Promoting a Safe School Environment: A Handbook for Pennsylvania Career and Technical Educators

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Preface

The Pennsylvania Department of Education Bureau of Career and Technical Education consulted with Mark D. Threeton, Ph.D., to develop this safety guide for the purpose of providing information to career and technical education (CTE) programs.

This publication is a practical handbook designed for all CTE professionals within Pennsylvania. While CTE programs are diverse and follow unique educational formats per discipline, the competencies associated with providing safe and healthy CTE laboratories and classrooms are the same for most subject areas. Therefore, this publication is designed to provide all career and technical educators with a deeper understanding of the roles and responsibilities associated with establishing and maintaining a safe CTE learning environment.

This publication provides in-depth guidelines on: 1) providing a safe CTE learning environment; 2) accident prevention; 3) modern safety and health programs; 4) preventable injuries; 5) attitude formation; 6) developing safety consciousness; 7) organizing an effective safety and health program; 8) instructional practices; 9) safety regulations and requirements; 10) laboratory safety concerns and hazards; 11) hazard identification and prevention; 12) occupational safety and health inspections; and 13) liability concerns. Using this publication as a guide, CTE professionals can promote safe and healthy laboratories and classrooms to enhance learning and skill development.

Introduction

Providing a Safe CTE Learning Environment

CTE laboratories and classrooms are often filled with dangerous tools, equipment, processes, materials, and supplies within a wide range of environmental conditions, which can be difficult to control. Career and technical educators, unlike their academic counterparts, are expected to manage the learning environment to control for these potential hazards. This is often easier said than done, particularly for new instructors. While providing a safe learning environment can appear to be an overwhelming task, with education, preparation, and perseverance comes success.

Since the beginning of vocational education in schools and other institutions, educators have been concerned about the health and safety of their students. A great deal of attention has been focused on providing a safe educational environment to promote enhanced learning and skill development. A combination of technical abilities, as well as pedagogical knowledge and skills, places career and technical educators in a unique position to positively contribute to the health and safety of their students. However, learning to establish and maintain a safe educational environment is an ongoing professional development process. Therefore, the information within this publication is designed to assist career and technical educators in providing a safe teaching and learning environment while simultaneously preparing students to work safely and successfully in the school, as well as transfer those assets to on-the-job.

Pennsylvania Laws

Laws in Pennsylvania that are directly applicable to school safety and health include, but are not limited to, the Eye Safety Act 116 (24 P.S. § 5301) and the Worker and the General Safety Law 159 (24 P.S. § 5301). It is imperative that all CTE professionals comprehend these laws, as the provisions contained within these laws are aimed at controlling specific hazards. Below are the specific sections of the legislation most applicable to CTE.

Pennsylvania Eye Safety

Local boards of school directors, boards of education, college boards of trustees, and governing bodies of private schools shall adopt such rules and regulations as may be necessary for the provision, maintenance and use of eye protective devices as required to meet the provisions of the law.

Section 1 (24 P.S. § 5301)

Every teacher, student, visitor, spectator, and every other person in any laboratory or laboratory in public or private schools, colleges, and universities who is engaged in or is within the area of known danger created by:

1. The use of hot liquids, solids or gases or caustic or explosive materials,
2. The milling, sawing, turning, shaping, cutting, grinding or stamping of solid materials,
3. The tempering, heat treatment or kiln firing of metals and other materials,
4. Gas or electric welding, or
5. The repairing or servicing of vehicles, etc. shall wear industrial quality eye protective devices at all times while engaged in such activities or exposed to such known dangers.

Section 2 (24 P.S. § 5302)

Schools, colleges, and universities shall have the power to receive federal, state and local moneys and to expend the same to provide such devices and shall furnish such devices to all visitors and spectators and all other persons required under the provisions of this act to wear them.

Section 3 (24 P.S. § 5303)

Enforcement of this act shall be in accordance with standards, rules and regulations promulgated by the State Board of Education.

Section 4 (24 P.S. § 5304)

For the purposes of this act, “industrial quality eye protective devices” mean devices meeting the standards of the American Standard Safety Code for Head, Eye and Respiratory Protection, Z2.1-1959, promulgated by the American Standards Association, Incorporated.

General Safety Law

The General Safety Law contains provisions aimed at controlling specific hazards.

Section 2 General Safety and Health Requirements (43 P.S. § 25-2)

a) All establishments shall be so constructed, equipped, arranged, operated, and conducted as to provide reasonable and adequate protection for the life, limb, health, safety, and morals of all persons employed therein.

b) All belts, pulleys, gears, chains, sprockets, shafting, and other mechanical power transmission apparatus, stationary engines, electrical equipment, and apparatus shall be properly guarded to protect workers from injury.

c) All cranes, hoists, steam or electric shovels, plant railroads, and other apparatus or devices used for moving, lifting, lowering, and transporting material shall be designed, constructed, equipped, and operated as to eliminate dangerous conditions.

d) The point of operation on all saws, planers, jointers or other power-driven woodworking machines and all power presses, planers, shapers, and other power-driven machine tools, and dangerous parts of any other machines or devices shall be provided with guards of a type approved by the department. Laundry machines, extractors, washers, ironers, and other machines or apparatus shall be provided with guards where, because of accident hazard, they are required by the department.

e) “All toxic and noxious dusts, fumes, vapors, gases, fibers, fogs, mists or other atmospheric impurities, created in connection with any manufacturing process, emitted into or disseminated throughout areas where persons are employed in such quantities as, in the opinion of the department, would injure the health of employees or create other dangerous conditions, shall be removed at the point of origin, or, where this is impractical, personal protective devices shall be provided and worn by persons subjected to such hazards.

f) …. [Omitted because not applicable to CTE.]

g) All building construction, demolition, and cleaning, including window cleaning, shall be conducted in a manner as to avoid accident hazards to workers or the public. Scaffolds, ladders, material hoists, window cleaning devices, safety belts, and other equipment used in such operations, shall be designed, manufactured, constructed, and erected as to be safe for the purpose intended. All stairs, open-sided floors, platforms, and runways shall be provided with proper railings and toe-boards.

h) When employees, due to the nature of employment, are subject to injury from flying particles, falling objects, sharp or rough surfaces or materials, hot, corrosive or poisonous substances, acids or caustics and injurious light rays or harmful radioactive materials, they shall be provided with and shall wear goggles, other head and eye protectors, gloves, leggings, and other personal protective devices.

i) …. [Omitted because not applicable to CTE.]

Section 3 Lighting, Heating, Ventilation, and Sanitary Facilities (43 P.S. § 25-3)

All establishments shall be adequately lighted, heated, and ventilated. Proper sanitary facilities shall be provided in sufficient number for the persons employed, and shall include toilet facilities, washing facilities, dressing rooms, and wholesome drinking water of approved quality.

Section 4 Fireworks and Explosives Plants (43 P.S. § 25-4)

…. [Omitted because not applicable to CTE.]

Section 5 Floor Space (43 P.S. § 25-5)

The floor space of workrooms in any establishment shall not be so crowded with machinery as to thereby cause risk to the life or limb. Proper clear aisle space shall be maintained where necessary to walk between machines, equipment or material. Machinery shall not be placed in any establishment in excess of the sustaining power of the floors and walls thereof.

Section 6 Removal of Guards (43 P.S. § 25-6)

No person shall remove or make ineffective any safeguard, safety appliance or device attached to machinery except for the purpose of immediately making repairs or adjustments, and any person or persons who remove or make ineffective any such safeguard, safety appliance or device for repairs or adjustments shall replace the same immediately upon the completion of such repairs or adjustments.

Section 7 Prohibited Use of Dangerous Machinery (43 P.S. § 25-7)

“If any machinery, or any part thereof, is in a dangerous condition or is not properly guarded, the use thereof may be prohibited by the Secretary of Labor and Industry or his authorized representative, and a notice to that effect shall be attached thereto. Such notice shall be removed only by an authorized representative of the department after the machinery is made safe and the required safeguards are provided, and in the meantime such unsafe or dangerous machinery shall not be used.”

Section 8 Air Space for Workroom (43 P.S. § 25-8)

The owner, agent, lessee, or other person having charge or managerial control of any establishment, shall provide or cause to be provided not less than 250 cubic feet of air space for each person in every workroom in said establishment where persons are employed.

Section 9 Canneries and Labor Camps (43 P.S. § 25-9)

All canneries for the canning or preserving of fruits, vegetables and meats shall be kept in a clean and sanitary condition, and all labor camps operated in connection with such canneries and all other labor camps shall be located, constructed, maintained, and operated in all respects as to provide for the health, safety, and comfort of occupants of such camps.

Section 10 Safe Practices (43 P.S. § 25-10)

The department may prepare and publish for the use of industry recommendations for safe practices as a guide in the elimination of accidents.

Section 11 Industrial Homework (43 P.S. § 25-11)

Industrial homework shall be conducted in such manner as to ensure the safety and health of all persons so employed.

Section 12-16 …. [Omitted because not applicable to CTE.]

Pennsylvania Fire and Panic Act (35 P.S. § 1221)

The Pennsylvania Fire and Panic Act contains safety provisions, which pertain directly to facilities. The basic sections of this act are located in Section I.

General Requirements

“Every building enumerated in this act, erected or adapted for any of the purposes of several classes of building covered by the act (schools and colleges are class I), shall be so constructed, equipped, operated and maintained, with respect to type of construction and materials used, fireproofing, number and type of ways of egress, aisles and passageways, stairs and fire escapes, wall openings, exits, and exit signs, doors and doorways, shaftways and other vertical openings, emergency lighting, automatic sprinkler systems, fire alarm systems, fire drills, electrical equipment, inflammable and explosive materials, heating apparatus and fuel storage, number of occupants, ventilation, arrangement of seating and standing space, construction and equipment of stages, projection rooms, and dressing rooms, and all other fire and panic protection as to provide for the safety and health of all persons employed, accommodated, housed, or assembled therein.”

The Pennsylvania Code, (22 Pa. Code § 339.23) Vocational Education Safety

This regulation applies to school entities that provide vocational education programs under Article XVIII of the Pennsylvania School Code. While there are multiple objectives associated with the Vocational Education Safety portion of the Pennsylvania Code specifically addresses that programs within Pennsylvania shall be provided with consistent safety standards in the following areas:

1. Safety instruction shall be practiced in the laboratory and classroom.
2. Equipment guards and personal safety devices shall be in place and used.
3. Class enrollment shall be safe relative to classroom or laboratory size and number of workstations.
4. Workstations shall be barrier-free, assuring accessibility and safety under Section 504 of the Rehabilitation Act of 1973 (29 U.S.C.A. §794), 34 CFR 104.22(a) (relating to existing facilities) and the Americans With Disabilities Act of 1990 (42 U.S.C.A. §12101—12213).
5. Provisions shall be made for safe practices to meet individual educational needs of handicapped persons under Section 504 of the Rehabilitation Act of 1973, 34 CFR 104.33(b) (relating to free appropriate public education), OCR Guidelines, Title VI of the Civil Rights Act of 1964 (42 U.S.C.A. § 2000d—2000d-4a) and 45 CFR Part 80 (relating to nondiscrimination under programs receiving federal assistance through the Department of Health and Human Services effectuation of Title VI of the Civil Rights Act of 1964).
6. Storage of materials and supplies must meet 34 Pa. Code Part I (relating to Department of Labor and Industry).
7. Safety practices must meet state and federal regulations.

Significant Findings

Significant incidents from the past show there is good reason for concern related to safety and health practices in CTE programs. In Pennsylvania, there are more than 80 different classifications of instructional programs (CIPs), and each contain similar occupational hazards to their corresponding professional workplace. Unfortunately, accidents do occur in these educational programs and in some instances are very severe. As an example, a tire assembly explosion severely injured a teen that was working in an automotive technology program. Consequently, the student lost the use of his right eye and part of his brain. Later during the school year, another student was pinned to a workstation by a vehicle in the same automotive technology program. This incident resulted in the student being slightly injured (Beach, 2014).

In 2010, an 11th grade student in an electrical technology program was injured while completing an assigned activity in a laboratory setting. The student was instructed to cut what was thought to be a de-energized wire and replace it. Unfortunately, this wire was concealed in a junction box, which

in actuality was still energized. Consequently, the student was hospitalized for a burn suffered from being energized by 277 volts of electricity. Nine-months later, a similar injury occurred in another electrical technology program in the same state. On both occasions, the instructors were not present during the event (Massachusetts Department of Public Health, 2011).

In another instance, the National Institute for Occupational Safety and Health (NIOSH) investigated an incident in which an 11th grade student in a carpentry program was injured while truing a piece of stock. Despite successfully passing an Occupational Safety and Health Administration ten-hour safety course, the student's finger came in contact with the cutting head of a jointer (Massachusetts Department of Public Health, 2009). Consequently, the student was transported to the hospital, where the finger was amputated at the middle knuckle. While the student's instructor was present, they did not witness the incident.

Yet another example occurred when, a 17-year-old student was participating in a work-based learning experience, through the school's agricultural program. The student lost control operating a forklift while attempted to make a right-hand turn. The forklift tipped over and landed on the student, ultimately causing traumatic internal injuries, leading to death (NIOSH, 2004a).

These accidents highlight the need for concern related to safety and health in CTE programs. While these incidents occurred in other locations, Pennsylvania-based research findings promote a call to action within the commonwealth. For example, Threeton and Evanoski (2014) revealed four deficient classifications of safety and health practices within the trade and industry sector of Pennsylvania CTE programs including: 1) Management Commitment; 2) Identify and Prioritize Potential Hazards; 3) Hazard Prevention; and 4) Training Personnel. Therefore, this publication is designed to assist in correcting these deficient items as well as providing CTE professionals with a deeper understanding of the roles and responsibilities associated with establishing and maintaining a safe CTE learning environment.

Accident Prevention

The prevention of accidents has become a priority within business, industry and education. In the early years, the focus of accident prevention was on engineering aspects to provide safe work environments. During this period, engineers and technicians designed safeguards for hazardous tools, equipment, and machinery. The guarding of tools, machines, and equipment became a major contributor to the reduction of accidents. In later years, attention was given to scientific methods of collecting and analyzing data on industrial accidents, which resulted in significant findings. For example, upon analysis of 75,000 industrial accidents, H.W. Heinrich (1931) concluded that 88 percent of industrial accidents were caused by unsafe acts of individuals, 10 percent of accidents were due to unsafe equipment or surroundings, and 2 percent were caused by nature, or "acts of God." As a result of these types of studies, the accident prevention focus shifted to the development and enforcement of safety rules. As was discovered after implementing safeguards for hazardous equipment, the development and enforcement of safety rules became a contributor to the reduction of accidents.

The Three E's of a Modern Accident Prevention Program

More recently, investigators have focused their efforts on behavior-based safety research. For example, examining the relationships between education, attitude formation, and the reduction of accidents. The results of behavior-based safety investigations led to a modern program of accident prevention, the three E's. The three E's (engineering, education and enforcement) are the basis of an effective safety and health program. CTE instructors should follow the three E's basic principles (Liberty Mutual, 2007; Kigin, 1973; Williams, 1972):

Engineering – determining the best method of safely and successfully performing educational tasks and/or jobs, as well as utilizing appropriate safeguards.

Education – instructing students and/or workers in these methods; and

Enforcement – confirming that students and/or workers follow these methods (i.e., including enforcement of health and safety rules, regulations, and standards).

In the unfortunate event that an accident occurs, administrators typically have three questions (Liberty Mutual, 2007; Threeton & Walter, 2013) including:

- Were the educational tasks/jobs properly set-up? (*Engineering*)
- Was the student/worker properly taught? (*Education)*
- Was the student/worker following instructions? (*Enforcement)*

The primary purpose of the three E's is the prevention of accidents. Safety rules, regulations, and standards are the foundation of this accident prevention program. Thus, if the answer to any of the aforementioned questions is "no" the career and technical educator has not properly performed his or her job. Utilizing the principles of the three E's is strongly encouraged, as it will help control accidents, which could result in injury to individuals, as well as damage to facilities and equipment.

Preventable Accidents, a Culmination of Factors

According to H. W. Heinrich, of the Engineering and Loss Control Division of the Travelers Insurance Company, accidents result from a chain of sequential events, which are metaphorically similar to a line of falling dominoes. Thus, as one domino falls it triggers the next and so on. By removing factors such as unsafe conditions and acts from the learning environment, career and technical educators can prevent this chain reaction. Heinrich further identified five factors in a sequence that if uninterrupted, result in accidents including: 1) ancestry and the social environment; 2) fault of the person; 3) the unsafe act; 4) mechanical or physical hazard; and 5) the accident. These five factors are briefly explained as follows:

1. **Ancestry and the social environment** refer to the background of the individual(s) involved in an accident. This includes, but is not limited to, inherited characteristics such as poor eyesight, poor hearing, and nervous tendencies, which may be partly responsible for an accident. Character traits such as recklessness, stubbornness, or greed may also be contributing elements. Behaviors such as careless habits, risk taking or showing off may result in unsafe acts.

2. An individual's lack of knowledge, skill, or being physically unsuited for a task may be defined as the **fault of the person** in an accident. Improper attitudes such as inattention, overconfidence, undue haste, or playfulness may also be contributing elements. It should be noted that fault of the person is not always assigned to the injured individual. Lack of safety organization on the part of the educator such as, failure to guard machines or personnel, lack of instruction and relaxed enforcement of rules can render fault.

3. The National Safety Council defines an **unsafe act** as a violation of a commonly accepted safety procedure. If a task is performed in an unconventional manner rather than the standard procedure, it could be considered an unsafe act.

4. **Mechanical or physical hazard** refers to the condition presented when a dangerous piece of equipment, machinery or tool is left unsecured.

5. **The accident** is an unplanned, uncontrolled event that causes injury, death or the possibility of injury.

It should be noted that it is the role and responsibility of every career and technical educator to anticipate danger and control hazardous situations, or potential accident causes within the learning environment. In order to fulfill this obligation, career and technical educators must be cognizant of the basic accident types including:

- **Striking against** – in contact with sharp or rough objects by striking, kneeling, walking, slipping, etc.
- **Struck by** – falling, flying, sliding, moving objects.
- **Caught in, on, or between** – foot in floor grate, sleeve on moving machine, fingers between moving parts, etc.
- **Fall from above** – ladder, scaffolding, chair, etc.
- **Fall from same level** – slipping on oil, ice, etc.
- **Strain or overexertion** – pulling or pushing something too heavy, resulting in strain or hernia.
- **Electrical contact** – shock or electrocution.
- **Inhalation, absorption, ingestion** – asphyxiation, poisoning, drowning, etc.
- **Exposure to temperature extremes** – burning, scalding, freezing, heat exhaustion, sunstroke, frostbite, etc.

The targets of an accident prevention program are unsafe conditions and acts. Utilizing safety, engineering, education, and enforcement interrupts the series of events that cause accidents. Therefore, career and technical educators must adopt the three E's of modern accident prevention (Threeton & Walter, 2013).

Developing Safety Consciousness

Attitudes and Safety

Safety consciousness is the mental/emotional guide for personal conduct that tends to minimize the dangers and risks of working and living in a highly mechanized world (Meanor et al., 2018). The behavior is not usually what causes an accident, but rather the mental mindset possessed by the individual(s) before the incident. Studies of accidents have revealed that workers progress through three developmental stages including:

- **Cautious** – an individual in this stage may be inexperienced, unsure of him/herself and or have a desire to perform tasks correctly.
- **Overconfident** – an individual in this stage has learned how to successfully perform occupational specific tasks and as a result, develops an overinflated trust in their skills and abilities.
- **Mature** – an individual in this stage has surpassed the overconfident stage, understands dangers/hazards, and has developed the skills, abilities, and positive safety attitude necessary to successfully complete occupational specific tasks.

Career and technical educators must comprehend these stages well in order to successfully plan safety instruction. Storm (1993) noted that auto insurance companies recognize the overconfident stage, as it represents the most accident-prone subgroup. Over the years there has been conflicting information on “accident prone” workers. Historical studies have revealed that a few individuals cause the greatest number of accidents, which supports the idea of accident proneness (Greenwood & Woods, 1919; Newbold, 1926). However, other investigations have concluded that accidents are caused and are not the result of traits of certain individuals (Williams, 1972).

As a result of these mixed findings on accident proneness, the prudent career and technical educator should assume all students to be accident prone, and actively promote safety consciousness within their educational program.

Although all individuals can be susceptible to accidents, in 2019 the Bureau of Labor Statistics reported over 300 workers under the age of 24 died from work-related injuries. Similarly, safety related literature has also illustrated that teens are at a higher risk of injuries and fatalities as compared to adults (NIOSH, 2017). When considering safety consciousness, it is critical to grasp that a relationship exists between attitudes and the number of accidents in adults and teenagers alike. For example, Metropolitan Life Insurance Company reported faulty attitude as the largest contributor to all accidents attributed to human causes, while the National Safety Council later found that for all accidents attributable to personal causes, 50 percent were due to improper attitudes of workers (Meanor et al., 2018; Williams, 1972).

Accidents should be viewed as preventable through proper knowledge, skill, and positive safety attitudes. While difficult to measure, attitudes toward safety are revealed by people’s actions and or habits. Career and technical educators must be mindful of characteristics associated with positive safety attitudes in students including, but not limited to:

- Visible compliance with all program safety rules
- Cooperation and team spirit
- Willingness to help others comply with safety rules
- Physical checks of tools, machines and equipment before and after use
- General caution in working with tools, machines and equipment
- Concentration on the task at hand
- Warnings others of approaching a dangerous situation
- Awareness and concern for the safety of others working nearby
- A willingness to ask health and safety related questions

Other methods of measuring safety attitudes would include reviewing student records such as grades, attendance, as well as quiz scores on tool, machine, and equipment operation. However, while examining these records can be helpful, they do not necessarily reflect a positive attitude toward safety.

Assisting laboratory participants in developing positive safety attitudes must be a priority of every career and technical educator. It is important to note that positive safety attitudes can only be demonstrated in a safe environment. If a laboratory and classroom is safe, participants will usually have positive safety attitudes. Thus, safety must receive an endless amount of emphasis in theory and practice. For instance, safety education must be included in every theory lesson and instructional demonstration while simultaneously promoting positive mental attitude via direct and indirect methods. Meanor et al. (2018) explained the premise of employing direct and indirect methods to foster desirable safety attitudes:

> The indirect method says, “attitudes are caught rather than taught!” Attitudes are greatly influenced by those we admire or with whom we associate. Students are strongly influenced by their teacher’s attitude, so the teacher’s actions must reflect safety consciousness. Since attitudes are contagious, you can use peer pressure to spread safety consciousness. The direct method is based on the premise that attitudes are learned and therefore can be taught. Following this method, the instructor may make a planned effort to develop good safety attitudes. Such an instructor views lessons on the proper attitude towards safety in the same way as lessons on skills. (p. 45)

As has been emphasized throughout this publication, it is imperative to comprehend that a relationship exists between attitudes and accidents. This critical finding is particularly important to instructors, as CTE students are classified as an at-risk subgroup. Thus, accidents must be viewed as preventable through proper knowledge, skill, and positive safety attitudes. In order to assist in preventing accidents, the following recommendations are provided for teaching safety consciousness:

- **Motivate students by promoting a basic desire to learn.** Encourage students to do well in tool, machine, and equipment operations. Information should be presented with respect to self-preservation.

- **By doing, learn.** This is the basic philosophy of career and technical educators. Students develop safe working skills/habits as they do things safely within the laboratory. This promotes safety consciousness and reinforces safe behavior via repetition.

- **Teach by example.** Students' attitudes will often replicate that of their instructor. It is important to guard against dulling students' safety consciousness. Thus, the instructor must always demonstrate safe conduct.

- **Program control.** Without discipline in the career and technical education program, optimum teaching and learning is impossible. Disciplinary actions should be consistent, fair and enable the instructor to maintain control.

- **Safety rules.** All safety rules must consistently receive 100 percent enforcement. Having a few rules consistently enforced is far better than a large number of rules rarely enforced. The consequence(s) for violation of safety rules must be clearly defined before they occur.

- **Warnings and threats**. Career and technical educators should avoid repeatedly using warnings and threats as a strategy for enforcing safety rules. According to multiple studies, verbal instructions unsupported by other forms of stimulation are relatively ineffective (Williams, 1972). The effects of warnings and threats are short-term. As an alternative, career and technical educators should clearly define consequences for violation of safety rules before they occur. This information should be made available to students both verbally and in writing during the orientation period.

- **Using positive rather than negative instruction is beneficial.** Positive reinforcement informs students how to act under certain situations, while negative instruction often focuses on a few key points to remember, not the total process.

- **Group dynamics.** The attitude of a student's peer group is an important motivator that must not be overlooked. Techniques such as group discussion, role-playing, establishing a safety supervisor and laboratory safety committee are very effective methods of involving the entire class in developing safety consciousness.

- **Essential connections**. It is imperative to connect laboratory experiences to on-the-job situations. Thus, news releases, safety journal articles, pictures of accidents, video clips, and guest speakers are important resources.

Organizing an Effective Accident Prevention Program

The responsibility for an effective accident prevention program begins and ends with the CTE instructor. He or she may greatly increase the likelihood of successful exercise of that responsibility through careful organization and effective control of the physical environment, as well as stimulation of a high level of student involvement. While multiple educators can assist in organizing the program for an entire educational institution, it remains the responsibility of each

instructor to consistently carry out the plan. All educational personnel must be fully supportive as well as actively engaged within the accident prevention program. Additional support or interventions may be necessary for those who are reluctant to develop and maintain the plan.

Steps of a Successful Health and Safety Program

In 1970, the United States Congress passed the Occupational Safety and Health Act. The purpose of the Act was to “assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources.” The act is administered by the Occupational Safety and Health Administration (OSHA), which issues standards for safe and healthful working conditions, equipment, tools, facilities and processes.

Occupational Safety and Health Act standards contain four major categories including general industry, construction, maritime, and agriculture. While the Occupational Safety and Health Act does not presently cover Pennsylvania public schools, many Occupational Safety and Health Act standards have been adopted and are being enforced by insurance companies and other agencies. Thus, many of the Occupational Safety and Health Act standards are enforced even without formal state adoption. Meanor, et al. (2018) noted that career and technical educators have two basic responsibilities in connection with the Occupational Safety and Health Act: 1) to operate their laboratories in compliance with federal guidelines; and 2) inform students of the law and prepare them to function within it. Therefore, there are several specific areas of operation in which career and technical centers and schools should voluntarily attempt to comply with standards including:

- **Hand-tool, machine, and equipment safety.** The design and physical condition of every item included in a CTE classroom and laboratory must be safe and in good working order. Substandard items should be renovated or replaced by pieces known to be well designed and constructed.
- **Safety in working with hazardous materials.** Exposure to hazardous materials must be minimized and, if necessary, eliminated. Appropriate personal protective equipment must be available, and its use enforced.
- **Hazard communication practices.** Practices must be aligned with the Globally Harmonized System by providing a common and coherent approach to classifying chemicals and communicating hazard information on labels and safety data sheets.
- **Training in safety and health requirements.** Teachers and students should be taught to recognize work hazards and potentially dangerous environmental conditions.
- **Fire protection.** All necessary fire protection devices and services, including fire extinguishers, sprinkler systems and fire department assistance, should be available.
- **Physical plant design.** The physical plant in which a CTE program is carried out must be planned so that it is free of safety and health hazards. Key design features of such a structure include adequate space, proper storage of materials, a good arrangement of rooms, and an effective organization of equipment.

- **Physical plant condition.** The floors, walls, partitions, ceilings, windows, doors and other parts of a classroom/laboratory must be kept in good repair.

- **Air environment.** Students and teachers must be able to work in air that is clean, fresh, safe and comfortable. Effective heating, air conditioning, mechanical ventilation and exhaust systems are necessary.

- **Visual environment.** Natural and artificial lighting systems must be properly designed and maintained so that people working in a laboratory can see clearly and comfortably.

- **Auditory environment.** Sound intensities must be reduced to a level at which hearing will not be damaged. It should be noted that hearing damage is a factor determined by both the intensity of the sound and the duration of exposure. Since instructors cannot realistically limit lengths of exposure, it is most important that they seek preventive measures to reduce noise levels. These measures may include the use of noise absorbing materials and/or utilization of hearing protection devices that may reduce the risk of work-related hearing losses in the future.

- **Utility service systems.** Electrical, water, gas, and compressed air systems must be planned and constructed so that hazards related to the use of these utilities are minimal.

- **Housekeeping.** Classrooms and laboratories must be kept clean and in good working order at all times. Adequate storage of materials, especially waste products, is of major importance to health and safety.

- **Sanitary facilities.** All surfaces within the entire facility including, drinking fountains, wash facilities and restrooms must be well designed, in good operating condition and cleaned regularly.

- **First aid and emergency procedures.** Teachers, students and civil service employees should be trained in basic first aid and emergency procedures.

- **Class discipline.** Failure to have students abide by safety rules and safe practices can promote an unsafe work environment. Career and technical educators must require the needed classroom/laboratory discipline to ensure a safe educational program for all students.

While the Occupational Safety and Health Administration does not require the development of a comprehensive safety and health program in schools, it is an effective way to comply with Occupational Safety and Health Administration standards (OSHA, 2011). Therefore, the following three steps are highly recommended, as they have the potential to assist in the development of a successful health and safety program:

1. **Employer leadership**, which in the case of CTE involves administrators and instructors.

2. **Safe working conditions** provided by administrators, support staff, and instructors.

3. **Employee cooperation,** which in the case of CTE involves student cooperation in education/training.

These three elements are absolutely necessary for the health and safety program to be successful. Safety instruction must be an integral element of the entire educational program and reflect as closely as possible the actual conditions found within the occupational environment. The instructor must establish general and specific objectives for the health and safety program. For example, some objectives must be general and related to safety consciousness and attitude formation, while others more specifically focused on development and maintenance of a safe and healthful CTE program environment.

Responsibilities of Administrators, the Instructors and Students

Administrators

To implement a successful health and safety program within an educational institution, administrators must fulfill several responsibilities. For example, a designated administrator must secure support from, and maintain liaison with, the occupational advisory committee in obtaining approval for the health and safety program. Allocating financial support, as well as expediting facility and equipment upgrades necessary for enhanced learning and safe practice are key administrative functions, which should include input from the occupational advisory committee. This is particularly important, as research has suggested there is need for concern related to inadequate funding allocations for safety and health support within Pennsylvania CTE programs (Threeton, 2016).

Additionally, the administrator must provide leadership in the health and safety program. This should include but is certainly not limited to implementing instructor in-service accident prevention training, requiring safety supplies/apparatus, and developing and maintaining organized emergency procedures. The administrator should create a climate which stimulates faculty and staff by promoting discovery, analysis, and correction of unsafe conditions. Two ways administrators can specifically provide a safe facility are: 1) organize the educational institution in such a way as to provide safe and manageable class sizes; and 2) plan with the instructors the installation of safety devices (Meanor et al., 2018).

Administrators should regularly assist instructors by securing cooperation from outside personnel and/or agencies such as qualified community resources in cardiopulmonary resuscitation (CPR), first aid trainers, OSHA personnel, and other professionals with expertise in health and safety. Enlisting outside cooperation publicly promotes the institution’s health and safety program, while simultaneously assisting in the professional development of faculty, staff and students. Another critical function of educational administrators is the implementation and organization of **emergency action plans**. These plans describe in detail how the facility will function in the event of an emergency. Emergency types would include fires, weather conditions, physical threats, etc. While these action plans vary significantly from one institution to another, the primary concern is that all functions are properly addressed for each potential emergency. Due to liability concerns, the development of emergency action plans is often outsourced to external agencies of subject matter safety experts. The following examples include a highly abbreviated set of emergency

action plans. While the chief school administrator is ultimately responsible, the instructors, school personnel and students have a major role in carrying out the emergency action plan.

Natural Gas Leak

The following steps are typical procedures within many institutions:

1. Notify the building administrator.
2. Evacuate building and auxiliary buildings according to institutional plan (Note: building administrator/instructor may activate fire alarm).
3. Instructor should take grade book and account for all students after reaching safe area.
4. Call 911 (building administrator).
5. Call maintenance (building administrator).
6. Designated administrators make sure building is clear (check: mobility impaired students, bathrooms and other closed areas).
7. Designated administrator notifies transportation department of impending emergency.

Once an actual emergency is determined:

8. Building administrator activates crisis team.
9. Designated administrator notifies transportation department of alternate bussing location.
10. Building may be reoccupied once building administrator gives permission.

Release of Toxic Chemicals within Building

1. Inform building administrator.
2. Evacuate building according to institutional plan.
3. Designated administrators make sure building is clear (check: mobility impaired students, bathrooms and other closed areas).
4. Instructor should take grade book and account for all students after reaching safe area.
5. Call 911 (building administrator).
6. Designated administrator notifies transportation department of alternate bussing location.
7. Building administrator activates crisis team.

Fire or Smoke

1. Pull nearest fire alarm (if not already sounding).
2. Evacuate building and auxiliary buildings according to institutional plan.
3. Designated administrators make sure building is clear (check: mobility impaired students, bathrooms and other closed areas).
4. Instructor should take grade book and account for all students after reaching safe area.
5. Call 911 (building administrator).
6. Designated administrator notifies transportation department of impending emergency.

Once an actual emergency is determined:

7. Building administrator activates crisis team.
8. Designated administrator notifies transportation department of alternate bussing location.
9. Building may be reoccupied once building administrator gives permission.

Physical Threat Received

1. Inform building administrator immediately.
2. Call 911 (building administrator).
3. Initiate institutional lock down (building administrator).
4. Instructors lock classroom/laboratory doors, students and staff in hallways proceed to safe area.
5. Instruct students to move to floor or under desktops, tables or workbenches.
6. Instructors stay with students and **DO NOT** let anyone leave the classroom/laboratory. **DO NOT** let anyone in classroom/laboratory unless notified by building administrator or police.
7. Turn bell system off (building administrator).
8. Remain in classroom/laboratory until administration or police give the designated all clear signal.

If building must be evacuated:

9. Administrators or police will administer evacuation procedures.
10. Instructor should take grade book and account for all students after reaching safe area.

Bomb Threat Received

1. Keep caller on the line for as long as possible.
2. **DO NOT HANG UP THE LINE.**
3. Inform building administrator.
4. Call 911 (building administrator).
5. **DO NOT USE ELECTRONIC EQUIPMENT** (i.e., cell phones or any other radio frequency device).
6. Administrator or emergency personnel will evaluate evacuation of building.
7. Notify transportation of impending emergency (building administrator).

If building must be evacuated:

8. Administrators or police will administer evacuation procedures
9. Instructor should take grade book and account for all students after reaching safe are

Injury, Illness or Death

Serious Injury or Illness:

1. Call 911 if immediate medical attention is needed.
2. Contact school nurse.
3. Contact building administrator.
4. Contact parent or legal guardian (building administrator).

Non-Threatening Injury or Illness:

1. Contact building administrator.
2. Contact school nurse.
3. Contact parent or legal guardian (building administrator).
4. After confirmation with parent/legal guardian, administrator will proceed.

Death of Student or Institutional Personnel:

1. Contact building administrator.
2. Activate crisis management team (building administrator).

Instructors

The instructor is responsible for incorporating safety instruction into the planned CTE program. Students must receive an endless amount of general and specific safety education. Initially this should take place during the first few weeks of the program. After the initial safety instruction, students should be issued a safety evaluation, which measures both general and specific safety elements. It is imperative that each student earns a 100 percent on the safety evaluation before being permitted to work in the laboratory. This is a particularly important point, as 50 percent of the CTE professionals within a Pennsylvania based research study revealed that they permitted students to participate in laboratory activities without earning 100 percent on a safety evaluation (Threeton & Evanoski, 2014). This finding is of great importance, as the margin for error within some CTE programs is so small that any form of miscommunication can be the difference between life and death. While it may take multiple attempts for some CTE students to earn a perfect score on safety evaluations, investment in the remediation process can safeguard life and limb. Once a perfect score is achieved, an original copy of each completed safety evaluation must be kept on file with the instructor and in some institutions a photocopy is also secured by an administrator. The document should include: 1) the student's signature; 2) the date the evaluation was competed; and 3) the final grade. Later, as the CTE program progresses, separate units devoted to safety should be included when appropriate. It is important to note that each instructional lesson plan should emphasize safety points regardless of the primary content.

Every instructor must develop safety rules and regulations that are specific to his or her individual occupational education program. These rules and regulations should be planned well in advance and explicitly communicated to students. The instructor must clearly define consequences for violation of safety rules and regulations before they occur. This information should be made available to students both verbally and in writing during the orientation period.

The prudent instructor of secondary-level students will provide copies to the parents or guardians of the students as well.

With the increased incidents of school violence and other horrific events of the day, educators are called upon now more than any other time in our society to employ crisis intervention strategies to promote safety and health within the institution. Probable examples in which an intervention could be required would include, but not limited to active shooter(s), physical threats, inclement weather, fires and smoke, chemical spills, gas leaks, etc. For this reason, career and technical educators must establish and maintain a written emergency action plan that corresponds with school protocol but is also unique to the specific CTE program (see Appendix A).

Instructors must also focus on their own professional development by reading technical service bulletins, attending technical update workshops, and subscribing to journals that provide occupational specific information on new safety practices. Working with Occupational Safety and Health Act and the National Institute for Occupational Safety and Health, attending trade shows, regularly holding occupational advisory committee meetings, and reading professional journals, will enable the instructor to keep abreast of the latest information on safety.

Proper instruction on the use of all tools, machines, and equipment is the major responsibility of the instructor. Demonstrating for students how to do something safely and successfully the first time will have the greatest impact. Care should be taken to emphasize the key safety elements

and not assume that the students already know the subject matter. Records of all safety lessons must be kept on file with the instructor. This must include: 1) when the instruction was given; 2) a record of attendance; and 3) safety evaluation of the students' knowledge and skill development.

The instructor must be present at all times when students are working in the classroom and laboratory. Further, the instructor must continuously serve as a role model by performing all functions in a safe and professional manner. This is not the time to show students the "tricks of the trade" that involve unsafe short cuts. If students observe the educator engaging in unsafe practices, they will more than likely assume it is okay to follow suit. Finally, it is important to remember that safe practice cannot take place within an unsafe environment. The laboratory must be regularly examined for proper layout, equipment guarding, storage, as well as the condition and the handling of tools and materials. A record of maintenance inspections should also be kept on file. Recommended improvements should regularly be forwarded to the designated administrator and the occupational advisory committee.

Students

While it is unrealistic to place all responsibility for safety on students, enlisting their cooperation can be highly effective. Involving students in a program safety committee simulates activities found within the world-of-work. A CTE program safety committee is a very effective method of promoting a safe environment. A safety awards program can also be an effective method. Incentives, such as tools or gift cards are widely used in business and industry and can be incorporated in the CTE program. Advisory committee members and community sponsors such as hardware stores, tool companies, and department stores sometimes donate these awards.

However, while awards programs promote safety, they downside is the award can be so great that an accident/incident may be covered up due to peer pressure. Therefore, care should be taken by the instructor and student leaders to clearly outline categories of behavior for which awards are earned. For example, using positive reinforcement by providing an award to the entire class for consistently wearing personal protective equipment without a reminder from the instructor. This method promotes an accountability system, which is critical to students' personal and professional development.

Instructional Practices

As mentioned previously, the instructor must establish both general and specific objectives for the health and safety program. By establishing objectives at the outset, the health and safety program will be marked with a path toward success. There are specific methods, which can be of assistance in implementing the health and safety program objectives. Verbal instructions must always be reinforced with **information sheets**. These sheets should present general laboratory safety regulations as well as specific rules for all tools, machines, and equipment. Information sheets have the ability to assist students while participating in class discussions, as well as in learning safety practices, which are regularly evaluated on tests and quizzes. The safe use of tools, machines, and equipment must also always be reinforced with information sheets.

Demonstrations are a commonly used to assist in accomplishing health and safety program objectives. The demonstration method has the ability to clearly illustrate the use and care of tools,

machines, equipment, as well as personal protective equipment. It is highly recommended that the instructor routinely, reinforce the safety rules while conducting demonstrations.

Field trips and **resource personnel** can also provide an abundance of information to support the health and safety program. Safety posters and literature should be displayed throughout the laboratory and classroom to provide a constant reminder of the importance of safety. Both Occupational Safety Health Administration and National Institute for Occupational Safety and Health provide a multitude of resources such as free workplace safety posters and other occupational education information, which will assist instructors in implementing their health and safety programs.

Special Populations

Career and technical educators regularly adapt curriculum and instructional methods, as well as the learning environment, to successfully accommodate students with special needs. Byproducts of an inclusive CTE program include an enhanced learning environment which promotes future career success as well as courtesy, sensitivity, and mutual respect for everyone. Thus, career and technical educators who consistently convey a positive attitude to students, parents, administrators, and other teachers, and remain flexible and sensitive to the special needs of learners, have a greater chance of being successful (Miller & Miller, 2002).

As the complexities of student special needs become more pronounced, career and technical educators must be adequately prepared to successfully accommodate diverse learners. For this reason, it is critical that educators are knowledgeable about federal legislation, which impacts CTE. Significant federal legislation has been enacted to protect and serve every special population currently recognized under the law. Thus, the prudent instructor comprehends that legislative mandates not only protect the educator and the institution but also put them in a better position to serve all students effectively and efficiently (Miller & Miller, 2005).

Review of Significant Federal Law

Rehabilitation Act of 1973 (Pub.L.93-112) (29 U.S.C. § 701) (Section 504)

Section 504 of the Rehabilitation Act of 1973 prohibits the discrimination of qualified individuals with a disability. This law is intended to protect these individuals within an educational setting as well as a work environment. Enforced by the Office of Civil Rights, Section 504 maintains that organizations and employers cannot deny qualified individuals with disabilities an equal opportunity to receive program benefits and services. This includes all federally funded programs, K-12 institutions, career and technical education settings, and postsecondary entities.

The Individuals with Disabilities Act

The Individuals with Disabilities Act (IDEA) is an historic piece of federal law enacted to ensure a free and appropriate education in the least restrictive environment. While IDEA has been amended numerous times, the most recent reauthorization occurred in 2004. However, the U.S. Department of Education periodically issues new and revised regulations to address integration and

interpretation of IDEA. Approximately six million individuals with disabilities receive special education related services through IDEA each year. Part B of the law applies to individuals who are 3 to 22 years of age, while Part C relates to babies and toddlers. Free and appropriate education denotes special education and related services that include specifically designed instruction that meets the unique needs of individuals covered by the law (Miller & Miller, 2005).

The Individuals with Disabilities Act requires that an **Individualized Education Program (IEP)** be developed for each eligible individual receiving special education and services under the law. An IEP is a legally binding document, which is personalized to meet the unique special needs of the individual. Items such as instructional goals, related services as well as adaptations and accommodations, etc. are detailed at length within the IEP. An IEP team is charged with the task of contributing knowledge, experience and commitment to develop a personalized educational program that will meet the unique special needs of the individual. The ideal make-up of an IEP team includes parents/guardians, the student, regular education teacher, special education teacher, career and technical education teacher when applicable, teacher of the gifted when appropriate, local education agency representative, guidance counselor, as well as the principal. As outlined in the Pennsylvania code, IEP team meetings must include faculty from the vocational program in which students are recommended for placement (22 Pa. Code § 339.21).

Students with IEPs are eligible to receive the equivalent assistance in their CTE classes that they would normally receive in any other classroom. The IEP team will determine what adaptations and accommodations, if applicable, should be made for the student in the CTE classroom in the same manner that they typically decide class modifications. One particular area that IEP teams must consider when developing the plan is the student's maturity level in regard to safety (TDE, 2013). Like all CTE students, those with special needs must pass a safety test prior to participating in hands-on assignments in the lab/shop. This cannot be compromised. Although, accommodations can be made for the student when providing the safety test; accommodations may include but are not limited to reading the safety test question aloud for the student to respond orally, or providing the student with additional time to read, comprehend, and answer the safety questions. Exceptions cannot be made for students, regardless of their special circumstances, as the safety of the student, their classmates, and the instructor cannot be compromised.

Americans with Disabilities Act

The Americans with Disabilities Act (ADA) is one of the most significant pieces of federal law, which protects qualified individuals with disabilities in educational environments as well as work setting. While the Americans with Disabilities Act has been amended numerous times, the most recent authorization occurred in 2008. The Americans with Disabilities Act mandates equal opportunity for individuals with disabilities in public accommodations, employment, transportation, state and local government services, and telecommunications. The Americans with Disabilities Act covers a wide range of disabilities including sight, hearing, speech, learning disorders, and emotional illness.

Adaptations and Accommodations

Typically, educational institutions are able to accommodate students with special needs through basic facility modifications and adaptations of curriculum and instruction. However, career and

technical educators have valid reasons for concern about the inclusion of students with special needs in their programs. Major concerns often include health and safety related issues as a small error within some programs can mean the difference between life and death. For this reason, a thorough evaluation must be conducted in severe cases to determine if the individual is well suited for the program. For example, two factors must be considered: 1) the student's physical capabilities in successfully functioning within the program (e.g., ability to handle applicable equipment, machines and tools); and 2) the possible health and safety hazards created in the classroom and laboratory (Storm, 1993). While educators must work diligently to provide inclusive classrooms and laboratories, evaluation of these factors is particularly important as some students may have disabilities so severe that enrollment within CTE is not appropriate.

For those students with special needs who are appropriately placed within a CTE program, instructors must find a way to create a comprehensive learning environment for all students. Understanding strategies to support special needs students in CTE can aid in overcoming the struggles associated with diverse classrooms. Effective interventions include:

- Concentrating on aiding students with challenges; do not ignore them;
- Creating a culture of collaboration;
- Emphasizing relevance and foster a climate of high expectations;
- Using data to describe and create strategies for challenges;
- Monitoring progress and recognize the need for change;
- Encouraging professional development to aid in understanding and executing proper intervention systems;
- Utilizing a co-teaching approach, which allows CTE and special education teachers to work together on instructional strategies to deliver content in an appropriately adapted manner;
- Integrating Universal Design for Learning (UDL) as a resource; and
- Utilizing the Job Accommodation Network (JAN) as a resource.

Safety Regulations and Requirements

Equipment Safety

There are a multitude of safety items related to the use and care of equipment that must be considered including:

- Frequent cleaning and disinfecting all working surfaces. Please see: the CDC guidelines. If experiencing technical difficulty with the aforementioned link, simply conduct a web search for: "CDC, cleaning and disinfecting your facility".

- If not confident of a student's ability to use equipment, plan activities that will help the student to gradually develop knowledge and skill. For example, start with simple activities and progressively move toward more complex tasks.
- Enclose all gears, pulleys, moving belts, chains, and other power transmission devices in permanent guards.
- Provide and require the use of point of operation guards. These guards are used where the work or action takes place. For example, surrounding a grinding wheel, or over a saw blade.
- Fasten all stationary equipment, machines, and benches to the floor.
- Provide for the storage of equipment and machine accessories.
- Use painted lines on the floor to clearly establish aisles, hazards, and machine operator zones.
- Use OSHA/American National Standards Institute color-coding on hazardous equipment and machines such as red to identify stop buttons and yellow to designate caution..
- Place warning signs on machines and equipment unsafe to operate due to malfunction. It is best to lock the control switch and shut off electricity at the power box. A Lockout/Tagout procedure must be used to prevent machines and equipment from being energized during repair and or maintenance.

Personal Protective Equipment (PPE)

As a standing rule, **eye and face protection** must be worn wherever the possibility of this type of risk or injury exists. The type of face and eye protection must meet the appropriate American National Standards Institute requirements for the specific laboratory tasks. Types of face and eye protection would include, but not limited to, safety glasses, goggles, face shields and blinds. Eye and face protection should be frequently inspected, while pitted or scratched lenses should be replaced. Goggles and anti-fog safety glasses are recommended while used in conjunction with protective cloth mask face coverings, to prevent impaired sight from fogged lenses. A sanitation procedure must be performed frequently on safety glasses, in order to reduce or avoid the spread of disease. In the wake of COVID 19, the following recommendations are provided for disinfecting safety eyewear.

Maintaining a professional appearance is a key element of successful learning environments. Therefore, **head and body protection** such as American National Standards Institute approved hardhats and shoes, as well as other precautionary items including coveralls, vests, surgical gowns, aprons, gloves, coats, etc., should be worn when appropriate. Special care must be taken when considering designated institutional dress codes, as flame-resistant clothing is imperative within many CTE programs (i.e., welding, electrical, culinary, etc.). This is particularly important to consider with the increased volume of poly-blended fabrics being utilized by clothing manufactures today.

Respiratory protection helps to prevent illness and injury to the respiratory system of individuals. Respiratory protection must be worn when airborne hazards exist. For standards related to respiratory protection during the COVID 19 Pandemic, see the updated information provided from the Pennsylvania Department of Health. If experiencing technical difficulty with the aforementioned link, simply conduct a web search for: “Pennsylvania Department of Health, Face Covering Requirements”

For educational tasks which require work to be completed around airborne hazards such as dust, smoke, etc., appropriate professional respiratory protection must be utilized. OSHA identified that, the “primary objective shall be to prevent atmospheric contamination through engineering controls - when not feasible, appropriate respirators shall be used.” (29 CFR 1910.134) Respirators must be National Institute for Occupational Safety and Health (NIOSH) certified.

If a respirator does not fit the face of an individual properly, contaminated air can leak into the respirator face piece creating a harmful situation. Therefore, it should be noted that CTE programs in which respirators are utilized (i.e., collision repair, welding, etc.) have a responsibility to conduct user seal checks as well as and fit testing, etc., for each individual as part of an overall Respirator Protection Program. Before an individual uses a respirator, or is fit tested, the educational institution has a responsibility to ensure the user is medically sound. Therefore, prerequisite respirator medical evaluations are required in order to protect individuals as well as comply applicable respirator protection standards (29 CFR 1910.134). Research has revealed that there is need for concern related to current respiratory protection practices within the trade and industry sector of CTE (Threeton & Evanoski, 2014).

Hearing protection is designed to prevent hearing loss due to excessive noise levels. Noise levels are measured on the decibel scale. To put the decibel scale in perspective, the secondhand ticking on a clock is measured at approximately 20 decibels, while power tools can range between 87 -110 dB and up. While the use of noisy machines, tools and equipment is often unavoidable within many CTE programs, care should be taken to make sure that all individuals exposed to 85 dB or higher are required to wear professional grade hearing protection devices with appropriate Noise Reduction Ratings such as earplugs, canal caps and or muffs.

Prolonged exposure to noise levels of 85 decibels or above can cause permanent hearing loss. Recent research has revealed that there is need for concern related to hearing protection practices within CTE (Threeton et al., 2019). In addition to hearing protection, the following sound absorption techniques are strongly recommended within facilities to control hazardous decibel levels where appropriate:

1. Acoustical panels suspended from the ceiling;
2. Sound baffles to break up noise;
3. Acoustic plaster and spray on acoustic noise reverberation coating;
4. Acoustical decking;
5. Resilient pads mounted between machines and floor; and
6. Enclosing noise sources with acoustically absorbent materials.

Specific **physical limitations** may require students and instructors to wear additional personal protective equipment. For example, laboratories should be equipped with items such as ergonomically designed anti-fatigue mats, specialized kneepads, back supports, etc., when appropriate to assist in preventing and easing the impact of musculoskeletal disorders within muscles, tendons, ligaments, joints, and spinal discs. For specific information on ergonomics and musculoskeletal disorders see: CDC ergonomics. If experiencing technical difficulty with the aforementioned link, simply conduct a web search for: "NIOSH, Ergonomics and Musculoskeletal Disorders."

Housekeeping Practices

As previously noted, the appearance and condition of the classroom and laboratory affect the attitudes and working habits of students. The term "housekeeping" is not intended to exclusively mean push-broom cleaning and disinfecting activities, but is concerned with orderliness and preservation of tools, equipment, operations, facilities, and materials to reduce or eliminate accidents, and develop desirable safety attitudes. For this reason, laboratory and classroom lighting should be glare free, evenly distributed, and bright enough to assist students as well as the instructor in performing tasks without visual difficulty (see Table 1). The recommendations within the following table are the result of calculations based on Illumination Engineering Society formulas for determining optimum illumination levels in educational institutions.

Table 1: Suggested Lighting Levels for Occupational Education Facilities (Storm, 1993)

Facility	Foot-candles (FC)
Classrooms, planning, rough testing	50
Color identification, special inspections, very severe and prolonged visual tasks	500
Extra fine assembly, testing, severe office tasks	200
Fine drafting and assembly, testing, medium to severe office tasks, inspection display lighting	150
Storage	10
Laboratories, offices, first aid stations, conference rooms	30-50
Waiting areas	20

To maintain brightness of finishes within desirable ranges, reflection factors should be:

Object	% of Light Reflection
Ceilings	80-85
Floors, desks, other equipment	40-60
Sidewalls	60

Note: Foot-candles are usually calculated with a professional grade light meter but can also be measured using the light meter function common in many digital cameras as well as reliable smartphone and/or tablet apps.

Frequent cleaning and disinfecting of all surfaces is vital. If experiencing technical difficulty with this link, conduct a web search for: “CDC, cleaning and disinfecting your facility”. Additional housekeeping practices include maintenance of classroom and laboratory floors, which must be kept free of debris. This is particularly important, as falls are a primary cause of fatal, and permanent total disability injuries (Meanor et al. 2018). Therefore, daily sweeping is essential, and specific sanitation procedures for spills must be regularly demonstrated for students. Floors can be made safer with non-skid materials such as abrasive paints, adhesive backed strips and rubber matting, etc. It should be noted that the use of incorrect cleaning products could cause floors to prematurely deteriorate and or become slippery.

Tools, equipment, and machines must be kept clean and orderly as well. Brooms, mops, brushes, rags, wipes, and cleaning supplies should be provided for regular housekeeping practices. Waste control is an important task that must not be overlooked. Waste materials must be regularly monitored and emptied. Flammable waste must be stored in approved storage containers, while recyclable items placed in appropriate receptacles. Good housekeeping practices cannot be achieved or modeled for students through an occasional grand cleanup. Instead, it should be planned and organized on a continual basis. Therefore, administrators, instructors, and students should share in responsibility for housekeeping practices.

Electrical Safety

It is important for students and educators to consider all electrical equipment as “hot” or energized. The temporary wiring of devices must be prohibited. There are a variety of Occupational Safety and Health Administration required inspections specific to electrical cords and equipment. These inspections include but are not limited to daily visual condition checks, and quarterly continuity electrical cord and grounding system checks on items such as equipment and ground-fault circuit-interrupters. Please refer to the Occupational Safety and Health Administration website for more specific information. The wise CTE instructor chooses to regularly perform these required inspections, while including students in the process, as they constitute teachable moments.

All control switches should be accessible to the operator. Sub-master switches (i.e., panic buttons, emergency stops) should be provided throughout the laboratory. An individual cut-off switch, separate from the operator control, should be provided for each machine and or piece of stationary electrical equipment. Improperly grounded and or damaged cords must be replaced before using any machine, tool and or piece of equipment. Please note a Lockout/Tagout procedure must be used to prevent machines and equipment from being energized during repair or maintenance (29 CFR 1910.147).

Hazardous Materials/Waste

While almost all CTE programs utilize materials and or substances that are hazardous in nature, exposure must be minimized and if necessary, eliminated. CTE instructors must regularly discuss, demonstrate and promote safe working procedures with their students in handling these materials (NIOSH, 2002). Some examples of hazardous materials would include gasoline, carburetor cleaner, paint, oil, shellac, aerosol cans, etc.

Instructors must regularly assess their students’ knowledge of how to properly complete tasks that involve hazardous materials, prior to allowing them to carry out such tasks. When not in use, it

imperative that all hazardous materials and substances are stored according to the manufacturer's guidelines and disposed of properly. Specific guidelines on how to properly dispose of hazardous materials can be found at the U.S. Environmental Protection Agency

In the event that chemicals are handled, utilized, and stored within CTE programs, administrators, instructors, and students must all be familiar with applicable state and federal Hazard Communication Standards (29 CFR 1910.1200). Appropriate personal protective equipment must be available, and its use enforced. Furthermore, hazard communication practices must be aligned with the Globally Harmonized System by providing a common and coherent approach to classifying chemicals and communicating hazard information on labels and safety data sheets. Therefore, every CTE program is required to appropriately label hazardous substances as well as have a readily accessible file containing a Safety Data Sheet (SDS) for each hazardous material and chemical within the facility. As a continuous instructional practice, the SDS must be reviewed with all individuals to promote proper use of chemicals and related substances. In order to obtain the correct safety data sheets, contact the material supplier or manufacturer, or simply visit the following website. If experiencing technical difficulty with the aforementioned link, simply conduct a web search for: "Where to find SDS."

Fire Safety

Fire is of the greatest danger within CTE laboratories, more so than any other area of an educational institution. Potential causes of fire include leaking chemicals, short circuits, spontaneous ignition, welding, soldering and heating operations. Flammable materials, particularly liquids, must be stored in proper containers and placed in a fireproof cabinet. Fire extinguishers must be positioned throughout the CTE program and made easily accessible. They must also be inspected and serviced regularly by the appropriate professional agencies. Students should be instructed on how to properly select and use extinguishers.

Fire extinguishers are classified according to their ability to handle specific classes of fires. For example, Class A extinguishers are designed for fires involving ordinary combustibles, such as wood, cloth, and paper. Class B extinguishers are designed for fires involving liquids, greases, oils and gases. Class C extinguishers are designed for fires involving energized electrical equipment. Class D extinguishers are designed for fires involving metals such as magnesium, zirconium, sodium, potassium and titanium. Class K extinguishers are designed for fires involving cooking oils, animal oils, or fats in commercial kitchens.

Some fires may involve a combination of fire classifications. Thus, ABC-rated fire extinguishers should be made available as well as other types if applicable. The instructor must collaborate with a local fire department, and the occupational advisory committee in selecting the appropriate classification(s) of laboratory extinguishers. It may also be necessary to include the institution's insurance carrier in such decisions.

It is imperative that fire exits be kept free of obstructions. In addition, fire drills should be regularly conducted throughout the academic year. While schools and career and technology centers follow predetermined evacuation plans during fire alarms, it is the instructor's responsibility to see that students follow the prescribed protocol.

General Safety Practices

General safety practices should include periodic safety inspections of the laboratory, including storage and classroom areas. Hazard analysis must also be conducted periodically to identify and correct at-risk areas. Accident or incident reports should be completed for every accident in the laboratory. This is a must within all educational institutions. Appendix D provides a sample accident/incident report to assist in implementing this process. In the unfortunate event that an accident occurs, first aid must be readily available. Thus, first aid practices should be a part of every planned CTE program, and the instructor must know and follow the prescribed institutional procedures for such events. For example, a secondary-level instructor may be required to call the school nurse for assistance. It is also imperative that all visitors to the CTE program be properly registered and wear appropriate personal protective equipment.

Colors for Health and Safety

Colors are of great importance in life and affect feelings, attitudes, and behaviors. Papadatos (1973), highlighted that research conducted in industry demonstrated that the positive benefits of appropriate color selections include increased production, fewer absences, and higher morale. Career and technical education programs can also benefit from the appropriate use of color. For example, laboratories must comply with prescribed safety color-code standards which, if implemented correctly, have the ability to positively affect the educational environment. Safety color-codes were established by Occupational Safety and Health Administration and American National Standards Institute with designated meanings, which individually correspond. A major benefit of standardized safety color-coding is the consistency across all occupational environments (See Table 2).

Table 2: Colors for Health and Safety

Color	**Meaning**
Red	Designates “danger,” “stop,” and location of fire protection equipment and apparatus.
Orange	Designates “warnings” and dangerous parts of equipment and machines, which may cause injury.
Yellow	Designates “caution” and markings of physical hazards
Green	Designates “safety” and location of first aid equipment.
Purple	Designates radiation hazards.
Blue	Designates warning against starting or moving equipment under repair.
Black, White, Yellow or Combination of Black with White, or Yellow	Designates traffic and housekeeping markings.

Note: This table represents the color codes of both ANSI/NEMA Z535.1-2017 and OSHA.

Inspection for Health and Safety

One of the methods available to CTE instructors to ensure that potential hazards are identified before an accident occurs is to complete regular safety inspections. Safety inspections typically contain items designed to evaluate workplaces, machines, equipment, materials, power sources, practices, students, instructors, and administrative procedures, etc. There are several types of safety inspections including:

- **Periodic inspections,** which are conducted at regular intervals (i.e., daily, monthly, semiannually, etc.) and are usually performed within one laboratory or an entire building. OSHA and/or other regulatory agencies sometimes specify inspection intervals. The most common periodic inspection is fire, which includes alarm systems, procedures, and equipment.
- **Intermittent inspections** are conducted at irregular intervals as needed. They may be unannounced and often deal with areas of concern as indicated within accident reports.
- **Continuous inspections** provide students with an opportunity to observe and inspect equipment, operations and personal protective equipment, etc. These inspections allow students to become more familiar with safe conditions and procedures.
- **Special inspections** are often required for new equipment, operations and processes, as well as following accidents, etc. Special inspections would include but not limited to health/safety surveys, hand tool inspections, personal protective equipment, ventilation, and lighting.

During inspections, the instructor can reasonably expect to encounter general conditions, specific hazards, and unsafe practices. Regardless of the type, there are three steps, which are critical to the success of any health and safety inspection including:

1. **Detection** - to examine the laboratory for possible hazards and unsafe practices.
2. **Analysis** - to examine the accident-producing capabilities.
3. **Correction** - to recommend corrective actions.

Inspection checklists are a helpful resource, designed to assist in the detection, analysis and correction of hazards and unsafe practices. If structured correctly, checklists can be implemented as a tool for accomplishing periodic inspections, intermittent inspections, continuous inspections, and special inspections. A sample safety inspection checklist is provided in Appendix E to assist in implementing this process. CTE professionals are also encouraged to visit the National Institute Occupational Safety and Health website for a detailed index of safety checklists for career and technical programs within schools (NIOSH, 2004b). If experiencing technical difficulty with the aforementioned link, simply conduct a web search for: “NIOSH, Safety Checklist Program for Schools.”

Liability within Career and Technical Education

Providing a safe learning environment has been emphasized throughout this publication for two reasons. First, providing a safe environment is key to the welfare of the students and instructor. Second, failure to provide a safe learning environment may result in the CTE professional/ and or entity being held liable for the injuries suffered by the students. **Liability** within this section refers to the state of being responsible by law for damages stemming from student injuries. Unfortunately, assignment of liability is not always clear-cut. **Negligence** on the other hand, refers to the lack of due diligence and care, or failure to act as a reasonably prudent and careful person (Kigin, 1973).

Liability can be alleviated to some degree through legislation, insurance protection, and accident prevention programs. State and federal legislative enactments, sometimes called “Good Samaritan” or “Hold-Harmless” laws can reduce liability cases. Protection against risk of financial loss can be provided through professional liability insurance policies. While often overlooked, prevention of accidents involves the development of acceptable procedures in the event of an incident. The best defense within legal proceedings is an accurate report of the accident. Therefore, when in doubt, document the incident, as legal action may not transpire for five or more years.

As highlighted throughout this publication, the key to preventing harm to school employees, students, and the environment is to establish a quality safety and health program. The health and safety program must contain a reliable record keeping system, which continuously archives evidence of safety instruction, safety evaluation, supervision, establishment and enforcement of rules, guarding of equipment, and maintenance of facilities and related apparatus.

While a quality safety and health program may take years to fully implement, the National Institute for Occupational Safety and Health has well-established guidelines to help with the process. The guidelines are divided into five sections including:

1. Assure management commitment
2. Assure employee and student involvement
3. Identify and prioritize potential hazards
4. Eliminate hazards
5. Train employees, students, and management

Thus, career and technical educators are strongly encouraged to visit the National Institute for Occupational Safety and Health website for further information on how to establish a safety and health program. If experiencing technical difficulty with this link, simply conduct a web search for: “NIOSH, How to Establish an Effective Occupational Safety and Health and Environmental Safety Program.”

All-Hazards School Safety Planning Toolkit

All incident response activities for the school district/school will utilize the principles of the National Incident Management System, as defined by the United States Department of Homeland Security. The Incident Command System will be used to manage all command-and-control responsibilities and school district/school staff will be trained in the National Incident Management System and Incident Command System.

Phases of an Emergency

1. Prevention/Mitigation – Prevention and mitigation are proactive efforts, laying the groundwork for avoiding and reducing the effects of incidents. Many school districts/schools have addressed prevention efforts to varying degrees. However, the potential to minimize risk through mitigation efforts needs to be explored further by many school districts/schools.

2. Preparedness – Preparedness is a critical part of any “All Hazards” School Safety Plan. A sound preparedness strategy informs the staff about what to do in order to keep students safe in the event of an incident. It helps school districts/schools to develop and practice routines that reduce the likelihood of panic during stressful situations. This also means that school districts/schools have designed procedures for communicating to parents, staff, and the community and reunification of children with their parents/guardians. Preparedness is also the link that ties the school district with the larger community.

3. Response – The response phase is designed to ensure that the action steps in the “All Hazards” School Safety Plan are properly implemented when an incident occurs. Typically, the response phase outlines the responsibilities for those who have a role in the response effort.

4. Recovery – How quickly a school district recovers from an incident is impacted by how well that district manages its post-incident communications with response agencies, the local community, parents/guardians, students, district staff, and the media. It is important to ensure that the appropriate level of support is provided to those who suffer physical or emotional trauma during an incident. Recognizing warning signs and providing assistance will help to reduce the overall impact of an incident.

For additional information see the: “All-Hazards School Safety Planning Toolkit”.

Summary

CTE laboratories and classrooms are often filled with dangerous tools, equipment, machines, and processes as well as a wide range of conditions, which are difficult to control. With their technical background combined with pedagogical knowledge and skills, career and technical educators are in a unique position to positively contribute to the health and safety of their students. However, learning to establish and maintain a safe educational environment is an ongoing professional development process. The information examined within this publication was not intended to frighten educators, but rather to highlight the enormous responsibility associated with providing a safe teaching and learning environment. Establishing a comprehensive safety and health program is an effective way to successfully implement the elements discussed in this publication. While establishing and maintaining a safe teaching and learning environment can appear to be an overwhelming task, with education, preparation, and perseverance comes success.

Appendix A: Essential Elements of Safety and Health Programs: A Checklist for CTE Teachers

	Yes	No
The instructor operates the CTE program in compliance with State and Federal regulations as required within Pennsylvania Code, § 339.23.		
Records of safety lessons delivered to students are kept on file with the instructor. Appropriate documentation includes: 1) the date when the safety instruction was delivered, 2) a record of corresponding pupil attendance, 3) supporting information sheets/handouts and 4) the safety evaluation of each student's knowledge and skill development.		
Records of completed safety evaluations are kept on file with the instructor. Appropriate documentation includes: 1) the evaluation and date in which it was completed, 2) the final grade (i.e., a perfect score is required for each student prior to participation in lab related activities) and 3) the student's signature.		
Safety rules are visibly posted in the CTE program with clearly defined consequences for violation.		
A hazard prevention safety committee has been maintained by the instructor, which includes faculty, administration, students and school employees. Appropriate documentation includes meeting minutes. (i.e., a minimum of two meetings evenly distributed throughout the academic year).		
The instructor regularly engages the Occupational Advisory Committee (OAC) in discussions on occupational safety and health elements and needs within the program. Appropriate documentation includes meeting minutes.		
The instructor has a written maintenance plan within a handbook, file or computer software program for both routine and preventive maintenance. The plan should include: 1) a list of apparatus such as tools, machines, equipment, facilities, etc. that require maintenance, 2) the maintenance requirements and service intervals for each item, 3) the date service was completed and 4) the individual or vendor responsible for the maintenance and or housekeeping task(s).		
The instructor regularly conducts safety inspections within the CTE program to identify potential hazards and unsafe practices. Appropriate records include: 1) the original copy of the inspection and date in which the inspection was conducted, 2) a signature of the individual that completed the inspection and 3) the written procedures for corrective action if needed.		
The instructor has assured that every hazardous material and substance within the program is appropriately labeled and contains a corresponding Safety Data Sheet (SDS) within a readily accessible file.		
The instructor visibly displays a written statement outlining all Personal Protective Equipment (PPE) required to work safely within the CTE program.		
The instructor has a written emergency action plan that corresponds with school protocol but is also unique to the specific CTE program. Appropriate records include: 1) escape procedures, signals and routes, 2) procedures for accounting for all personnel, 3) rescue and medical duties and 4) protocol for reporting emergencies.		

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Appendix B: Safety Related Resources and Organizations

American Association for Vocational Instructional Materials

American College of Occupational and Environmental Medicine

American Hearing Research Foundation

American Industrial Hygiene Association

American National Standards Institute, Inc.

American Red Cross

American Society of Safety Engineers

Arts, Crafts, and Theatre Safety

Association for Career and Technical Education

Association for Career and Technical Education Research

Better Hearing Institute

CareerSafe

Center for Occupational Research and Development

Consumer Product Safety Commission

Engineering and Safety Services

Environmental Protection Agency

CTE Safety Consulting Services By Dr. Mark Threeton

Illuminating Engineering Society of North America

International Safety and Equipment Association, Inc.

International Technology and Engineering Educators Association

MAVCC

Advance CTE

National Safety Compliance

National Safety Council

National Fire Protection Association

National Institute of Occupational Health and Safety

Occupational Health and Safety Administration (OSHA), United States Department of Labor

OSHA- Region III Office (*Pennsylvania)

Office of Vocational and Adult Education

Pennsylvania Department of Education

Pennsylvania Department of Labor and Industry

Pennsylvania Worker and Community Right to Know Program

Power Tool Institute

Prevent Blindness America

SafeSchools

ServSafe

Underwriters Laboratories

Appendix C: Technology Related Support

ACTE Online Store

Adobe for Career and Technical Education

EMC Publishing

Paradigm Publishing

SoftTech

Appendix D: Institutional Accident/Incident Report

Institutional Accident/Incident Report	
Staff member completing this report	Date of report
Date of incident	Time of incident
Location of incident Individual(s) involved in the incident: Student _____ Faculty/Staff _____	
Description of incident:	
Action taken in responding to emergency:	
Corrective action(s) needed to prevent similar incidents:	
Witnesses to the incident: _____	
Investigator's Signature	Date
Administrator's Signature	Date

Appendix E: Safety Inspection: A Checklist for CTE

Safety Inspection: A Checklist for CTE

Housekeeping	**Satisfactory**	**Unsatisfactory**	**Not Applicable**
General appearance and orderliness			
Adequate and proper storage space for inventory			
Tables, desks, benches, and other walking and working surfaces are kept clean and disinfected			
Tool supply area and material storage is orderly			
Materials are stored in orderly fashion and in safe condition			
A spring-lid, metal container is provided for secure disposal of oily and solvent-soaked rags			
Waste materials are regularly emptied			
All hazardous materials are stored according to the manufacturer's recommendations			

Physical Condition	**Satisfactory**	**Unsatisfactory**	**Not Applicable**
Machines, benches, and other equipment are arranged to conform to good safety practices			
Condition of stairways, aisles, and floors			
Condition of walls, windows, and ceiling			
Illumination is safe, sufficient, and well placed			
Ventilation, and air pollution control			
Temperature			

Fire extinguishers are proper type, adequately supplied and inspected and properly located			
Emergency exits are clearly marked and unobstructed			
Storage of flammable materials adhere to applicable safety standards			
Proper procedures have been formulated for emptying the room of pupils and taking precautions in case of emergencies			

Machinery	**Satisfactory**	**Unsatisfactory**	**Not Applicable**
Point of operation guards			
Belts, pulleys, gears, and shafts are guarded			
Cleaning, and sanitization			
Adherence to routine and preventative maintenance			

Equipment	**Satisfactory**	**Unsatisfactory**	**Not Applicable**
Equipment is arranged so that workers are protected from hazards of other apparatus and passing individuals			
All equipment control switches are easily available to the operator			
Danger zones are properly identified			
All machines/equipment are “locked off” when the instructor is out of the laboratory and during service/repair			
Non-skid areas are provided around machines			
Equipment is in safe working condition			
Equipment is appropriately guarded to comply with the state and federal safety standards			
Tools and equipment are kept clean/disinfected and in safe working order			
There is a master control switch for all of the electrical installations			

First Aid	**Satisfactory**	**Unsatisfactory**	**Not Applicable**
An adequately stocked first-aid cabinet is provided			
Fire blankets			
Emergency showers			
Eye-wash station			
All accidents, incidents and close calls are reported			
Safety Data Sheets (SDS) (i.e., a safety data sheet is required for each hazardous material within the CTE program inventory.)			

Other (*add items as needed*)	**Satisfactory**	**Unsatisfactory**	**Not Applicable**
Accident prevention signs and tags			
Is one person within the CTE program clearly responsible for the safety and health plan? (i.e., the instructor)	Yes	No	
Are hazardous materials properly labeled and stored?	Yes	No	

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