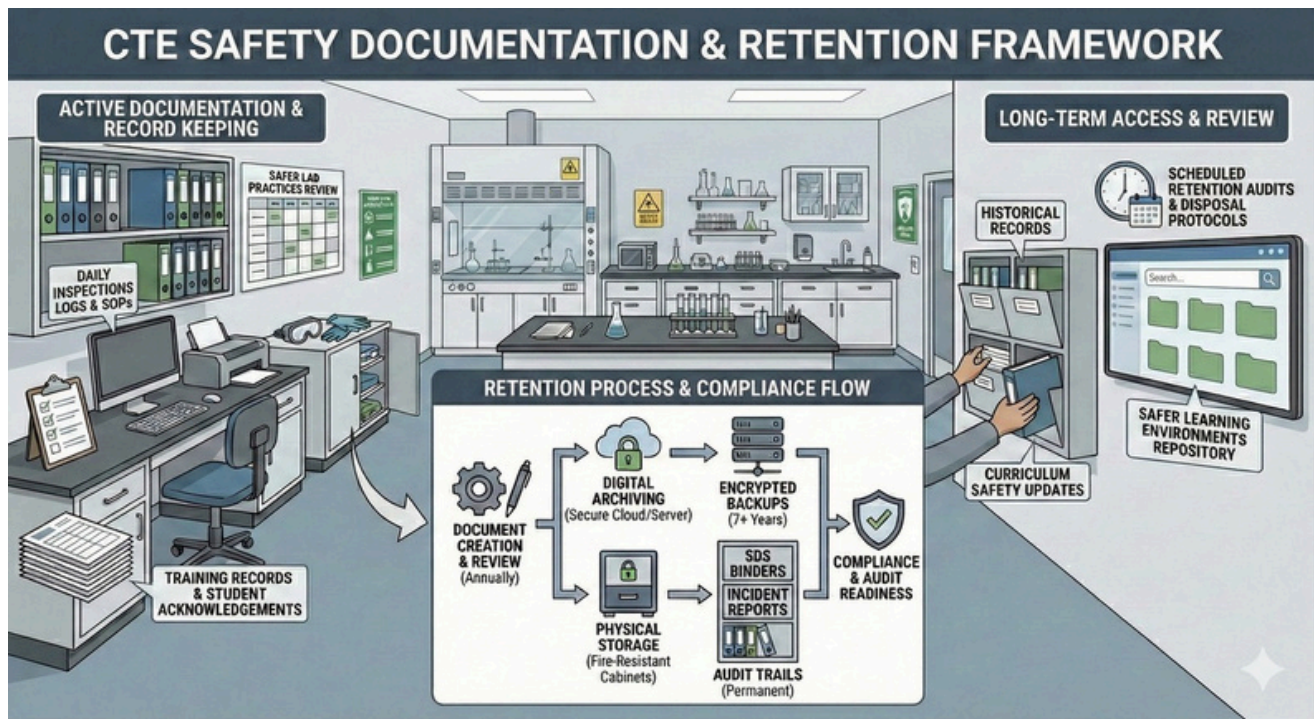
Memory is not evidence.

Discipline-Specific Considerations

- ▶ **Manufacturing:** Machine safety and guarding
- ▶ **Construction:** Tool, fall, and jobsite safety
- ▶ **Automotive:** Lift, fuel, and electrical safety
- ▶ **Health Sciences:** Infection control and exposure prevention
- ▶ **IT:** Electrical and ergonomic safety
- ▶ **Agriculture:** Equipment and chemical safety

Figure 40

This figure shows how teacher safety training is tracked and documented. It helps educators understand that training records are essential for accountability and compliance.



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9.2 Student Safety Instruction and Authorization

Students must receive explicit safety instruction and demonstrate competence before being authorized to use equipment or participate in hazardous tasks. Authorization is task-specific and revocable (OSHA; NIOSH).

Implications for High School CTE

Effective student authorization systems include:

- ▶ Documented safety instruction tied to specific hazards
- ▶ Written skill authorization records for tools and machines
- ▶ Visible authorization indicators (badges, rosters, tags) (Farmer, 2018)
- ▶ Immediate revocation of authorization for unsafe behavior

Enrollment does not equal authorization.

Access is earned through safe performance.

Program-Specific Context

- ▶ **Manufacturing:** Machine-specific authorization
- ▶ **Construction:** Tool and equipment authorization
- ▶ **Automotive:** Lift and vehicle authorization
- ▶ **Health Sciences:** Procedure competency verification
- ▶ **IT:** Electrical system access control
- ▶ **Agriculture:** Equipment and animal handling authorization

Figure 41

This diagram outlines how student authorization is documented and monitored. It reinforces that access to tools and equipment must be earned and verified.



| 9.3 Documentation, Record Retention, and Legal Defense

CTE safety documentation must be current, complete, and verifiable. Documentation protects students first and institutions second (Roy, 2019)

Implications for High School CTE

Defensible documentation includes:

- ▶ Teacher safety training records
- ▶ Student safety instruction logs
- ▶ Equipment inspection and maintenance records
- ▶ Incident and near-miss reports
- ▶ PPE training acknowledgments

If it is not documented, it will not be believed.

Program-Specific Context

- ▶ **All CTE programs:** Documentation supports accountability

Records must be retained according to district and state policy.

Figure 42

Courtroom gavel.



| 9.4 Program Review and Continuous Improvement

CTE safety systems must be reviewed regularly to identify gaps, address emerging hazards, and resulting safety risks, and improve practice. Continuous improvement is a professional expectation (ACTE; NASDTEC).

Implications for High School CTE

Effective review systems include:

- ▶ Regular safety audits and inspections
- ▶ Review of incident trends and near misses
- ▶ Updates to training and procedures
- ▶ Communication of lessons learned
- ▶ Verification that corrective actions are completed

Past success does not guarantee future safety.

Discipline-Specific Considerations

- ▶ **All CTE areas:** Continuous improvement strengthens program credibility

Safety systems must evolve as programs evolve.

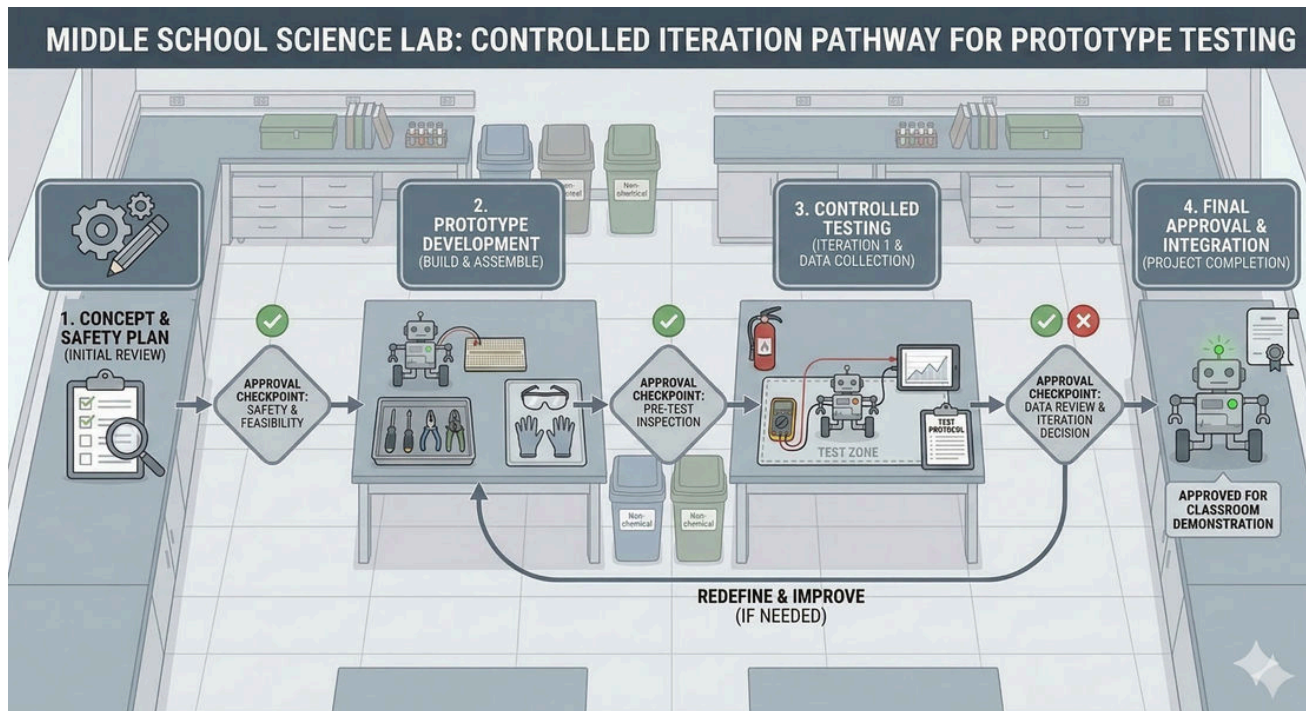
High-performing programs often rely on strong relationships and shared norms. Those matter. Yet in safety leadership, memory is not evidence. Documentation serves the same purpose as a flight recorder. It does not replace professionalism; it makes professionalism visible. When safety training, authorization, and inspection systems are recorded consistently, leaders protect both students and the integrity of the program.

Closing Note from the Safety Desk

CTE safety programs succeed when training is intentional; documentation is complete, and oversight is consistent. These systems protect students, support educators, and ensure that programs withstand professional and legal scrutiny (OSHA; ACTE).

Figure 43

This figure illustrates how ongoing review, feedback, and updates strengthen safety systems over time. It encourages teachers to view safety as a dynamic process that evolves with instructional practices and emerging risks.



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× MANUFACTURER INSTRUCTIONS AS A CORE SAFETY STANDARD

If it cannot be defended on paper, it cannot be defended after an incident.
— James Palcik, CHO, Safer STEM

In high school CTE programs, tool safety does not begin with reminders about PPE or verbal warnings about moving parts. It begins earlier, with the disciplined use of equipment exactly as the manufacturer intended. Manufacturer instructions define how tools are designed to operate safely, the limits that must not be exceeded, and the conditions under which injury risk is reduced.

Ignoring those instructions undermines both student safety and professional credibility (OSHA; ANSI/ISEA). Potential liability exists for those CTE instructors and administrators who ignore these operational manuals and manufacturer PD sessions.

Manufacturer guidance is not optional documentation. It is the most specific, task-relevant safety direction available for each individual machine or tool used in a CTE instructional space.

10.1 What Manufacturer Instructions Actually Provide

Manufacturer instructions, including operator manuals, service manuals, Safety Data Sheets (where applicable), guarding specifications, approved accessories, inspection requirements, and maintenance schedules, function as tool-specific safety standards.

They define:

- ▶ Approved and prohibited uses
- ▶ Required guarding, interlocks, and safety devices
- ▶ Startup, operation, and shutdown procedures
- ▶ Accessory compatibility and configuration limits
- ▶ Inspection and maintenance boundaries
- ▶ Conditions under which equipment must be removed from service
- ▶ Authorized maintenance technicians and vendors contacts

These instructions are developed through engineering analysis, testing, and incident history. They represent the safest known way to operate that specific piece of equipment as designed (ANSI/ISEA; ASSP).

When educators treat manufacturer instructions as optional, students learn unsafe habits that do not transfer to the workplace. When educators treat them as the baseline expectation, students develop professional routines that align with industry practice, a documented goal of high-quality CTE programs (ACTE).



10.2 The Legal and Professional Rationale

CTE programs operate in environments where recognized legal safety standards and accepted professional practices define what “reasonable care” looks like. Manufacturer instructions connect directly to that framework.

- ▶ **Machine guarding and safer operation:** OSHA machinery and machine-guarding requirements rely on manufacturer-provided guards and accessories designed for specific machines. Substituting, removing, or bypassing these features violates both the intent of the standard and accepted professional practice (OSHA).
- ▶ **Control of hazardous energy:** Lockout/tagout expectations require machine-specific shutdown and isolation steps. These steps are defined by the manufacturer and must be followed during blade changes, jam clearing, troubleshooting, or maintenance (OSHA).
- ▶ **Electrical safety work practices:** NFPA 70E requires task- and equipment-specific procedures for electrical hazards. Generic rules are insufficient without reference to the manufacturer’s design and operating parameters (NFPA).
- ▶ **Risk assessment and safeguarding:** ANSI/ISEA B11 standards emphasize risk reduction based on machine design, intended use, and safeguarding methods; information that originates with the manufacturer (ANSI/ISEA).
- ▶ For hardwired equipment, this would involve shutting off the breaker employing a LOTO action. For 120V machinery and equipment this means unplugging it from the wall before servicing

Ignoring manufacturer requirements is not a neutral decision. It is a documented deviation from recognized safer practice.

If a manufacturer specifies a guard, procedure, or limit and it is ignored, that decision will be examined after an incident.

10.3 What This Looks Like in a High-Performing CTE Program

In effective CTE safety systems, every machine has its own written operating standard derived directly from manufacturer guidance. These standards are accessible, enforced, and taught explicitly with constant and consistent reinforcement.

A defensible operating standard in CTE includes:

- ▶ Approved uses and clearly stated prohibited uses
- ▶ Required guards and safety devices, and procedures if they are missing or damaged
- ▶ Pre-use inspections (power cords, belts, blades, emergency stops, ventilation)
- ▶ Correct setup procedures (work holding, tool selection, speeds, feeds, accessories)
- ▶ Maintenance boundaries distinguishing teacher/student actions from qualified service work
- ▶ Shutdown and energy-isolation steps for jams, adjustments, and servicing

This approach aligns with national CTE safety guidance emphasizing prevention, documentation, and professional safety culture rather than informal rule-of-thumb instruction (ACTE).

Every machine teaches students how seriously we take safety, before they ever touch the power switch.



10.4 The Instructional Payoff

Anchoring instruction to manufacturer requirements and recognized safety standards produces three measurable benefits:

- 01.** Fewer incidents and near misses because procedures are precise and machine-specific, not generic.
- 02.** Stronger skill transfer because students learn routines consistent with workforce expectations.
- 03.** Greater legal and professional defensibility because training, procedures, and expectations are grounded in recognized standards and documented guidance (OSHA; ACTE).

Manufacturer instructions do more than protect equipment. They protect students, educators, and programs.

Closing Note from the Safety Desk

Manufacturer instructions can feel technical and procedural. In reality, they represent the accumulated lessons of engineering analysis and prior incidents. Treating them as optional is similar to adjusting a prescription without reading the dosage. Precision is not rigidity. It is respect for boundaries established through experience. When instruction mirrors manufacturer guidance, students learn not only how to operate tools, but how professionals honor their limits.

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ANNEX A

NFPA AND ANSI/ISEA STANDARDS DEFINING PROFESSIONAL CTE PRACTICE

CTE Instructional Context or Decision	Relevant NFPA / ANSI/ISEA Standard	Role of the Consensus Standard	Required Safer Practices	Professional Practice Implication
Selection and enforcement of eye and face protection	ANSI/ISEA Z87.1	Defines minimum performance and impact ratings for protective eyewear	Safety glasses with side shields (ANSI/ISEA Z87.1); goggles when splash or debris risk exists (Z87.1D3 2020)	PPE that is not ANSI/ISEA rated or certified is not professionally defensible
Use of chemical splash protection in labs or applied science spaces	ANSI/ISEA Z87.1 D3 (2020)	Specifies indirect-vented chemical splash goggles	D3-rated goggles; proper fit and storage; inspection before & after use	Choice of goggles is a professional judgment benchmark
Availability and placement of eyewash and emergency showers	ANSI/ISEA Z358.1	Establishes location, flow rate, activation, and maintenance criteria	Unobstructed access; weekly activation checks; tepid, hands-free water supply	Presence alone is considered insufficient—performance must meet the standard
Fire prevention, flammable materials, and ignition control Electrical systems, cords, and equipment use	NFPA 45 / NFPA 101 NFPA 70 (National Electrical Code)	Defines fire protection expectations for instructional environments Defines acceptable electrical installation and use	Ignition control; material quantity limits; housekeeping practices Grounded outlets; cord condition checks; no improvised wiring	NFPA standards establish baseline fire prevention practice Unsafe electrical setups undermine professional duty of care

CTE Instructional Context or Decision	Relevant NFPA / ANSI/ISEA Standard	Role of the Consensus Standard	Required Safer Practices	Professional Practice Implication
Storage, handling, and disposal of hazardous materials	NFPA 400; ANSI/ISEA labeling norms	Establishes material compatibility and hazard communication	Proper labeling; secondary containment; approved disposal routes	Improper storage is considered a foreseeable hazard
Machine and tool operation in CTE labs	ANSI/ISEA machines specific standards	Define guarding, emergency stops, and operational safeguards	Machine guarding; lockout awareness; documented training	Consensus standards shape expectations for safer tool use
Emergency planning and response readiness	NFPA 72; ANSI/ISEA Z535	Define alarm systems, signage, and emergency communication	Clear signage; audible/visual alarms; emergency procedures	Emergency readiness is a systems responsibility
Selection of gloves and hand protection	ANSI/ISEA 105	Establishes cut, heat, and chemical resistance ratings	Nitrile/non-latex gloves for chemicals; insulated gloves for thermal hazards	Glove choice must match hazard, not convenience
Damaged or missing engineering controls (extinguishers, eyewash, shutoffs)	NFPA / ANSI/ISEA referenced by OSHA	Establish when activities must cease	All activities prohibited until controls are restored	Continuing instruction is professionally indefensible

ANNEX B:

OSHA CONSTRUCTION STANDARDS

Instructional Activity or Condition	Does OSHA Construction (29 CFR 1926) Apply?	Primary Standard Reference	Required Safer Practices	Educator Decision Notes
Use of hand tools (hammers, screwdrivers, hand saws) on nonstructural classroom projects	No	OSHA 29 CFR 1910 (General Industry)	Safety glasses (ANSI/ISEA Z87.1 with side shields); task-specific gloves; hazard assessment before activity	Classroom fabrication alone does not trigger construction standards
Use of portable power tools (drills, sanders) for instructional fabrication	No	OSHA 1910 Subpart P	Safety glasses (ANSI/ISEA Z87.1) with side shields; hearing protection as needed; cord inspection; dust control	Emphasize safer tool condition checks and supervision
Framing, roofing, or structural assembly simulating realworld construction tasks	Yes	OSHA 1926 Subparts M, E	Hard hats; safety glasses (ANSI/ISEA Z87.1) with side shields; gloves; fall hazard controls; restricted access zones	Construction standards apply when work mirrors structural construction methods
Ladder or scaffold use for instructional construction simulations	Yes	OSHA 1926 Subpart L, X	Ladder inspection; fall prevention; footwear; supervision; exclusion zones	Height-related hazards trigger construction applicability

Demolition or material removal (wall sections, flooring mock-ups)	Yes	OSHA 1926 Subpart T	Eye and face protection - safety glasses (ANSI/ISEA Z87.1) with side shields; dust control; material handling protocols	Even simulated demolition requires construction safeguards
Use of stationary shop equipment (table saws, drill presses) in CTE labs	No	OSHA 1910 Subpart O	Machine guarding; safety glasses (ANSI/ISEA Z87.1) with side shields; push sticks; training documentation	These remain General Industry activities
Concrete mixing, masonry, or bricklaying activities	Yes	OSHA 1926 Subparts E, Q	Nitrile gloves; eye protection; dust control; skin protection; spill response	Cement and masonry tasks fall under construction
Electrical wiring beyond low-voltage classroom kits	Yes	OSHA 1926 Subpart K	Lockout awareness; insulated tools; PPE; instructor authorization	Real-world electrical installation triggers construction rules
Prefabricated kit assembly (sheds, benches, nonstructural builds)	Usually No	OSHA 1910	Safety glasses; gloves; material handling protocols	Evaluate complexity and structural risk
Any activity with damaged or missing engineering controls (extinguishers, eyewash/showers, shut-offs)	Prohibited	OSHA 1910 / 1926	All activities must stop until controls are restored	Duty of care overrides instructional goals

ANNEX C:

PURPOSE-DESIGNED CTE FACILITIES ALIGNED TO HAZARD TYPE

Guidance for Professional Instructional Planning and Risk Management

This table explains how CTE instructional spaces must be purpose-designed to match recognized hazard type, not course title. Aligning facilities to recognized hazards supports foreseeable risk reduction, regulatory alignment, and professionally defensible practice in high school CTE programs.

Facility Design and Hazard Alignment Table

CTE Hazard Type	Purpose Designed Facility Characteristics	Required Safer Controls	PPE Expectations (When Applicable)	Professional Practice Notes
Chemical hazards (corrosives, irritants, flammables)	Chemical-rated lab surfaces; controlled ventilation; spill containment; chemical-resistant finishes	Eyewash/showers (ANSI/ISEA Z358.1); labeled disposal containers; SDS access; secondary containment	Chemical splash goggles (ANSI/ISEA Z87.1 D3); nitrile/nonlatex gloves; lab coats as required	Methanol/methyl alcohol is prohibited, replace with ethanol and consult supervisor before demonstrations
Mechanical hazards (cutting, rotating, pinch points)	Dedicated shop space; fixed equipment layout; clear safety zones; machine guarding	Emergency shutoffs; machine guards; lockout/tagout capability	Safety glasses (ANSI/ISEA Z87.1 with side shields); task appropriate gloves when permitted	Equipment use requires prior training and documented authorization

Thermal hazards (hot tools, molten materials, heat sources)	Heat-resistant surfaces; clear separation from flammable materials; controlled access	Fire extinguishers; burn first-aid supplies; thermal isolation	Insulated gloves for hot/cold; eye protection based on task	Heat sources are not operated during instruction without supervision
Electrical hazards (line voltage, energized equipment)	Grounded outlets; GFCI protection; clearly labeled panels; restricted access	Lockable disconnects; inspection protocols; emergency shutoff access	Safety glasses; insulated tools when applicable	Live electrical work is prohibited for students
Compressed gas and pressure hazards	Secured cylinders; rated regulators; dedicated storage and use areas	Cylinder restraints; valve protection; inspection logs	Safety glasses; gloves as required	Transport and setup are instructor controlled
Biological hazards (microorganisms, biological materials)	Non-porous surfaces; handwashing sinks; waste segregation	Biohazard disposal procedures; disinfection protocols	Gloves (nitrile/nonlatex); eye protection when splash risk exists	Activities align with BSL appropriate school guidance
Dust and particulate hazards (wood, metal, composites)	Dust-controlled work zones; separation from instruction areas	Dust collection systems; housekeeping protocols	Safety glasses; respiratory protection if approved	Dry sweeping is avoided to reduce airborne particulates

CTE Hazard Type	Purpose Designed Facility Characteristics	Required Safer Controls	PPE Expectations (When Applicable)	Professional Practice Notes
Noise hazards	Acoustic considerations; separation of noisy equipment	Noise exposure monitoring; scheduling controls	Hearing protection when required	Noise control supports both safety and instruction
Mixed or highrisk hazards	purpose designed spaces only	Layered controls; restricted access; documented risk assessment	Task-specific PPE based on hazard	Mixed hazards require elevated review and approval
Facilities with damaged or missing engineering controls	Not suitable for instruction	All activities prohibited until controls are restored	N/A	Duty of care overrides instructional goals

ANNEX D:

CTE GENERAL SAFETY TEST

Below is a student-facing version of the CTE General Safety Test, with no answers included.

CTE General Safety Test

Total Questions: 20

Student Name: _____

CTE Course / Program: _____

Date: _____

Part A: True / False

Circle T for True or F for False. **01. T / F** – Safety rules in CTE labs are based on real workplace standards and expectations.

02. T / F – Personal protective equipment (PPE) is only required when the teacher is watching.

03. T / F – Machine guards and safety devices must never be removed or bypassed.

04. T / F – Students should report unsafe conditions or damaged equipment immediately.

05. T / F – Loose clothing, jewelry, and long hair can create safety hazards in CTE labs.

06. T / F – Horseplay and distractions are acceptable if no tools are in use.

07. T / F – Students must be trained and authorized before using tools, equipment, or machinery.

08. T / F – Following safety rules helps prepare students for real-world careers.

Part B: Fill in the Blank

Write the correct word or phrase in each blank.

Use the following words:

POWER PERSONAL TRAINING MACHINE WRITTEN ACCEPTABLE

01. Before using any tool or machine, students must receive _____ and teacher approval.
02. _____ guards and safety shields are designed to protect users from moving parts.
03. Proper _____ protective equipment (PPE) such as goggles, gloves, or hearing protection must be worn as required.
04. Emergency equipment such as _____ stops, fire extinguishers, and first-aid kits must be clearly identified and accessible.
05. Students should always follow _____ instructions for tools, equipment, and machines.
06. A safer CTE lab depends on awareness, responsibility, and _____ behavior.

Part C: Multiple Choice

Circle the best answer for each question.

01. Which action shows professional behavior in a CTE lab?

- A. Rushing to finish first
- B. Ignoring posted safety signs
- C. Using tools only as instructed
- D. Modifying equipment for convenience

02. What should you do if a machine guard is missing or damaged?

- A. Use the machine carefully
- B. Ask another student what to do
- C. Continue working without it
- D. Stop and notify the instructor

03. Why is PPE important in CTE programs?

- A. It looks professional
- B. It prevents injuries and reduces risk
- C. It is optional for experienced students
- D. It slows down work

04. Which practice is NOT considered safe in a CTE lab?

- A. Keeping work areas clean
- B. Wearing required PPE
- C. Bypassing safety devices or machine guards to save time
- D. Following lockout and shutdown procedures

Student Reminder

Safety expectations apply at all times in CTE laboratories and shops.

Following procedures, wearing required PPE, and asking questions when unsure are part of being a professional learner.

05. If you are unsure how to safely complete a task, you should:

- A. Guess and continue
- B. Watch another student
- C. Skip the task
- D. Ask the instructor for clarification or guidance

06. Why are safety procedures emphasized in all CTE programs?

- A. To limit student creativity
- B. To meet grading requirements only
- C. To prepare students for safer workplace practices
- D. To reduce the amount of work completed

CTE GENERAL SAFETY TEST

Teacher Answer Key

Total Questions: 20

Part A: True / False

Question	Correct Answer	Rationale
Safety rules in CTE labs are based on real workplace standards and expectations.	T	CTE safety expectations reflect OSHA, NFPA, and industry practices.
Personal protective equipment (PPE) is only required when the teacher is watching.	F	PPE requirements are hazard based, not supervision-based.
Machine guards and safety devices must never be removed or bypassed.	F	Removing or bypassing guards creates foreseeable and unacceptable risk.
Students should report unsafe conditions or damaged equipment immediately	T	Prompt reporting supports injury prevention and corrective action.
Loose clothing, jewelry, and long hair can create safety hazards in CTE labs.	T	These increase entanglement, ignition, and contact hazards.
Horseplay and distractions are acceptable if no tools are in use.	T	Horseplay undermines situational awareness and safety culture.
Students must be trained and authorized before using tools, equipment, or machinery.	F	Training and authorization are foundational to professional practice.
Personal protective equipment (PPE) is optional if students feel confident using equipment.	T	PPE is determined by hazard, not confidence or experience.
Following safety rules helps prepare students for real-world careers.	T	Safety compliance is an employability and professionalism skill.

Part B: Fill in the Blank

Word Bank:

Power; personal; training;
machine; written; acceptable

Sentence

Before using any tool or machine, students must receive **training** and teacher approval.

Correct Answer

Training

Machine guards and safety shields are designed to protect users from moving parts.

Machine

Proper **personal** protective equipment (PPE) such as goggles, gloves, or hearing protection must be worn as required.

Personal

Emergency equipment such as **power** stops, fire extinguishers, and first-aid kits must be clearly identified and accessible.

Power

Students should always follow **written** instructions for tools, equipment, and machines.

Written

A safer CTE lab depends on awareness, responsibility, and **acceptable** behavior.

Acceptable

Part A: True / False

Question

Which action shows professional behavior in a CTE lab?

Correct Answer

C

Rationale

Using tools only as instructed reflects training and authorization.

What should you do if a machine guard is missing or damaged?

D

Activities must stop until safety controls are restored.

Why is PPE important in CTE programs?

B

PPE reduces exposure and helps prevent injuries.

Which practice is NOT considered safe in a CTE lab?

C

Bypassing safety devices violates OSHA-aligned expectations.

If you are unsure how to safely complete a task, you should:

D

Instructor guidance is required before proceeding.

Why are safety procedures emphasized in all CTE programs?

C

They prepare students for safer workplace practices.

Scoring Guide (Instructor Reference)

- ▶ **18–20:** Excellent understanding of CTE safety expectations
- ▶ **15–17:** Good understanding; minor review recommended
- ▶ **Below 15:** Safety retraining required before tool or machine use

INSTRUCTOR NOTE (FOR CTE SAFETY MANUALS)

This assessment reinforces industry-aligned safety culture, personal responsibility, and professional conduct consistent with ACTE High Quality CTE Framework and ITEEA-STEL standards guidance for secondary CTE programs. Successful completion supports documentation of training, authorization, and due diligence.

ANNEX E:

PPE BY ACTIVITY MATRIX

High School CTE Laboratories and Shops

Personal protective equipment in CTE environments must be selected through a documented hazard analysis and risk assessment and matched to the specific risks introduced by tools, machines, materials, energy sources, and student behavior. PPE is required whenever hazards cannot be eliminated through engineering or administrative controls.

Federal OSHA standards require employers to assess potential workplace hazards and select appropriate PPE (29 CFR 1910.132[d]). Eye and face protection is mandatory wherever there is risk from flying particles, molten material, chemical splash, or injurious light radiation (29 CFR 1910.133). Machine hazards must be controlled through guarding and safe operation practices (29 CFR 1910.212, Subpart O). Where hazardous chemicals are used in lab-like CTE instruction, chemical hygiene–style controls apply (29 CFR 1910.1450).

NSTA and NSELA reinforce that PPE must match the potential safety hazard and corresponding risk, be worn by both students and instructors, and be enforced consistently as part of an educator’s duty of care.

PPE by Activity and Hazard Profile

CTE Area / Process	Required PPE (Minimum)	Add PPE When...	Rationale / Hazard Link
General shop presence	ANSI/ISEA Z87.1 safety glasses with side protection; closed-toe shoes; fitted clothing; hair secured	Hearing protection when noise levels warrant	Baseline protection against unexpected flying debris and impact hazards in active shops
Woodworking: table saw, miter saw, circular saw	Z87.1 eye protection; hearing protection	Face shield for high chip ejection; dust controls	Flying chips, kickback projectiles, and high noise exposure

Woodworking: router, shaper, jointer, planer	Z87.1 eye protection; hearing protection	Face shield over glasses for heavy chip loads	High-velocity chips; rotating machinery hazards require guarding and eye protection
Band saw / scroll saw	Z87.1 eye protection	Cut-resistant gloves for material handling only (not at blade)	Blade contact and flying debris hazards
Drill press	Z87.1 eye protection	Face shield for brittle materials	Flying chips and entanglement risks
Bench or pedestal grinder	Z87.1 eye protection plus face shield; hearing protection	Gloves for handling sharp stock away from wheel	Sparks, fragments, and wheel failure hazards
Angle grinder / cut-off wheel	Z87.1 eye protection plus face shield; hearing protection; nonmelting clothing	Gloves for sharp edges or heat	High-energy sparks, fragments, and noise
Welding and plasma cutting	Welding helmet with proper filter; safety glasses underneath; welding gloves; flame-resistant clothing; leather footwear	Hearing protection; respiratory only under a compliant program	Burns, slag, sparks, and injurious light radiation
Oxy-fuel cutting / brazing	Filtered goggles; gloves; flame resistant clothing	Face shield for heavy slag	Eye injury and burn hazards during gas welding operations
Sheet metal work	Z87.1 eye protection; cut resistant gloves (ANSI/ISEA 105)	Forearm protection for repetitive handling	Laceration hazards from sharp edges

Lathe, mill, CNC machining	Z87.1 eye protection (goggles for coolant splash); fitted clothing; hair restraint	Face shield for heavy chip production	Flying and sharp waste chips and entanglement hazards at rotating equipment
3D printing / laser cutting (school approved)	Z87.1 eye protection as required; heat-resistant gloves for hot parts	Respiratory protection only if justified	Hot surfaces and material-specific fumes or particulates
Automotive labs	Z87.1 eye protection; chemical resistant gloves for fluids; protective clothing	Face shield for fluid splash; hearing protection for impact tools	Flying debris, pinch points, and chemical exposure
Painting, finishing, solvents, adhesives	Splash goggles; chemical resistant gloves; apron or coat	Respiratory protection only under 1910.134 program	Chemical splash and vapor hazards
Construction technology (dust, masonry)	Z87.1 eye protection; task appropriate gloves	Hearing or respiratory protection if justified	Dust, flying particles, silica, fibers, crystalline and noise
Electrical / electronics work	Z87.1 eye protection; insulated tools as required	Arc-rated PPE only for qualified tasks	Wire clipping, solder spatter, and electrical hazards
Chemical handling in CTE	Splash goggles; chemical resistant gloves; lab coat or apron	Face shield for corrosives	Chemical splash and exposure risks under lab-style controls
Equipment maintenance (authorized only)	PPE per task plus lockout/tagout		Hazardous energy control required during servicing

CTE-Specific PPE Rules

PPE must match the hazard. OSHA and NFPA require a documented hazard analysis and risk assessment and appropriate PPE selection for each task (29 CFR 1910.132[d]; 1910.133). PPE is not optional when hazards are present.

There is no blanket glove rule for rotating machinery. Gloves are appropriate for handling sharp or hot materials but can increase entanglement risk near rotating equipment. Standard operating procedures must clearly define when gloves are required, permitted, or prohibited based on the task and machine.

ANNEX F:

CTE STUDENT SAFETY ACKNOWLEDGMENT FORM

(Adapted from DeLuca, V.W., Haynie, W.J., Love, T.S., & Roy, K. R. (2014). Designing safer learning environments for integrative STEM education (4th ed.). International Technology and Engineering Educators Association.)

CTE (Career & Technical Education) STUDENT SAFETY ACKNOWLEDGMENT FORM

Student		Student #	
Teacher		Date	
Subject		Room #	

PURPOSE:

This CTE program is designed to be practical by providing hands-on skills involving the use of tools, machinery, apparatus, and other items typically found in the workplace. The CTE teacher will introduce students to various activities involving these products that may present potential hazards or risks; therefore, ALL students must conduct themselves in a safer and responsible manner at all times. Students are expected to follow safety procedures at all times, ask for clarification if they are not 100% certain on the safer operation of a tool, and to notify the teacher if they discover a damaged or broken tool or piece of machinery. Students making poor choices and exhibiting unwanted or dangerous behaviors will be subject to consequences, including removal from the room.

GENERAL SAFETY PROCEDURES:

01. Students are expected to behave respectfully at all times; understand that fooling around or horseplay causes injuries.

02. Do not enter lab / shop / room unless a teacher is present.

03. Students must always wear personal protective equipment (PPE) including safety goggles, safety glasses with side lenses, protective gloves, ear protection and other items as directed by the instructor. Failure to wear PPE properly will result in the student being removed from the room.

- 04.** Students must follow safety precautions specific to each tool, machine, apparatus or equipment being used. If unsure about the safer operation of the equipment, the student must speak to the teacher and gain a thorough understanding before operating any tool or machinery.
- 05.** Students who have long hair (past shoulder) must keep it held back with a hairband, hairnet, or worn in a ponytail as this is a health hazard when working in a CTE laboratory or shop classroom due to the proximity of moving and rotating parts of the machinery used.
- 06.** Students are only allowed to wear close-toe shoes; no sandals or flip flops are permitted in the CTE laboratory.
- 07.** Students are advised to avoid or tie back loose clothing that might get caught in tools or machines in the CTE laboratory. Wear appropriate clothing.
- 08.** Students must remove all jewelry before operating machinery, including watches, rings, necklaces, earrings, and other decorative items as this is a health hazard.
- 09.** Students are to stay behind the safety lines near the equipment unless you are instructed to operate machinery by your teacher and have a comprehensive understanding of the safer operating procedures including safety procedures.
- 10.** Students are to concentrate on the daily or weekly project or task and do not distract others in the room.
- 11.** Students are to immediately notify teacher of damaged or broken tools or equipment as this is a safety risk for themselves and others.
- 12.** Students must always use all tools and materials appropriately and only for their intended purpose following safety instruction guidelines and training from the teacher.
- 13.** Students are to keep their work areas neat and clean at all times; this includes properly storing tools and materials according to the organizational system in your CTE lab.
- 14.** Students are to notify the CTE teacher if they are taking medications that identifies any precautions regarding operating machinery. This is important for your personal safety.
- 15.** In the unlikely event of an accident, immediately report any injuries to the teacher.
- 16.** Students are to strictly follow additional machine-specific safety and operating procedures to ensure that they and their classmates are safer in the CTE lab.

17. Students must score 100% on all safety tests before operating any tool, equipment or machines. This is to demonstrate competency and to have a solid baseline understanding of the safer operating procedures for the various machinery, tools, and equipment in the CTE laboratory or shop classroom.

I have read and understand the general safety guidelines above. My teacher explained all of the guidelines to me and provided a demonstration. I fully understand and agree to follow these CTE safety rules and practices at all times. If at any time, I do not understand the safe way to use any tool, machinery, or hazardous materials, I will ask my teacher before I proceed.

Student's Signature		Date	
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CTE STUDENT SAFETY ACKNOWLEDGMENT FORM

I, _____ (student's name) have read and agree to follow each of the safety procedures set forth in this safety acknowledgment form. I realize that following these safety rules will help ensure my own safety along with the safety of my classmates and instructors. I will cooperate with my instructors and classmates to maintain a safer learning environment.

I will follow written and verbal instructions provided by the instructor and on the various tools, equipment and machines and will only use appropriately. I will accept responsibility for my actions and understand that I will be subject to disciplinary action if I violate safety rules or procedures.

(Student's Signature)

(Date)

Dear Parent/Guardian: The school and the district are excited that your child is participating in a career & technical program that will provide them with real world experience to prepare them for college and careers.

Students will not be allowed to work in the CTE lab or with tools, machinery, or hazardous materials until they return this signed contract with student and parent signature acknowledging understanding of safety rules and procedures and have scored 100% on all safety tests. Students will be using the following tools and machinery throughout the year.

All Students	9 th Graders	10th Graders	11th Graders	12th Graders

I have reviewed the CTE Lab rules and procedures with my child and agree to hold my student to these standards. My child has my 83 express permission to use these tools and machinery under adult supervision after they have been properly trained. I understand the risks involved in using these tools and machinery.

(Parent / Guardian Signature)

(Date)

(Parent / Guardian Printed Name)

(Phone Number)

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Almost every school in the United States must follow the OSHA 29 CFR 1910.1450 Laboratory Standard (or state equivalent safety program) for their science department safety requirements. Always follow your approved Chemical Hygiene Plan (CHP) or equivalent safety plan in your local school district jurisdiction and consult with your Chemical Hygiene Officer for more details.

