

Introduction



- Heat and cold stress:
 - Body temperature regulation can be impaired under temperature extremes and result in heat or cold-related illness
 - Field personnel must understand the nature of heat and cold stress-related disorders
 - They must know the necessary measures to prevent these problems
 - They must be able to identify and respond to these situations if they occur.

Learning Objectives



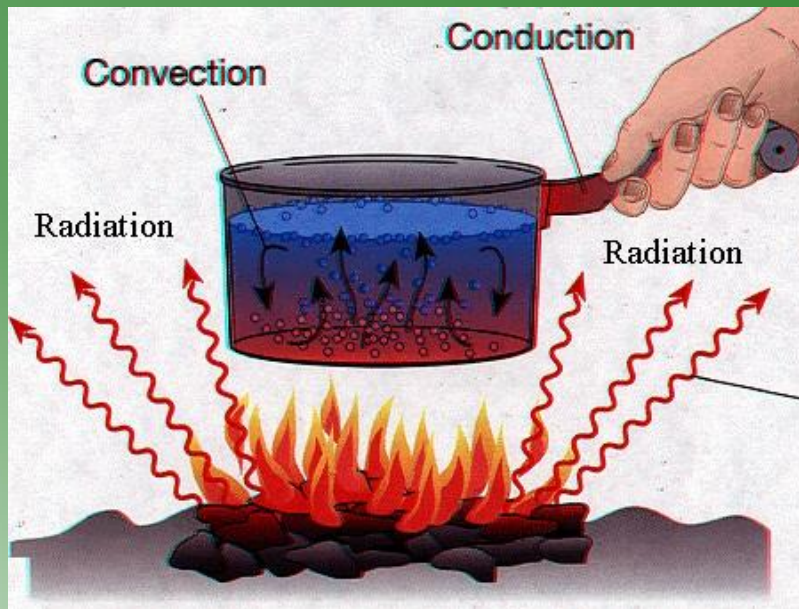
- At the end of this module, you will be able to:
 - Recognize potential heat and cold stress environments and situation
 - Identify symptoms and appropriate treatment for heat and cold-related illness
 - Take appropriate action to minimize the effects of heat and cold stress.

Heat Stress



- Heat is transferred whenever temperature differences exist between two or more bodies.

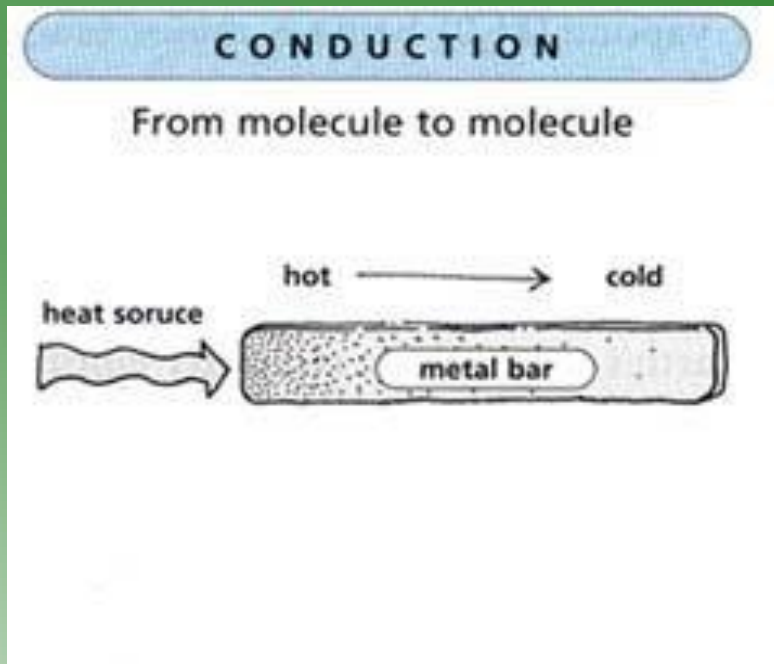
Net Heat Transfer



□ Net heat transfer moves from the body of higher temperature to the body of lower temperature and occurs by one or more of the following mechanisms:

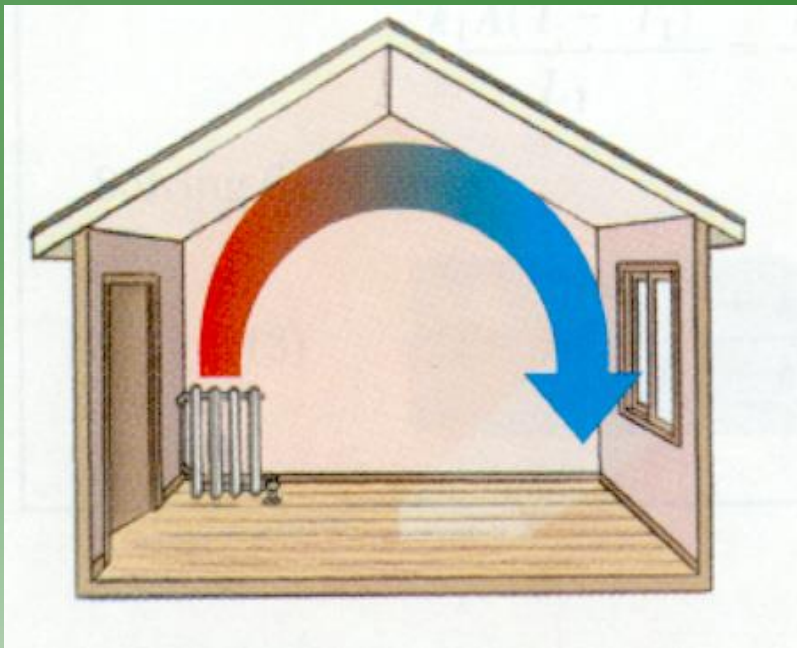
- Conductions
- Convection
- Radiation.

Conduction



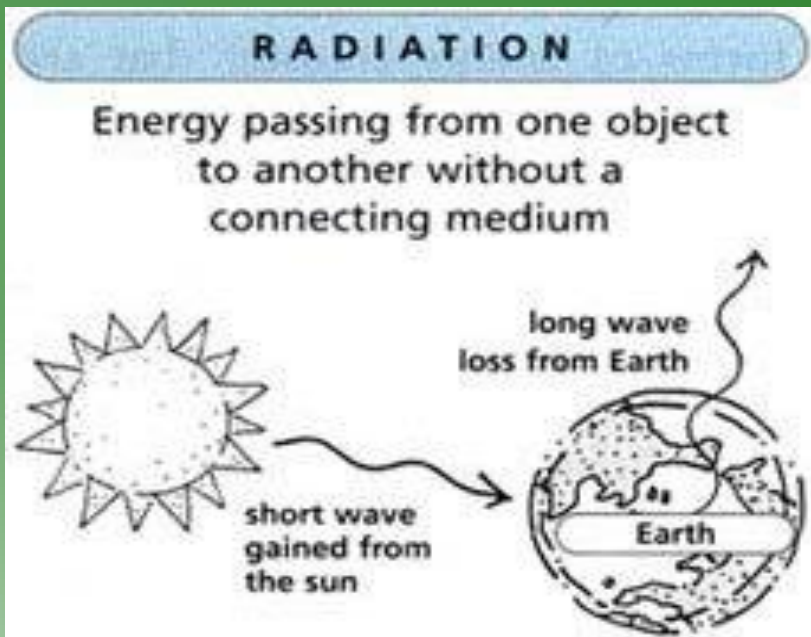
- Conduction is the transfer of heat from one point to another within a body, or from one body to another when the bodies are in physical contact.
- Although conduction can be a localized source of discomfort from direct physical contact with a hot or cold surface, it normally is not a significant component of total heat stress.

Convection



- Convection is the transfer of heat from one place to another by moving gas or liquid.
- For example, when you turn on your heater in your house, the air is circulated in order to reach an overall room temperature. Convection results from differences in **density** caused by temperature differences.

Radiation



- Radiation is the process by which electromagnetic energy (visible and infrared) is transmitted through space without the presence or movement of matter.

Net Heat Exchange

- The net heat exchange between a person and the environment can be expressed by:

- $H=M+R+C-E$

- Where **H**=body heat storage load
- **M**=metabolic heat grain
- **R**=radiant or infrared heat
- **C**=convection heat load
- **E**= evaporative heat loss

Heat Sources and Contribution Stress Factors



– Environmental

– Other

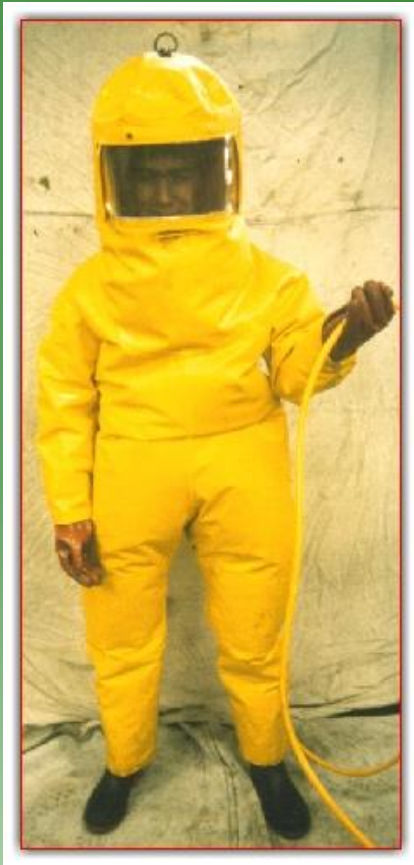
– Physical

Heat Stress Disorders and Symptoms



- Heat stress disorders result when the body's normal functions cannot reduce internal body heat.
- This often occurs when the air temperature is higher or nearly the same as body temperature. If it is also humid or if there is little or no air movement, the evaporative cooling mechanism of sweating can be lost.

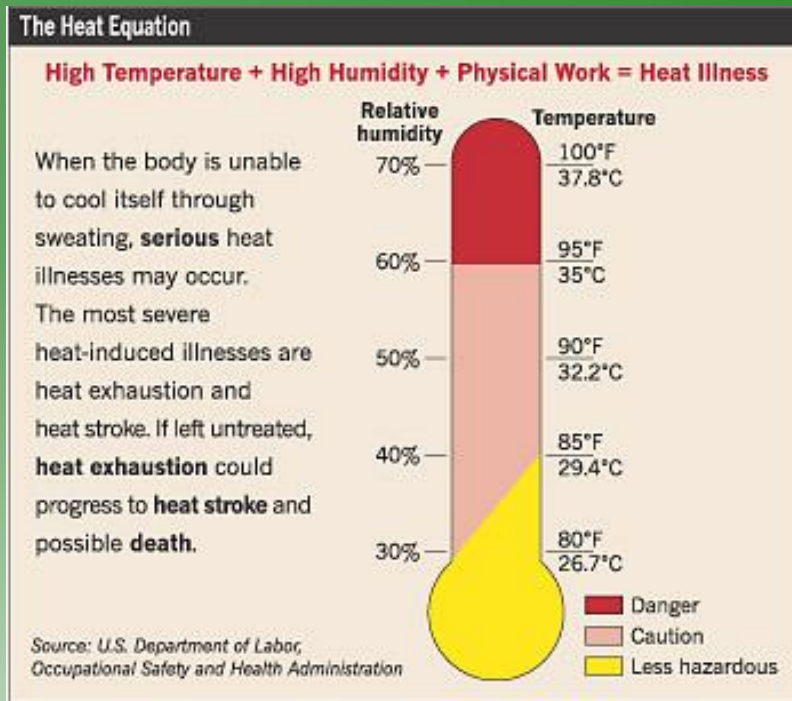
Contributors to Heat Stress



- When wearing Level A or Level B fully **encapsulating suits**, the protective clothing interferes with the body's evaporative cooling mechanism. The body temperature then begins to rise and there is a danger of heat stress disorders.

Heat Stress Disorders

□ Level of severity



Sunburn

□ Any or all of these symptoms may be present:

– Redness

Put cold water or cold wet cloths on the burned area.

Pain

Do not rub the skin

Mild swelling

Do not break blisters.

In severe cases, blisters and considerable swelling.

Apply aloe gel, ointments, sprays as appropriate.

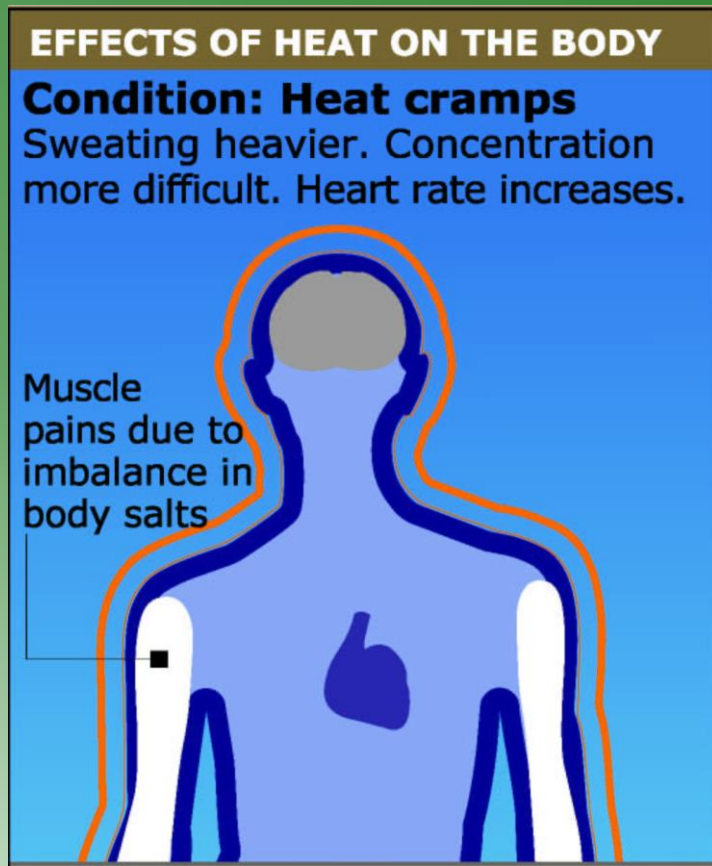
If sunburn is severe, seek medical attention.

Heat Rash Treatment



- Heat rash results when the sweat glands become clogged and inflamed. This is often caused by wearing protective clothing, because sweat is restricted from evaporating from the skin.
- Heat Rash can be treated by:
 - Cleansing the affected area of skin with cool water
 - Applying mild drying lotions or powders.

Heat Cramp Symptoms



- Muscle pains and spasms caused by **electrolytes** lost through:
 - Heavy Sweating
 - Vomiting
 - Convulsions.

- Normal pulse and blood pressure are still possible when a person is experiencing heat cramp alone.

Heat Cramp Prevention



- You can prevent heat cramps by:
 - Drinking any commercial sport drink
 - Drink cool water as often as desired, but drink at least one cup every 15 to twenty minutes.

- When on the job, drink on cup of replacement fluid every 15 to 20 minutes. If possible, vary your intake of both fluids, but drink even if you do not want to.

Heat Cramps

- Symptoms
- Any or all of these symptoms may be present:
 - Painful muscle cramping and spasms.
 - Heavy sweating
 - Vomiting
 - Convulsions
 - Normal pulse and blood pressure.
- Treatment
 - Move the victim to a cooler area.
 - Loosen the victim's clothing.
 - Apply hand pressure to the affected area or gently massage the cramped muscle.
 - Administer electrolyte replacement solution gradually.

Test your knowledge

□ One way to prevent heat cramps is to drink _____ periodically throughout the work day.

– Alcohol

– Water

– Soda

– Electrolyte Solutions

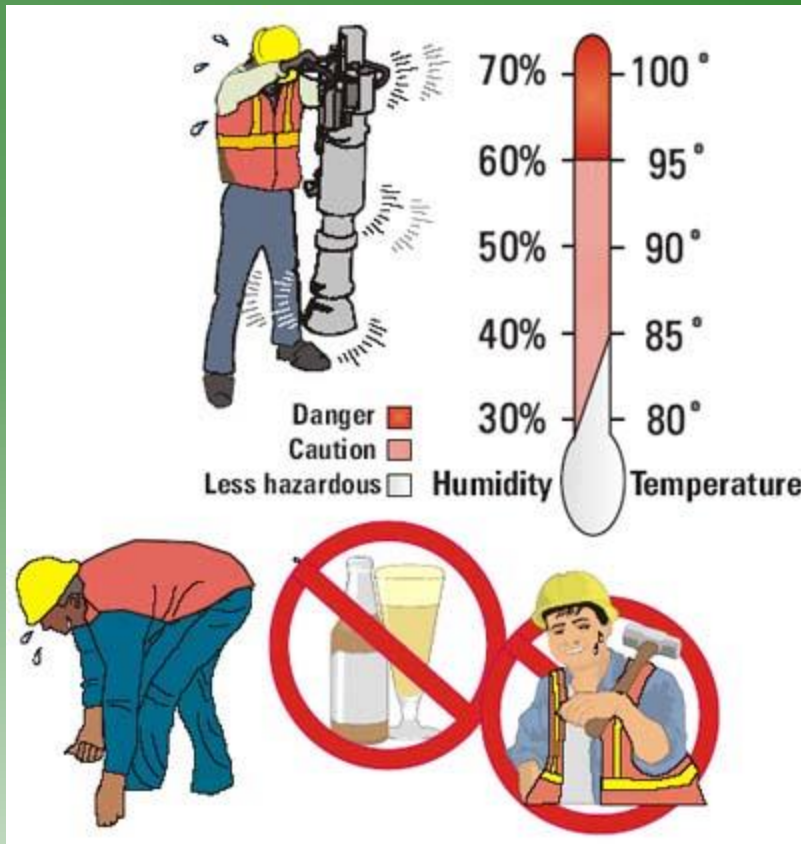
Heat Fainting

- Heat fainting caused by the pooling of blood in dilated vessels of the skin and lower body. The inadequate cardiac function results from the failure of the circulatory system to compensate for increased blood flow demands imposed by the need to cool the body.
- Heat fainting symptoms include fainting and dizziness and may accompany heat exhaustion.

- Symptoms
 - Fainting
 - Dizziness

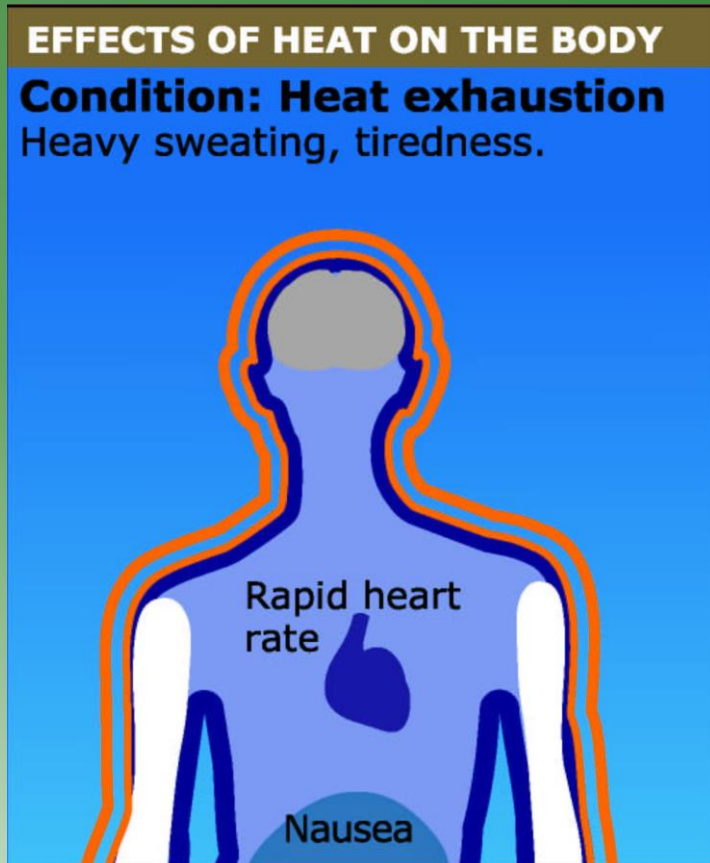
- Treatment
 - Remove the victim to a cooler area, and have him or her lie down.
 - Elevate the victim's feet 8 to 12 inches.
 - Loosen victim's clothing.
 - Get medical aid if symptoms are severe, become worse, or last longer than one hour.

Heat Exhaustion



- Heat exhaustion is a reaction to excessive heat, marked by prostration, weakness, and collapse resulting from dehydration.
- If treated properly, recovery is assured. However, if untreated, heat exhaustion may progress into heat stroke.

Heat Exhaustion



- There are various symptoms associated with heat exhaustion.
- Take this opportunity to find out more about:
 - Heat exhaustion symptoms
 - Heat exhaustion treatments.

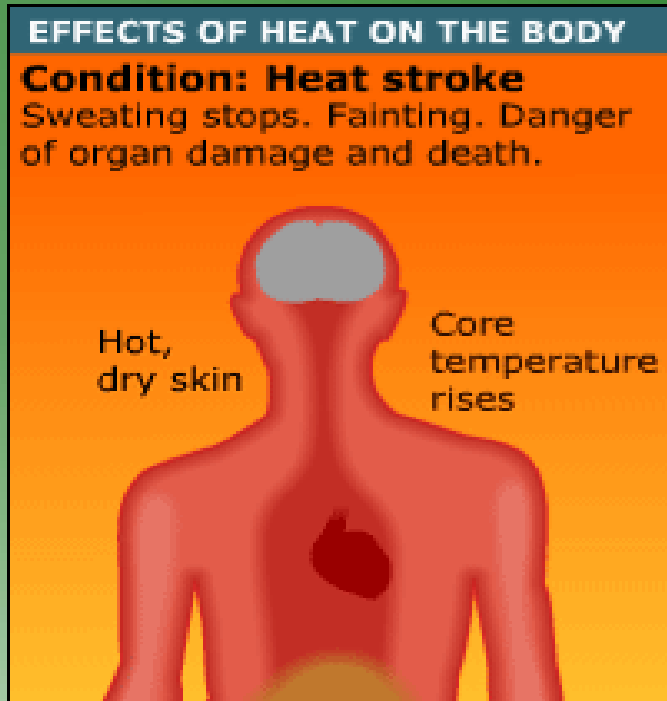
Test your knowledge

- Heat exhaustion is a common problem experienced by many workers in hot environments and does not require medical treatment.

True

False

Heat Stroke



- Heat stroke is a severe illness caused by exposure to excessively high temperatures.
- Heat stroke results from a breakdown in the body's cooling mechanism caused by untreated heat exhaustion symptoms.
- Heat stroke can occur when the failure to sweat results in the loss of evaporative cooling.

Test your knowledge

Heavy sweating is a symptom of heat stroke.

True

False

Measure to Prevent or Reduce Heat Stress

- Physical Ways to Reduce Heat Stress**
 - Types of Clothing Than Can Help to Reduce Heat Stress**
- Protective Skin Measures Than Can Help to Reduce Heat Stress**
- Other Suggestions to Help Reduce Heat Stress**

Supervisor Preparation for Working in Hot Conditions

- **Environmental Conditions** Assess the weather conditions at the field site.
 - **Heat Source** assess potential sources of heat the the field site, including radiation, conduction, and convection sources.
 - **Human Factors** assesses the degree of acclimatization of team members. Assign non-acclimatized team members to shorter lengths of time in the heat. Do this for at least 1 week.
 - **Monitor workers for symptoms of heat stress, especially during adverse conditions.**

Scheduling Work

TEAM SCHEDULE									
TEAM	MON	TUE	WED	THU	FRI	SAT	SUN	PRIORITY	REMARKS
1 ASSEMBLY TEAM 12								1	1. Allow 2. Review 3. Coffee
2 SERVICE TEAM 9								2	Training Plan-1st
3 FIELD TEAM 3								3	1. Allow 2. Review 3. Coffee

TEAM 1 TEAM 2 TEAM 3

Review of project assignments
Check for revisions!

New dates go into effect on Thursday

- Lifting and hauling should be scheduled for cool hours of the day.
- Schedule the work when the equipment is not operating.
- Scheduling work can be difficult. During hot working conditions, try to arrange work during cool periods of the day and allow for adequate rest periods.
- This is especially important when estimating the amount of work to be done each day.

Work-Rest Regimen



- If you have personnel that must wear respiratory equipment or protective clothing without cooling vests, consult an industrial hygienist to establish an appropriate work-rest regimen.
- Generally personnel wearing impervious protective garments should institute a formal heat stress monitoring program, including a work-rest regimen.

Protective Clothing



- Plan to have crew members wear head coverings and clothing that will reduce the heat load.
- Clothing should be light in color, absorbent, and reflective. When the ambient temperature is below 100 F, loose-fitting clothing or a limited amount of clothing should be worn. If the ambient temperature is above 100 F, crew members should cover their bodies as much as possible.
- Cooling vests are also available, generally for persons wearing **PPE** while working in hot environments.

Equipment and Supplies

- Obtain a reliable ambient temperature thermometer or wet-bulb globe thermometer to check the air temperature at the beginning of each workday and during the day.
- If your samplings involves moving heavy tools and equipment, especially to heights, provide a block-and-tackle for hoisting. This will make the work less strenuous and will reduce metabolic heat production in crew members.
- If you will be working near sources of intense heat in an industrial plant or in the direct sun, plan to use protective heat shields, insulating materials, and reflectors to reduce the heat load.
- Take electric fans for cooling and tarps to provide shade, if appropriate.
- Plan to provide crew members with sufficient electrolyte replacement solution.
- Provide emergency communication equipment for use between ground crews and those working in the heat, at heights, or in remote locations.

Monitor Employees



- Finally, during the workday, employees should be checked periodically for signs of stress and reminded to take rest breaks and replace fluids.
 - Monitor employees for signs of heat stress.
 - Remind employees to take rest breaks and replace fluids.
 - Temperatures should be taken at breaks to detect the onset of heat stress.
 - Weigh employees at the beginning and end of each workday to detect dehydration.

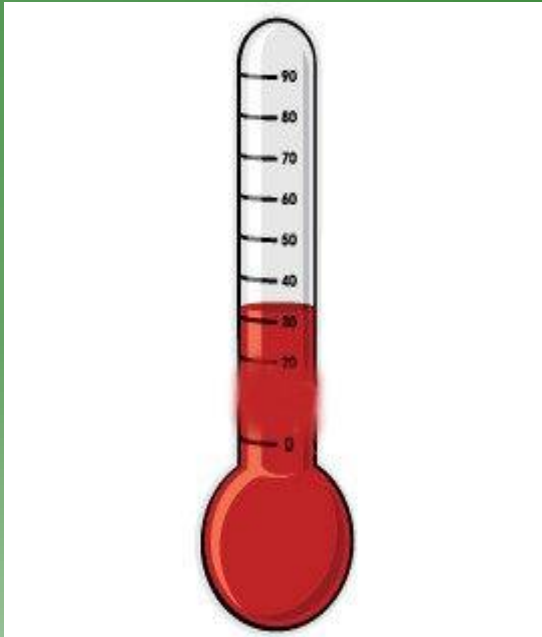
Test your knowledge

□ The onset of heat stress problems can be detected by weighing workers before and after each work day.

□ True

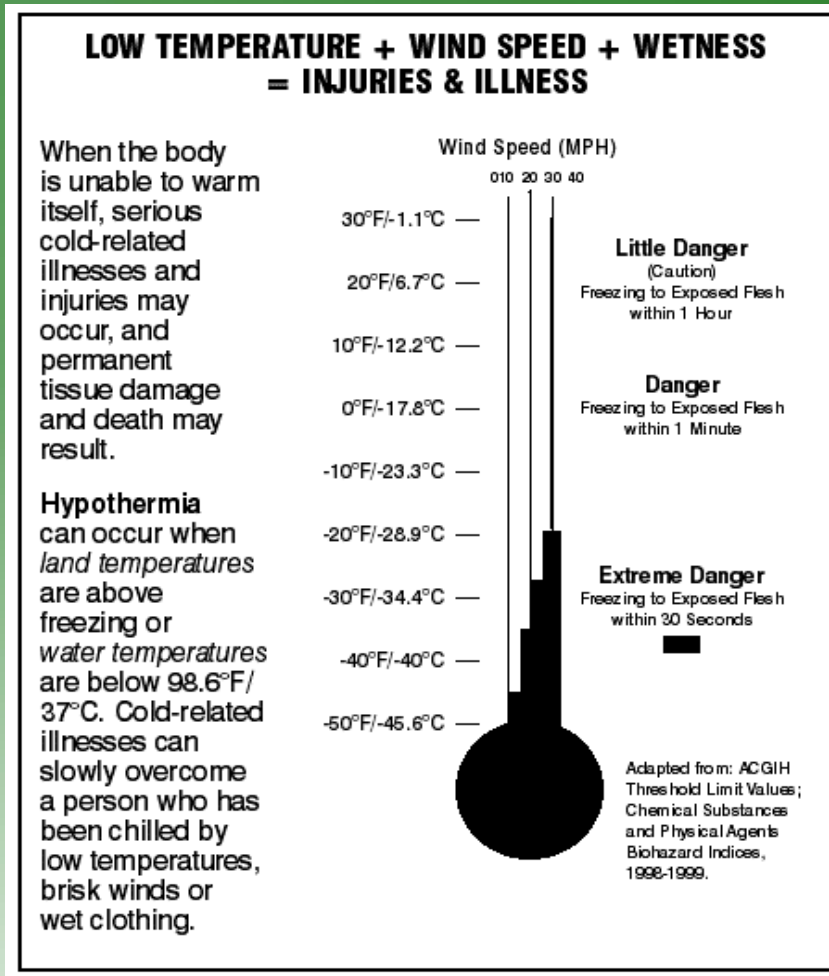
□ False

Cold Stress Related Disorders



□ Cold Stress.

Cold Stress

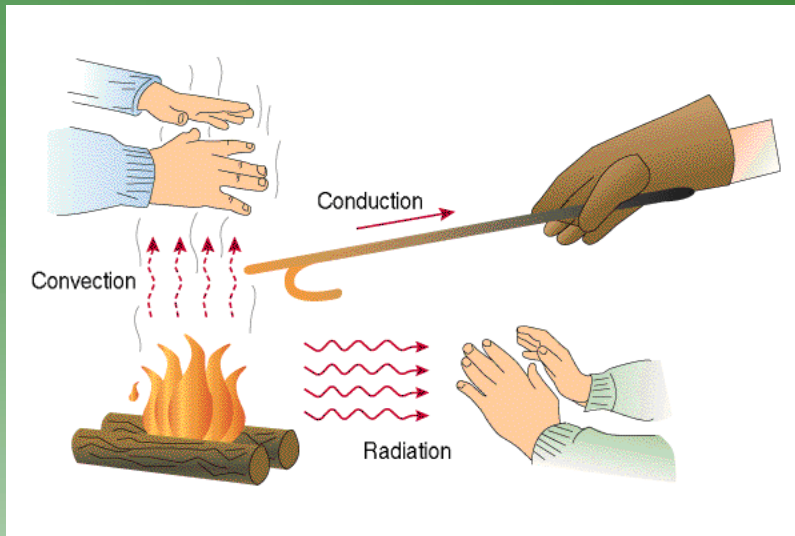


- The human body functions in a narrow range of internal body temperatures.
- Cold stress is the cumulative effect on the body resulting from loss of body heat.
- Humans must maintain body heat.

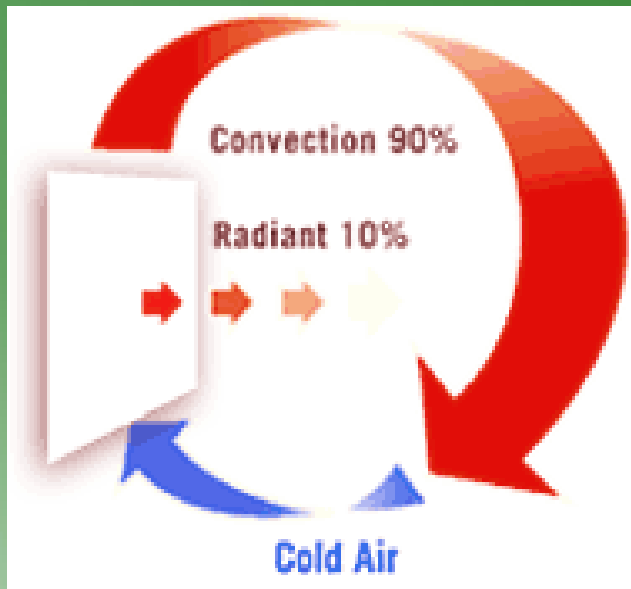
Loss of Body Heat Causes and Contributing Factors

□ There are four causes to the loss of body heat. They are:

- 1. Radiation
- 2. Conduction
- 3. Convection
- 4. Evaporation.



Heat Loss from Convection



- Heat loss from convection-that is, wind-is probably the greatest and most deceptive factor in loss of body heat.
- In essence, the wind blows away the thin layer of air that acts as an insulator between the skin and the outside air temperature.

Other Factors Contributing to Heat Loss



- Inadequate food, water, or sleep
- Lack of acclimatization
- Alcohol consumption (causes the dilation of blood vessels near the skin surface, resulting in increased heat loss)
- Fatigue
- Medications (e.g., sedative drugs, which interfere with the transmission of impulses to the brain)
- Cardiac and respiratory conditions (e.g., more difficult to maintain increased metabolic rate)
- Physical fitness of individual worker
- Age

Test your knowledge

The loss of body heat can be increased by the consumption of alcohol.

True

False

Cold Stress Disorders



- The body maintains its internal temperature by gaining heat from food and muscular work, or by losing heat through the factors previously mentioned.
- Cold stress disorders result when the body cannot maintain an adequate internal temperature.

Heat Escaping the Body



- ❑ Cold stimulates cold-sensitive nerve endings in the skin sending afferent impulses to **hypothalamus**.
- ❑ Reduction of blood flow results in less heat loss from skin surface.
- ❑ Vasoconstriction of peripheral vessels reduces blood flow to skin surface.
- ❑ Increase in **epinephrine** production influences smooth muscles and constriction of blood vessels.
- ❑ Drop in blood pressure affects hypothalamus.
- ❑ Skeletal muscle “shivering” helps generate body heat to maintain normal temperature.
- ❑ Suppression of sweat gland activity results in less water evaporation and body heat loss.

Cold Stress Symptoms

TREATMENT IN THE FIELD

BODY SIGNS/SYMPTOMS
TEMP. (rectal)

www.hypothermia.org

37.5°C NORMAL

36 FEEL COLD

Seek dry shelter, replace wet clothing with dry including socks, gloves, hat, cover neck, insulate whole body including HEAD from cold. Exercise but avoid sweating. External warmth (bath, fire) ONLY if CORE TEMP. above 35°C. Warm sweet drinks and food (high calories).

35 SHIVERING

BODY CORE TEMPERATURE BELOW 35°C = HYPOTHERMIA = HOSPITAL

CLUMSY

34 IRRATIONAL
CONFUSED
(may appear drunk)

NO EXERCISE, HANDLE GENTLY, REST.
NO EXTERNAL WARMTH (except to chest, trunk, eg. Hiebler Jacket).
Warm sweet drinks and calories.
Internal warming via warm moist air (exhaled air, steam) or warm moist oxygen (40 - 42°C at mask).

33 MUSCLE STIFFNESS

Monitor pulse, breathing. Restrict all activity, lie down with feet slightly raised.

32 SHIVERING STOPS, COLLAPSE. TRANSFER TO HOSPITAL. URGENT.

31 SEMI CONSCIOUS

30 UNCONSCIOUS

No response to painful stimuli

Nothing by mouth. Check airway remains open.
May tolerate plastic airway, put in recovery position, check airway, turn every 2 hours to protect skin, monitor pulse and breathing.

29 SLOW PULSE AND BREATHING

Slow mouth-to-mouth breathing, at victim's own rate (may be very slow).

28 CARDIAC ARREST

No obvious pulse or breathing
Pupils dilated

Check airway. CPR, with mouth-to-mouth breathing. Aim for normal CPR rates of 12-15 breaths/min. and 80-100 compressions/min. but slower rates of 6-12 breaths/min. and 40-60 compressions/min. may be adequate. Continue for as long as you can.

BELOW 28°C. NO VITAL SIGNS, COLD. DO NOT GIVE UP TREATMENT.

NOTE: NOT DEAD UNTIL WARM AND DEAD!

Avoid rapid rewarming and HANDLE GENTLY AT ALL TIMES.

Core temperature may lag behind skin temperature and continue to drop, so keep monitoring.



- The body limbs furthest away from your heart are generally the first areas affected by cold stress disorders. Shivering is the body's reflexive attempt to produce heat by rapid contractions of the muscles. If the body continues to lose heat, **hypothermia** will occur.

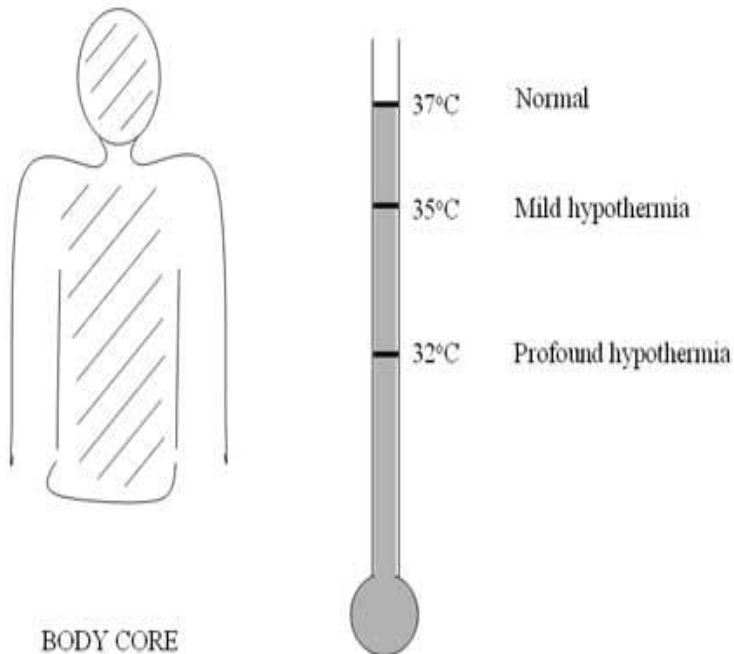
Cold Stress Prevention for In-Water Activities



- Field personnel who are required to perform diving or other in-water activities should wear thermal underwear under dry suits.
- After leaving the water, personnel should dry off and change into warm clothes as soon as possible. Consult diving manuals for temperature-related specifics.

Hypothermia

The onset of Hypothermia



- Hypothermia is the progressive lowering of body temperature accompanied by rapid, progressive mental and physical collapse.
- Hypothermia may occur on land or following submersion in moderately cold water—like 65 Fahrenheit or below.

Hypothermia



- In hypothermia, the entire body cools because of its inability to keep warm. The victim will die if not treated.
 - The first symptoms of Hypothermia
 - Treatment for Mild Cases
 - Symptoms before Collapsing
 - Treatment for Severe Cases

Test your knowledge

Drowsiness and slow, slurred speech are symptoms of hypothermia.

True

False

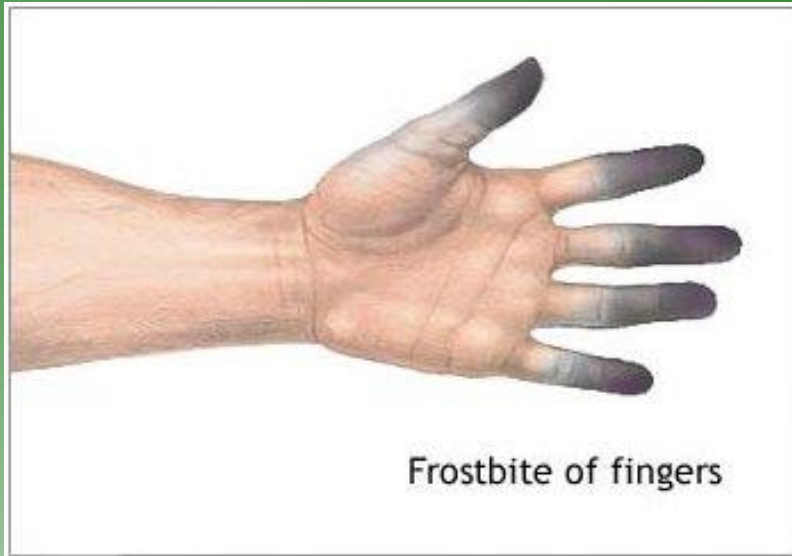
Test your knowledge

For severe hypothermia, wrap the victim in a blanket, sleeping bag, or extra coat, and go immediately to get help.

True

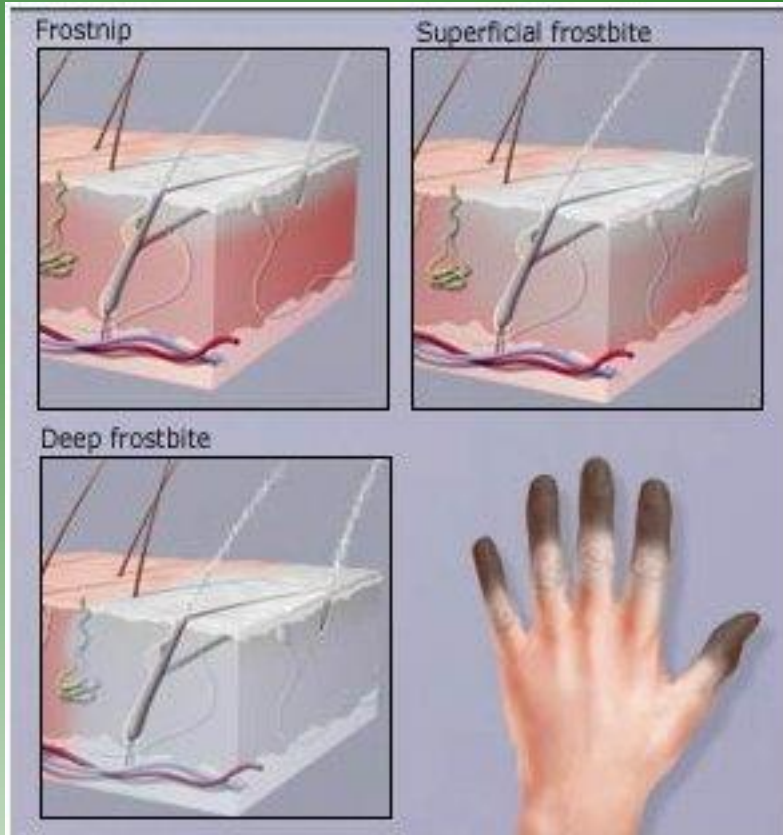
False

Frostbite



- ❑ Frostbite is another cold-stress disorder. Frostbite is the freezing of body parts exposed to the cold. The face, hands and feet are the most commonly affected.

Three Stages of Frostbite



- Severity of frostbite depends on the length of exposure.
- The three stages of frostbite are:
 - Frostnip
 - Superficial Frostbite
 - Deep Frostbite.

Treatment for Frostbite

Thaw frozen spots immediately by applying body heat, but do not rub or massage affected area.

Do not use snow to thaw frostbite; this can make the injury more serious.

Give victim warm, non-caffeinated drinks.

Have victim exercise fingers or toes as soon as they are warmed.

Do not allow a person with frostbitten feet to walk because it may cause additional damage.

For deep frostbite, **IMMEDIATE MEDICAL CARE IS URGENT.**

Remove person to a heated shelter to avoid further frostbite.

Remove all constricting items if it can be done without danger of further frostbite. Warm extremities in a carefully controlled warm water bath, if available.



Test your knowledge

- ❑ To treat frostbite, you should rub the affected area vigorously.
 - ❑ True
 - ❑ False

Measures to Prevent or Reduce Cold Stress

- There are many different ways to reduce cold stress
 - Clothing – types of clothing that can help reduce cold stress
 - Detection – Detecting Signs of Cold Stress
 - Prevention Tips- Cold Stress Prevention Tips

Supervisor Preparation for Working in Cold Conditions

- **Weather Conditions** **Assesses the weather conditions to determine adequate preparation and length of time the crew can work outside. Determine the typical wind conditions for the period in which the crew will be working.**
 - ▣ **Sheltered or Non-Sheltered Areas** **Identify whether the areas in which the crew will be working are sheltered or open to the wind and determine a means of providing shelter.**
 - **Availability of Warm Shelter** **Determine the need for scheduling enough crew members to allow alternate personnel to continue the activity while others warm themselves.**
 - **If you will be using a vehicle for a warming area or if you will use a heater in a closed room, determine how you can ensure there will be adequate ventilation to prevent carbon monoxide poisoning.**

Scheduling



- Scheduling work can be difficult. During cold working conditions, try to:
 - Schedule work during the least severe weather conditions
 - Rotate crew members to keep cold exposure short
 - Discontinue operations if winds increase or the temperature drops.

- Workers in heavy clothing may become fatigued easily and need more time to complete tasks. Be aware that you may have to discontinue operations if winds increase or the temperature drops.

Equipment and Supplies

- Cover metal handles of tools and control bars with thermal insulation material at temperatures below 30.2 F (-1 C).
- Take a reliable **ambient** temperature thermometer, wind gauge, and wind-chill chart.
- If the site is very windy, try to provide some means of shelter from the wind.
- If a source for hot food and beverages is not available, carry food and beverages (including water) and provide a means for warming them.
- Provide emergency communication equipment for use between ground crews and those working in the cold, at heights, or in remote locations.
- Carry several blankets and at least one sleeping bag for use in treatment of cold stress disorders.

Monitoring Employees



- Finally, during the workday, employees should be checked periodically for signs of cold stress and given frequent warming breaks.
 - Monitor employees for signs of cold stress.
 - Give employees frequent warming breaks.
 - Ensure employees wear clothing in layers.

Equipment Used for Monitoring

- Heat and cold stress situations are generally monitored by measuring the ambient conditions and correlating them to the potential stress experienced by the workers.
- However, in some extreme cases, it may be necessary to monitor the individual workers.



Emergency Preparation

- Know how to obtain medical assistance quickly, including ambulance service.
- Know the exact location of your work site in order to direct emergency vehicles.
- Know the name, address, and telephone number of the nearest medical treatment facility, as well as the travel time and their arrangements for accepting patients.
- Know the location of a water source or bring water with you.
- Know if any of the crew have special medical conditions or are allergic to medications.
- Prepare a plan for medical treatment and evacuation of any personnel working at heights or in a remote location.
- Make sure personnel know the symptoms of the major heat and cold stress disorders and how to respond with treatment.
- Make sure at least one crew member knows first-aid for heat and cold stress.

Heat and Cold Stress Training

- Remember, training is a priority.
- Ensure that all crew members have received the appropriate training and retraining. Personnel must have knowledge about hot and cold stress to recognize symptoms and precautions.



Summary

- The following factors are fundamental to preventing or reducing heat and cold stress:
 - Water and electrolyte replacement
 - Acclimatization
 - Proper work clothing
 - Appropriate work-rest regimens
 - Training
 - Medical screening.
- Prior to engaging in any field activities, you should be able to:
 - Recognize signs and symptoms of heat and cold stress disorders in yourself and others
 - Perform emergency treatment
 - Identify where and how medical attention can be obtained
 - Prevent or reduce the effects of heat and cold stress.

- You have completed the module on:
- Heat and Cold Stress