# Protective Envelope and Foam

*Maryland Fire and Rescue Institute, University of Maryland at College Park*

## Session 1-1
## Personal Protective Equipment and Introduction to Respiratory Protection

- **The student will be able to identify the uses of personal protective equipment, the importance of using respiratory protection, the physical requirements of the wearer, and properly don and doff personal protective clothing.**

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## Session 1-1
## Personal Protective Equipment and Introduction to Respiratory Protection

***Overview:***

- **Need for Protective Equipment**
- **Types and Use**
- **Donning and Doffing**
- **Respiratory Hazards**
- **Exposure to Respiratory Hazards**
- **Physical Requirements**
- **Cost of Wearing SCBA**
- **Safety Precautions**

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## Session 1-1
## Personal Protective Equipment and Introduction to Respiratory Protection

***Review:***

- **Need for Protective Equipment**
- **Types and Use**
- **Donning and Doffing**
- **Respiratory Hazards**
- **Exposure to Respiratory Hazards**
- **Physical Requirements**
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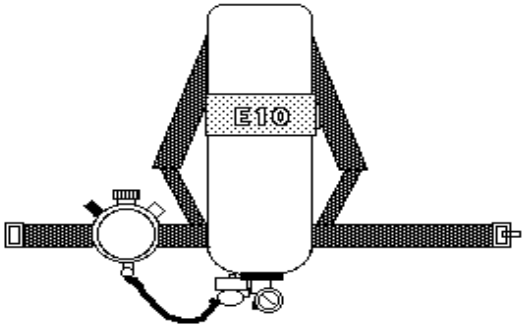
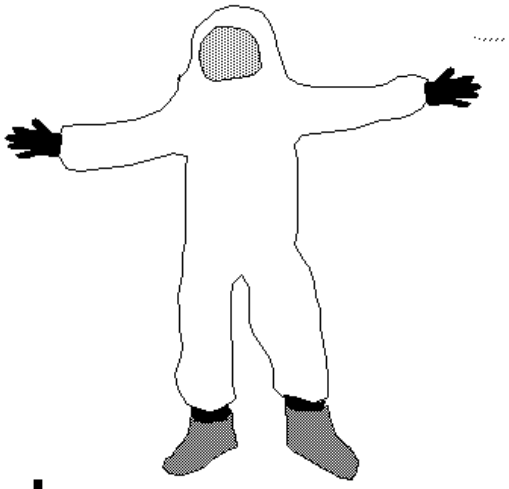
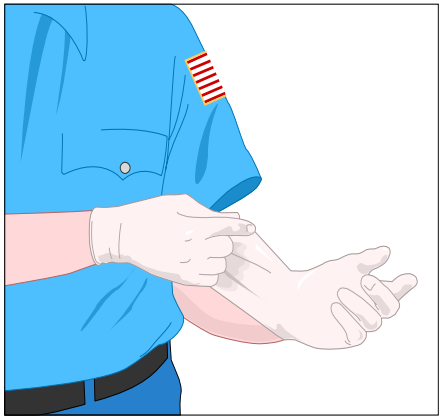
- **Safety Precautions**

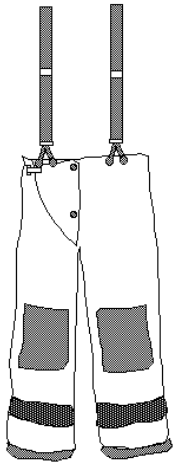
# *The Need for Protective Equipment*



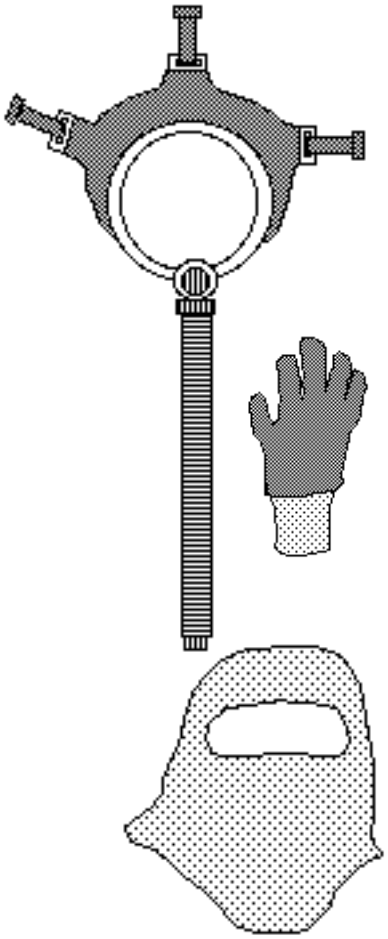

- **Exposure to injury**
  - **Firefighter actions**
  - **Actions of others**
  - **Effects of fire**
  - **Hazards**
- **Required in fireground tasks**
  - **Efficient firefighting**
  - **Rescue**
  - **Emergency care**
  - **Hazardous materials**



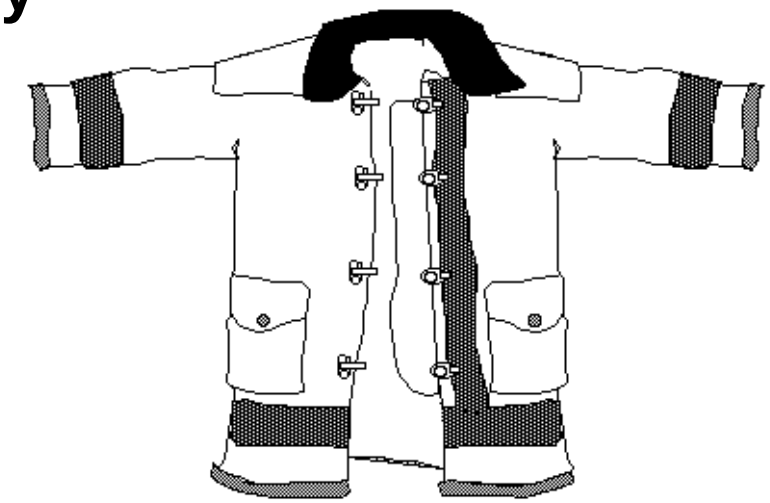




# *Causes of Injuries*



- **Excessive heat**
  - **Super-heated atmospheres**
  - **Radiated energy**
  - **Direct contact**
- **Sharp objects**
- **Blunt objects**
- **Electric current**
- **Falls**
- **Unbreathable atmospheres**



# *Respiratory Hazards*

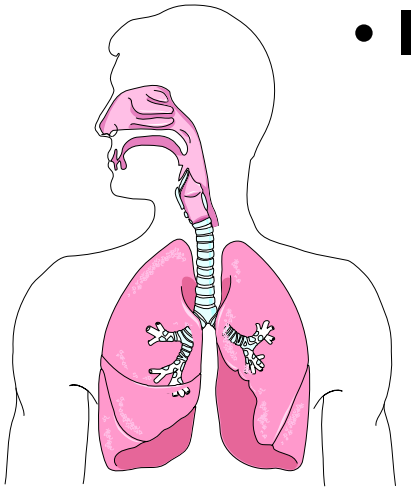
## $O_2$ Deficiency

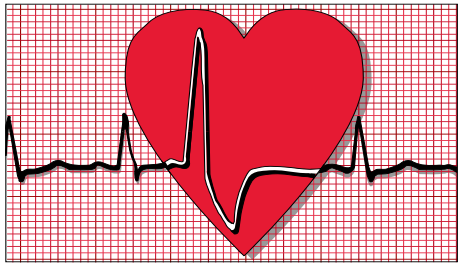
| | |
|---|---|
| 21% | Normal |
| 17% | Impaired muscle coordination, increased respiratory rate |
| 12% | Dizziness, headache, rapid fatigue |
| 9% | Unconsciousness |
| 6% | Respiratory and heart failure |

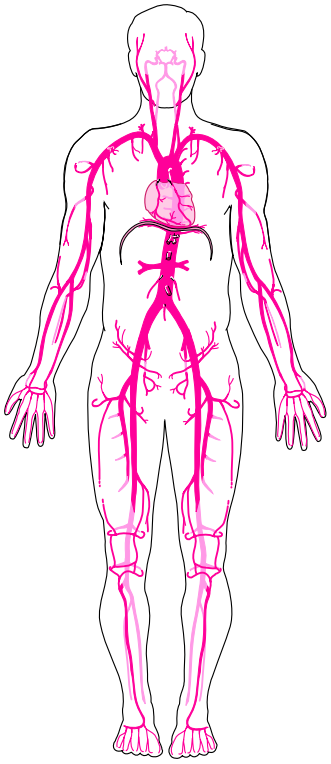
# Respiratory Hazards

## Elevated temperatures greater than 120° F and humid

- Thermal burns of respiratory system
- Collapse of circulatory system
  - Blood pressure decreased
  - Increased heart rate

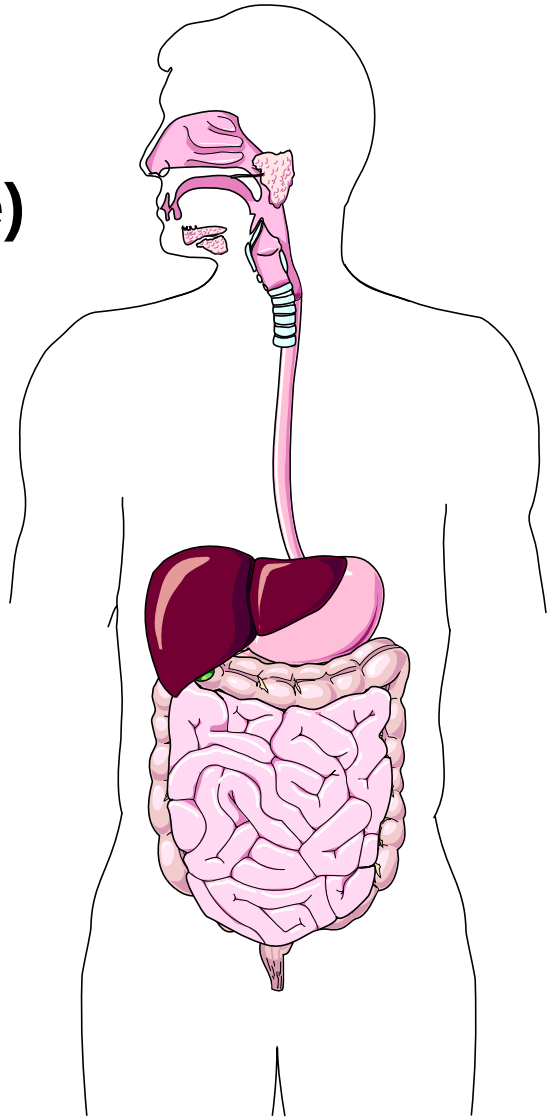






# *Respiratory Hazards*

- **Irritant particles (visible smoke)**
  - **Carbon, tar, dust**
  - **Results in irritation of gastrointestinal tract**
    - **Nausea**
    - **Vomiting**
    - **Diarrhea**

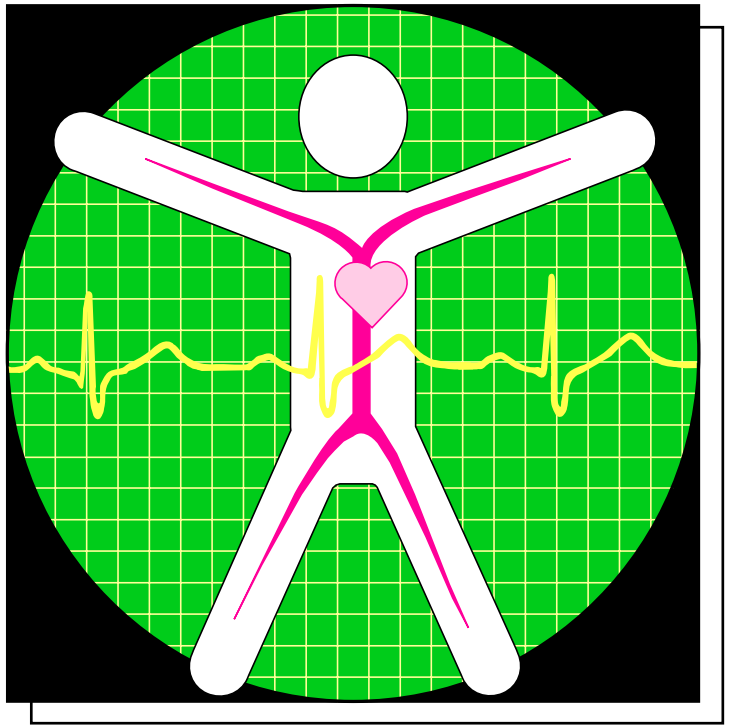


# *Symptoms of Exposure to Respiratory Hazards*

- **Impaired senses**
- **Changes in respiratory rate**
- **Mental confusion or dizziness**
- **Impaired motor skills**
- **Vomiting**
- **Convulsions**
- **Coma**
- **Death**
- **May be without symptoms**

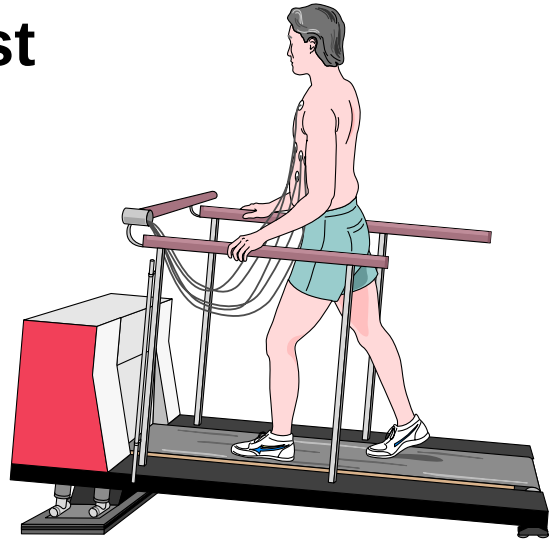
# *Medical Reasons to Deny SCBA Use*

- **Emphysema**
- **Chronic obstructive pulmonary disease**
- **Bronchial asthma**
- **X-ray evidence of pneumoconiosis**
- **Evidence of reduced pulmonary function**
- **Coronary artery disease**
- **Severe hypertension**



# *Medical Reasons to Deny SCBA Use*

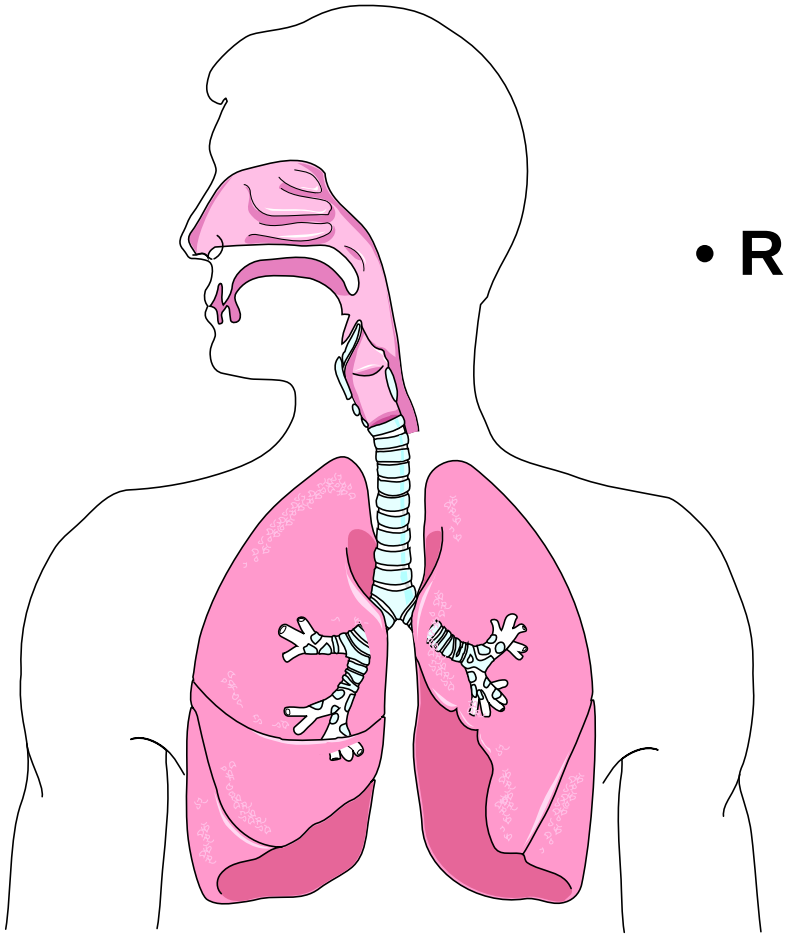
- **Epilepsy-grand or petit mal**
- **Anemia**
- **Diabetes**
- **Breathing difficulty with SCBA**
- **Claustrophobia or anxiety**
- **Abnormal EKG from stress test**
- **Punctured eardrum**



# *The Cost of Wearing SCBA*

- **Purpose**
  - **Protect respiratory tract**
- **Breathing**
  - **Inhalation - active process**
  - **Exhalation - passive process**
  - **Requires 2-3% body energy**
  - **$O_2$ and $CO_2$ exchanged**
    - **Quiet breathing = 500 ml**
    - **Heavy breathing = 3000 ml**
    - **Extreme breathing = 4600 ml**

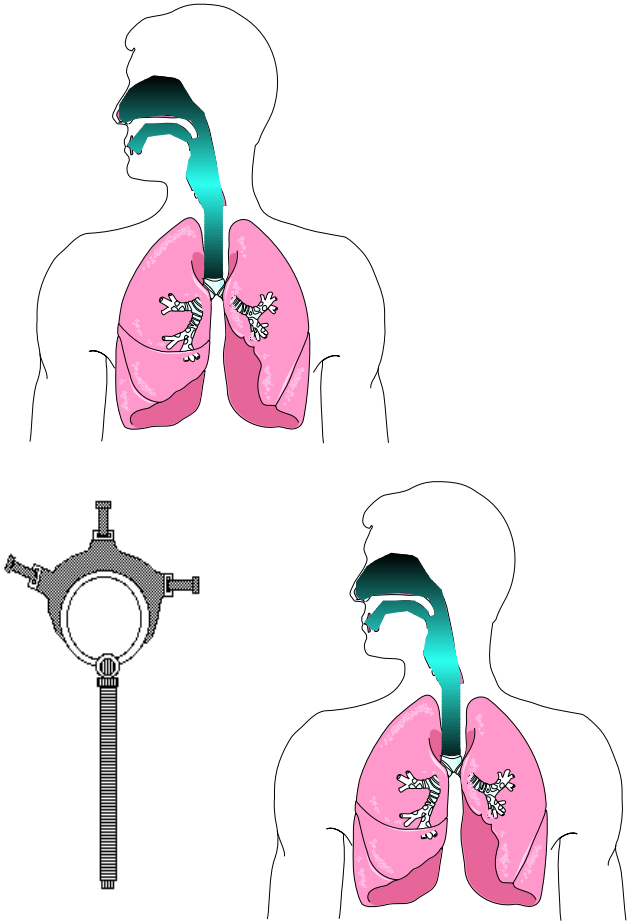
# *The Cost of Wearing SCBA*



- **Residual Volume**
  - **Air remaining in lungs after exhalation (approximately 1200ml)**

# *The Cost of Wearing SCBA*

- **Dead Air Space**
  - **Air located in upper respiratory passages**
  - **Approximately 150 ml**
  - **Increases with donning of facepiece (requires more work to move air)**



# *The Cost of Wearing SCBA*
## *Effect of Work on the Heart*

- **Blood carries $O_2$ to heart**
- **Heart attacks caused by demand exceeding $O_2$ supply**
- **Healthy hearts receive more $O_2$ than needed**
- **Age / disease reduces blood vessel size**
- **Firefighting requires 85-100% of maximum heart rate without use of SCBA**
- **SCBA creates extra work**