Managing Heat stress

(The Basics)

OBJECTIVES

Demonstrate an understanding of

- **Mechanisms of heat exposure**
- **The signs & symptoms of heat illness.**
- **How to manage heat illness**
- **How to prevent heat illness from occurring.**
- **The potential health effects of heat illness.**

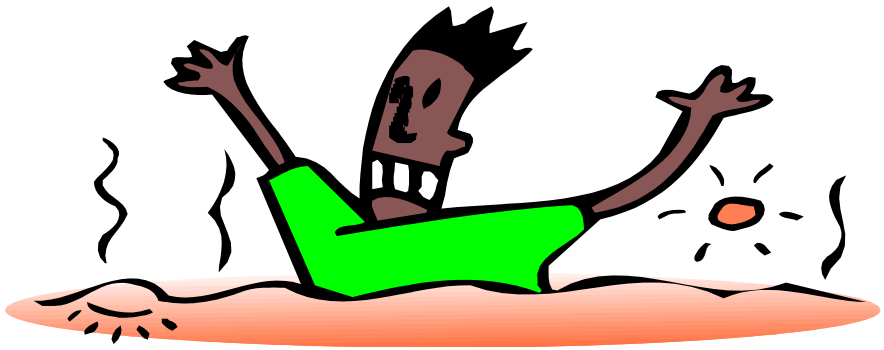
Heat Stress

Environmental heat and humidity, metabolic work load and clothing, individually or combined create heat stress for the worker.

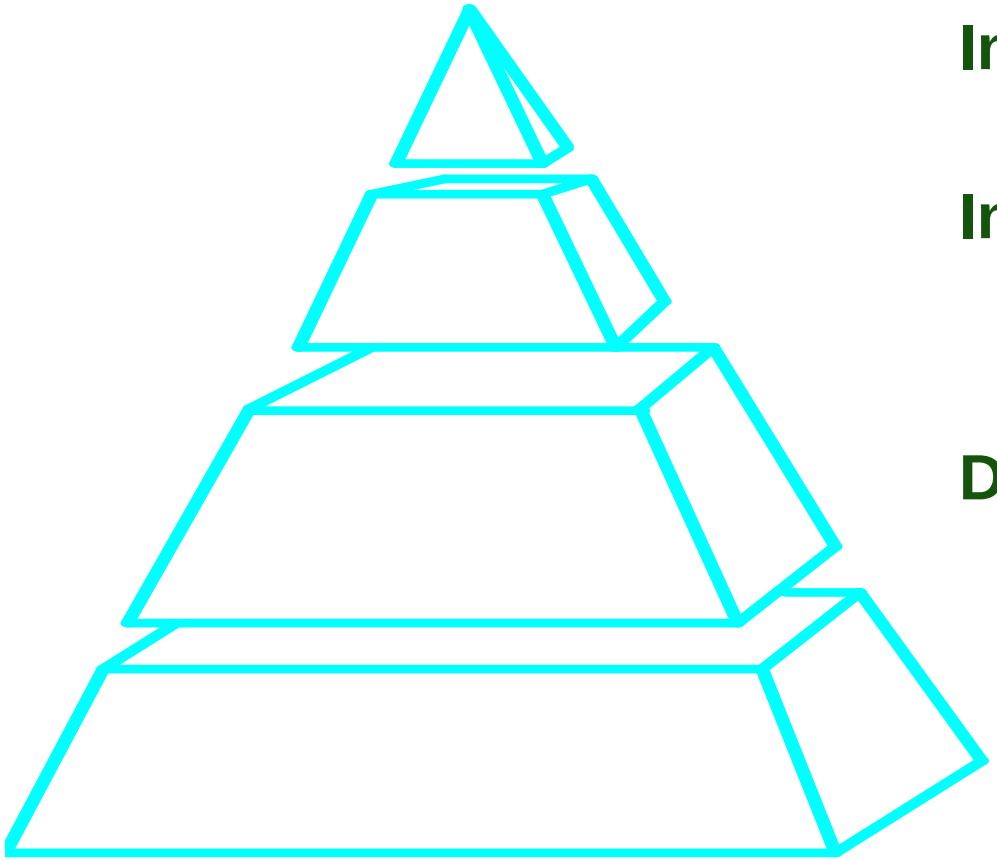
Heat Strain

The body's response to that stress, for example:

- **sweating, increased heart rate, elevated core temperature**



Progression of Effects



Increased Risk of Heat Disorder

Increased rate of Mistakes/Accidents

Decreased Performance: Lower Productivity

Initial Symptoms: Fatigue, Lethargy

The Bodies Cooling System

The body has an efficient method of maintaining the normal body core temp. at 37 °C

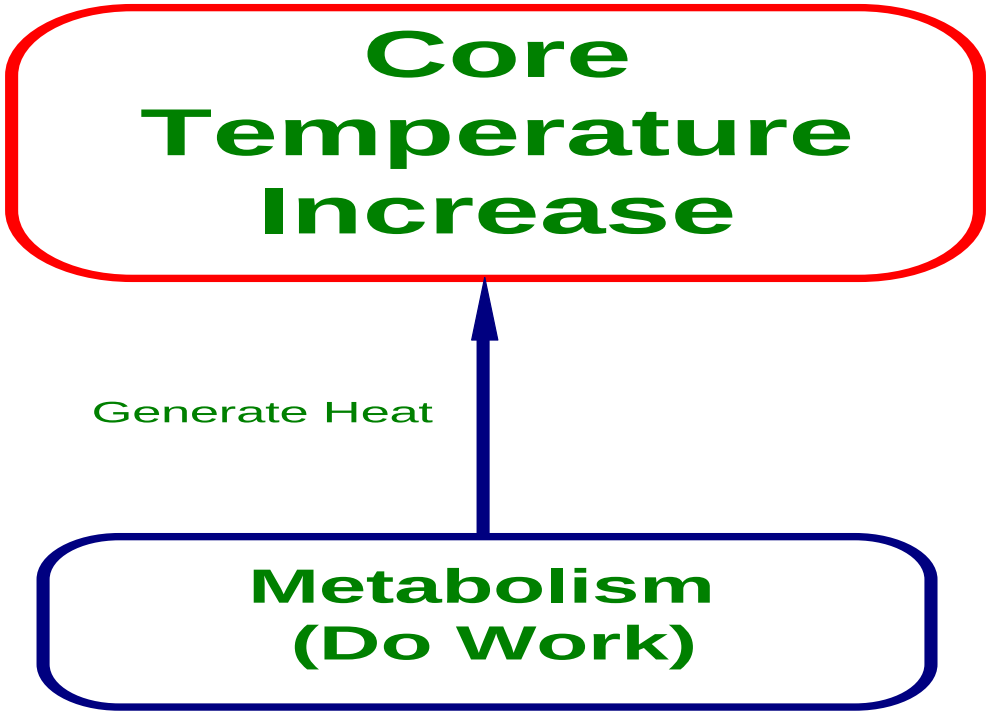
First symptoms occur at 37- 39 °C

Heat stroke at 40 °C

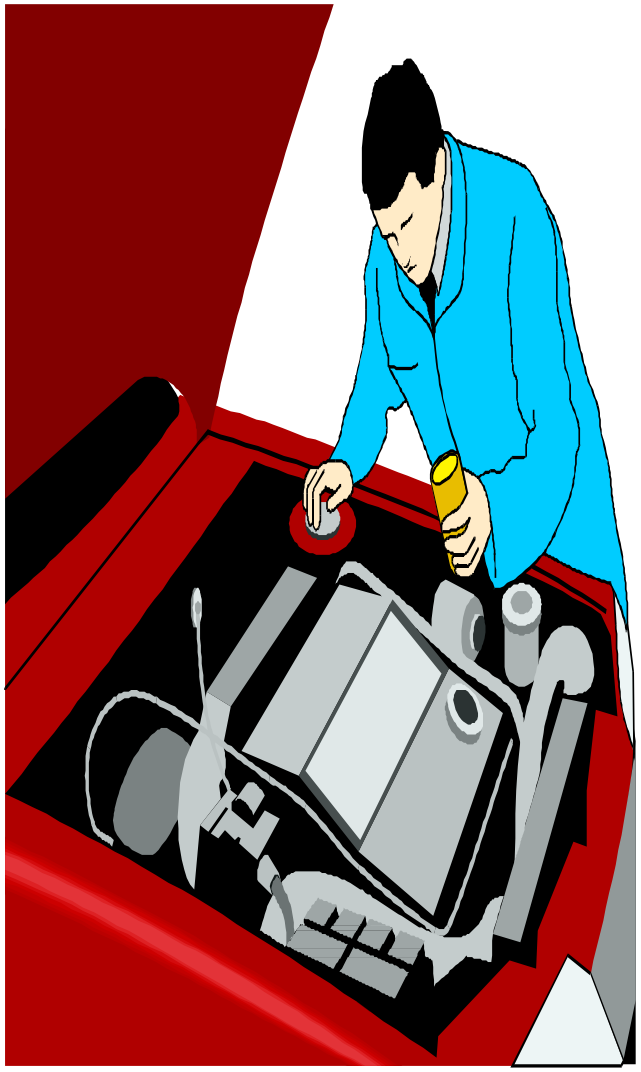
Death at 42 °C

A 2-3 °C increase in core body temperature can be potentially life threatening.

Metabolism Creates Heat

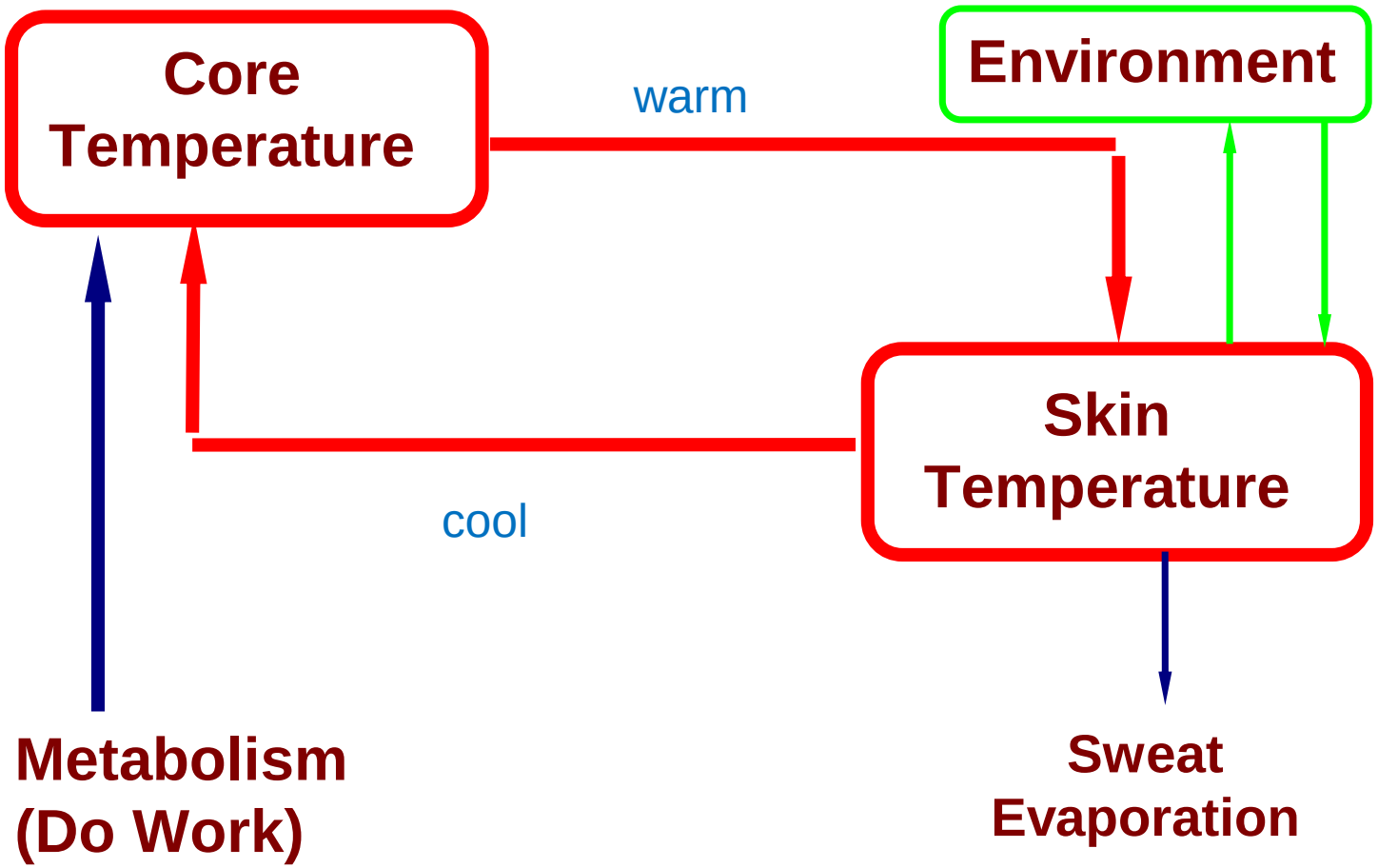


Dissipating Heat

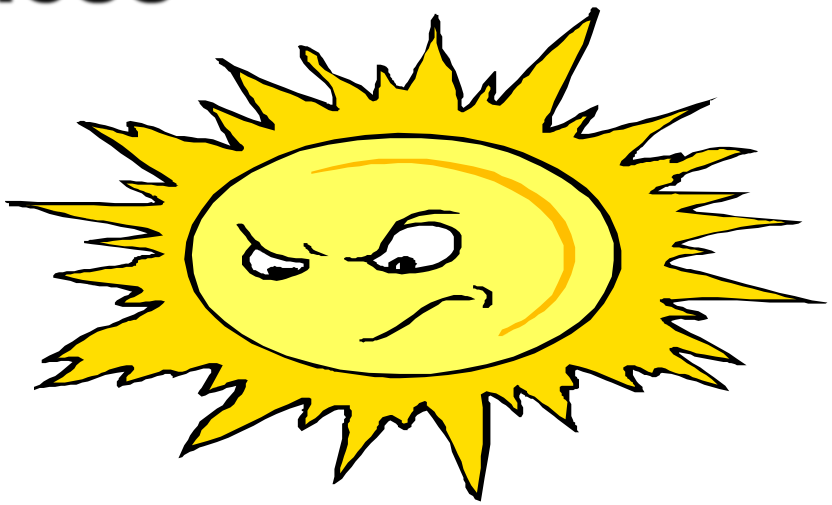


- The human body is like a car engine
- When it does work it generates heat
- The cooling systems are very similar;
  - circulating coolant (blood)
  - radiator (skin)

Heat Transfer Paths



Environmental Contributions to Heat Illness



- Temperature
- Humidity
- Air Movement
- Radiant temperature of surroundings
- Clothing
- Physical activity

Personal Factors Which Influence Heat Illness

- Age
- General Health
- Weight & Physical fitness
- Hydration State
- Acclimatisation
- Drugs

Clothing Factors for Heat Stress:

- **Ventilation:**
  - Affects the amount of cooling by sweat evaporation as air moves around and the skin.
- **Insulation:**
  - Affects heat transfer
- **Permeability:**
  - Affects sweat evaporation.
- **UV Protection:**
  - Long sleeves and trousers to protect from UV radiation and skin cancer.

Clothing

- Shirts should be designed to extend down outside the lower garment where possible. (Does this create safety issues?)
- The neck should be capable of being opened for convection.
- Sleeves should be long with buttons.
- One piece unrestricted (where practical)
- If sufficient free air flow is provided by openings for use in the humid tropics, the material could still be relatively dense.
- Colour; where solar radiation is an issue, should be a light dye type

Reflection of total sunlight by various fabrics

Item	Fabric	Contributing to the heat load[1]	Reflected
			per cent
	Data of Aldrich		
1	Shirt, Mock Leno, slightly permeable	55.9	44.1
2	Cotton, khaki—8.2 oz.	43.7	56.3
3	Cotton, percale, white	33.2	66.8
4	Cotton, percale, O.D.	51.5	48.5
5	Cotton, tubular balbriggan	37.6	62.4
6	Cotton, twill, khaki	48.3	51.7
7	Cotton, shirting worsted, O.D.	61.1	38.9
8	Cotton denim, blue	67.4	32.6
9	Cotton, herringbone twill	73.7	26.3
10	Cotton, duck No. 746	92.8	7.2
	Data of Martin (3)		
11	Cotton shirt, white unstarched, 2 thicknesses	29.0	71.0
12	Cotton shirt, khaki	57.0	43.0
13	Flannel suiting, dark gray	88.0	12.0
14	Dress suit	95.0	5.0

From: Blum, H.F., "*The solar heat load: its relationship to total heat load and its relative importance in the design of clothing".*

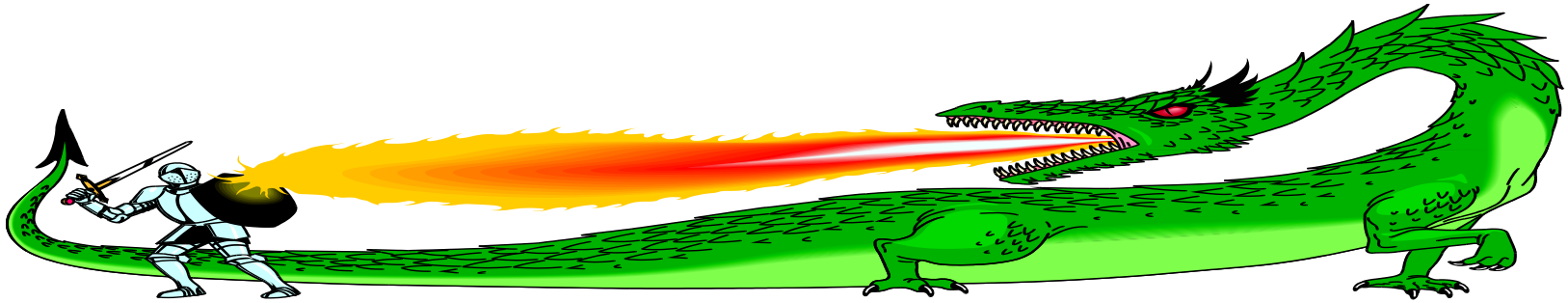
Vented Clothing

Who gets the hottest?

Black Bedouin robes gain two to three times as much heat by radiation from the Sun as white robes, but enhanced convection of air beneath the robe carries this heat away before it reaches the skin.
From Amiram, S., Taylor, C. R., Finch, V., & Borut, A., *Why do Bedouins wear black robes in hot deserts?* Nature Vol. 283. 24 January 1980.

Where might you see Heat Stress?

- Places readily recognised as being hot
- Physically demanding work
- Jobs requiring protective clothing

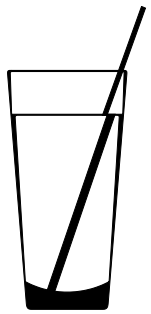


Factors Which Influence Heat Illness

- Dehydration
- Salt Balance
- Acclimatisation
- Alcohol

Fluid Replacement

- Thirst is generally an inadequate indicator
- Rule of Thumb: Drink until thirst is satisfied then have one more drink.
- Frequent Drinking, small quantities
- Water is the essential component but must be an acceptable drink.
- Pre and post-hydration is important when there are restrictions on drinking.



Caffeine

- **Can increase non-sweat body fluid losses (increased urine production) in some individuals.**
- **This effect is more common in less active individuals**
- **Moderate caffeine intake does not alter fluid-electrolyte parameters during exercise or always have a bad impact on the ability to perform exercise in the heat.**
- **It does add to the overall fluid uptake of the individual.**
- **Excessive caffeine intake can result in nervousness, insomnia, gastrointestinal upset, tremors and tachycardia in some individuals.**

Caffeine Content of Selected Beverages

Beverage	mg caffeine per 100mL
Coca Cola	9.6
Diet Coke	9.5
Diet Pepsi	10.1
Pepsi Max	19.4
Pepsi	10.7
Mountain Dew	15.2
Black Tea	17.8
Green Tea	10.6
Instant Coffee	24.1
Percolated Coffee	45.4
Drip Coffee	61.3
Decaffinated	2.4
Expresso	173
Chocolate Drink	2.1
Milk Chocolate (50g bar)	10.7

Source: Energyfiend.com

How Much Salt ?

- Salt tablets are not recommended.
- Average Westerrn diet is high in salt.
- As part of acclimatisation a hormone is produced within the body that improves the ability to conserve salt.
- Regulated quantities of electrolyte supplements may sometimes be used in situations of high sweat loss.

Acclimatisation

A complex physiological response that results in increased tolerance. ie. more efficient means of sweating with more dilute sweat.

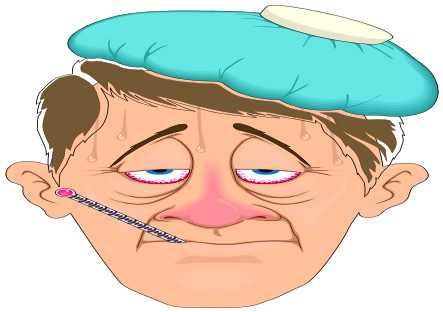
May take a week or longer to obtain.

Is rapidly lost in part or whole.

As a general practice, reduce expectations during periods of acclimatisation.

ALCOHOL

- **Alcohol acts as a diuretic (ie. it makes you pee more) hence increasing the risk of dehydration**
- **A 200 ml glass of beer may make you pass approx 300 ml of fluid.**
- **Electrolytes such as sodium & potassium are also lost.**



Heat Cramps

Symptoms: Painful muscle cramps, especially in abdominal or fatigued muscles.

Cause: Electrolyte imbalance due to prolonged sweating without adequate fluid and salt intake. Unacclimatised

First Aid: Rest in cool environment. Replace electrolytes. Massage muscles.

Heat Rash
(Prickly Heat)

Symptoms: Itching skin, reduced sweating, Skin rashes

Cause: Prolonged uninterrupted sweating, inadequate hygiene practices.

First Aid: Keep skin clean and dry, reduce heat exposure

Dehydration

Symptoms: Fatigue/weakness, Dry mouth. Increased response time.

Cause: Excessive fluid loss due to sweating, illness (ie. Vomiting or diarrhoea) or alcohol consumption

First Aid: Fluid replacement.

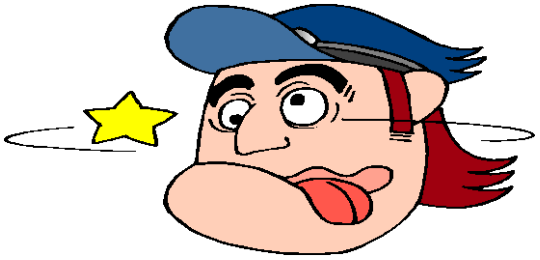
Heat Syncope
(Fainting)

Symptoms: Blurred vision (grey out), Normal Temperature, Fainting (brief)

Cause: Drop of blood pressure from prolonged static posture and heat exposure

First Aid: Lay on back in cool environment.

Drink water.



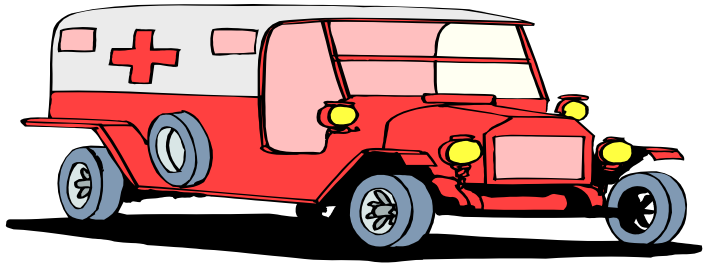
Heat Exhaustion

Symptoms: Fatigue, Blurred vision, Weakness, Dizzy, Headache

Signs: High pulse rate, profuse sweating, Low blood pressure, Insecure gait, Pale face, Collapse,

Cause: Dehydration, Low level of acclimatization, Low level of fitness.

First Aid: Rest in cool environment, Drink water, Loosen clothing.



Heat Stroke

Symptoms: Chills, Irritable, Restlessness

Signs: Euphoria, Red face, Disorientation, Hot dry skin (usually), Erratic behaviour, Collapse, Shivering, Unconsciousness, Convulsions, Body temp > 40°C (104°F)

Cause: Excessive exposure, Drug/alcohol abuse, Subnormal tolerance (genetic or acquired)

First Aid: Immediate cooling (ie spray with cool water and fan to evaporate) Get <u>immediate</u> medical attention.

Two approaches to control

1. **Modifying the work or environment to suit the work**

2. **Limiting work to suit the environment**

The approach taken will determine the assessment method. Approach 1. should be the first avenue of attack.

Control slides adapted from AIOH ; A guide to managing heat stress (2013)

Controls (Elimination/engineering)

- Hot tasks should be scheduled to avoid the hottest part of the day or where practical undertaken during night shifts.
- Walls and roof structures should utilize light coloured or reflective materials.
- Structures should be designed to incorporate good air flow. This will help remove the heat from the structure.
- Walls and roofs should be insulated.
- For field teams with high mobility, a simple portable shade structure or large umbrellas can provide relief from solar radiation.

Controls (Cont)

- Hot pipework and vessels should be insulated and clad.
- In high humidity areas more air needs to be moved, hence fans to increase air flow or in extreme cases, cooled air from ‘chiller’ units can also be utilised.
- Insulating barriers or reflective barriers can be used to absorb or re-direct radiant heat. These may be permanent structures or movable screens.
- Relocating hot processes away from high access areas.

Controls (Admin)

- Ready access to cool palatable drinking water is a basic necessity.
- Where applicable, suitable electrolyte replacements should also be available
- A clean cool area for employees to rest and recuperate can add significant improvement to the cooling process.
- Training workers to identify symptoms and the potential onset of heat-related illness as part of the ‘buddy system’.

Controls (cont)

- Consider pre-placement medical screening for work in hot areas (ISO 12894).
- Use work/rest cycles where higher level controls are not practical
- Encouraging “self-determination” or self pacing of the work to meet the conditions and reporting of heat related symptoms.

Controls (PPE)

- PPE such as cooling vests with either ‘phase change’ cooling inserts (not ice).
- Vortex tube air cooling may be used in some situations, particularly when a cooling source is required when supplied air respirators are used.
- Choose light coloured materials for clothing and ensure they allow good air flow across the skin to promote evaporative cooling.

Some Keys to the Prevention of Heat Stress

- Drink appropriate fluids to maintain hydration
- Education
- Cool the environment
- Cool the person
- Acclimatisation
- Reduce the exposure time
- Where practical, reschedule hot jobs to cooler times.