HEAT STRESS & HYDRATION

July 27, 2021

Presented by : Shawn Stasko Ph.D.

OBJECTIVES

1) Review heat stress and identify severity

2) Hydration 101 | What, when, and how?

3) How to evaluate hydration as part of your Heat Stress Prevention Plan

HYDRATION – IT'S WHAT WE DO

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- **BS Sports Biology and Nutrition**
  Springfield College, 2009
- **Ph.D. Physiology**
  University of Kentucky College of Medicine, 2013
- Hydration and Fatigue Management Expert for athletes and in professional work environments

Disclosures

Chief Scientific Officer
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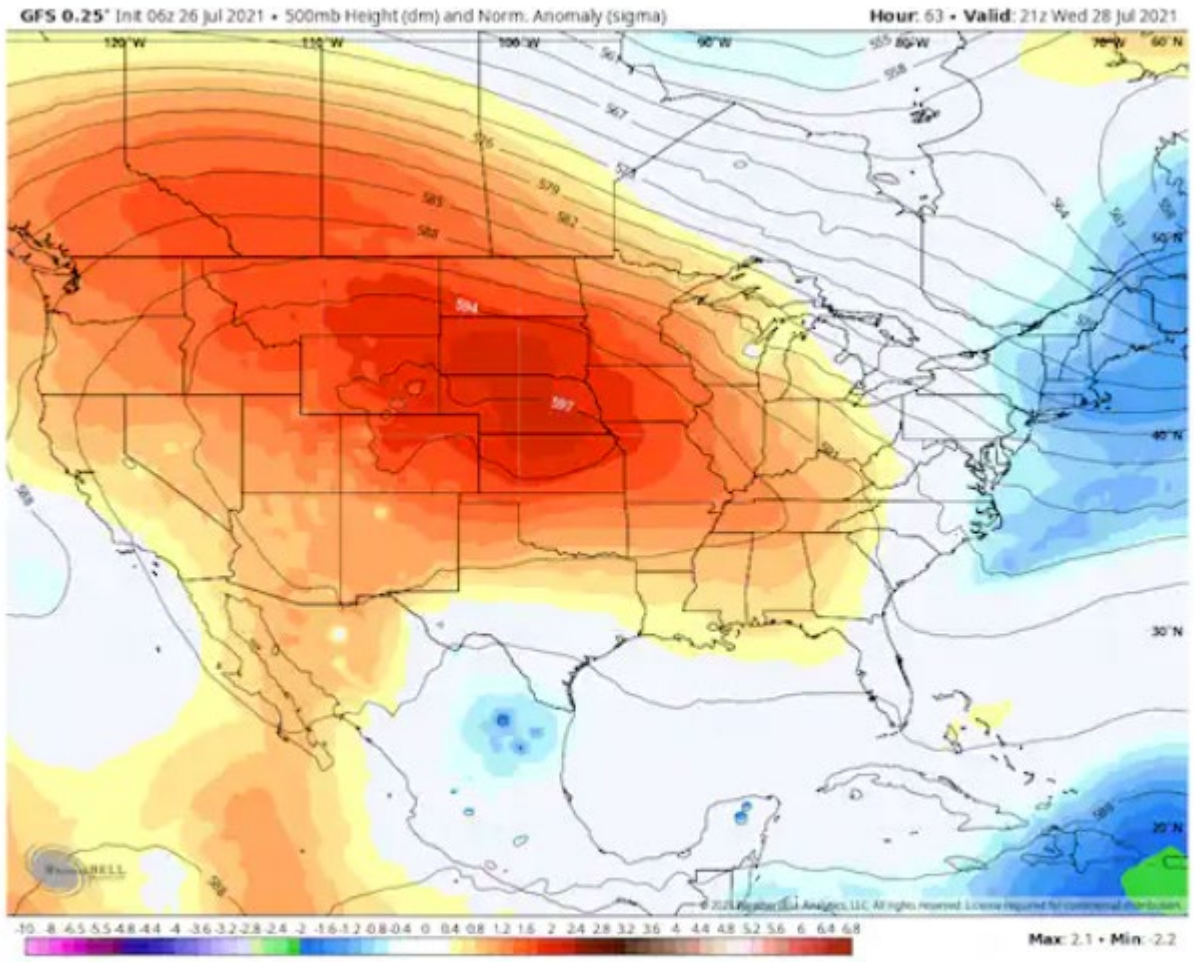
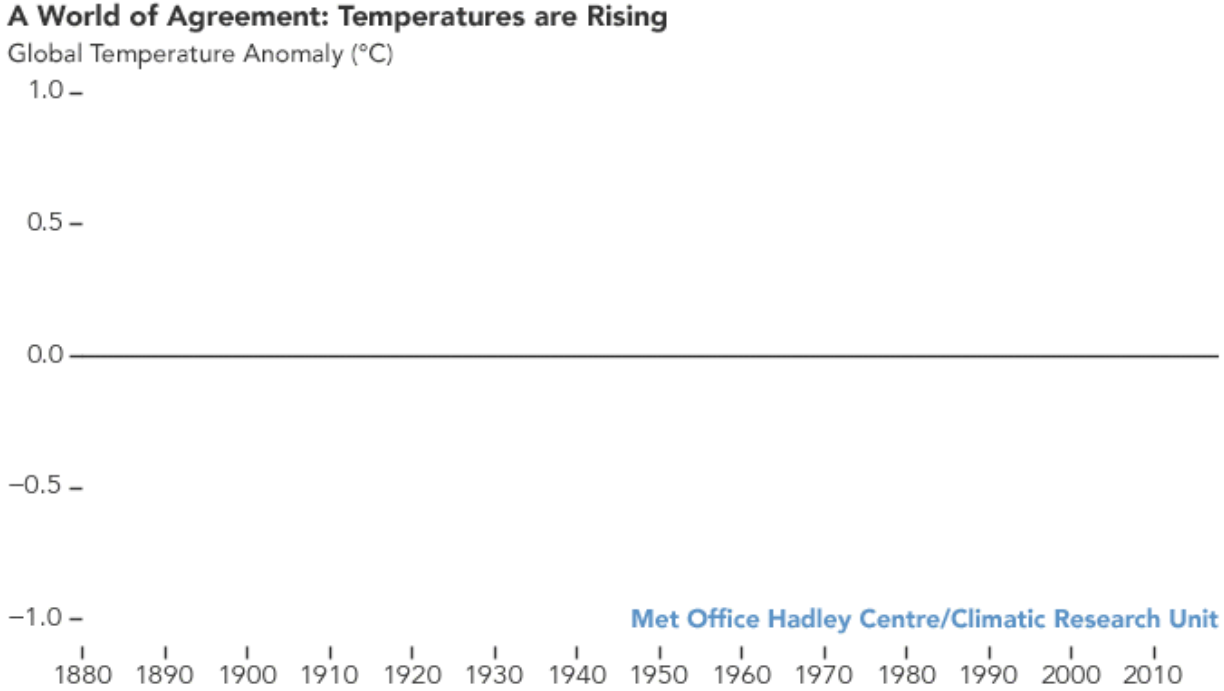
HEAT STRESS & SEVERITY

+ How it develops
+ Risk factors
+ Stages and symptoms

HEAT IS HERE TO STAY



The American GFS model simulates a ridge of strong high pressure or heat dome cresting over the western United States. (WeatherBell)



U.S. Heat Dome

August - 5 to 10 degrees above average

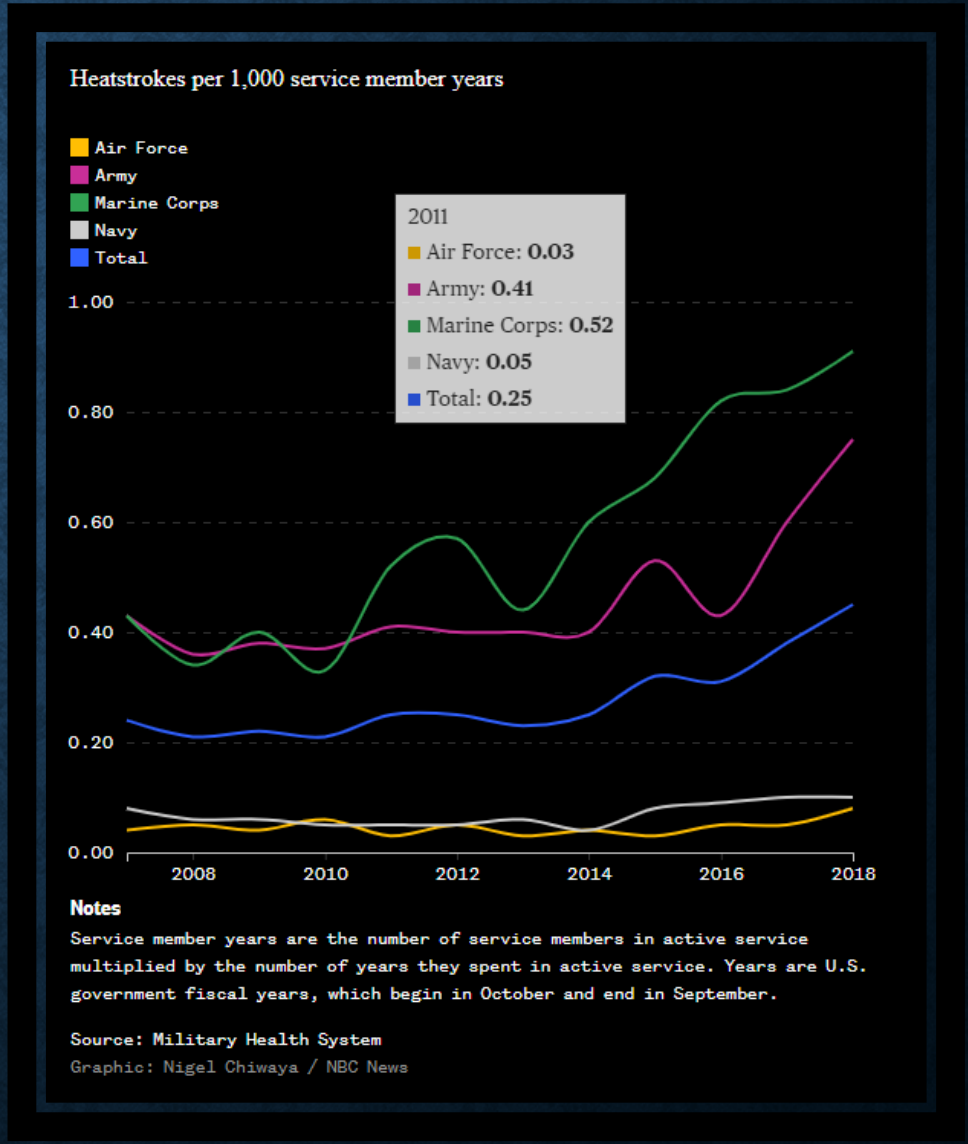
HEAT RELATED INJURIES ON THE RISE

In 2008,1766 cases of heatstroke or heat exhaustion were diagnosed in active-duty.

In 2018, 2792 were recorded.

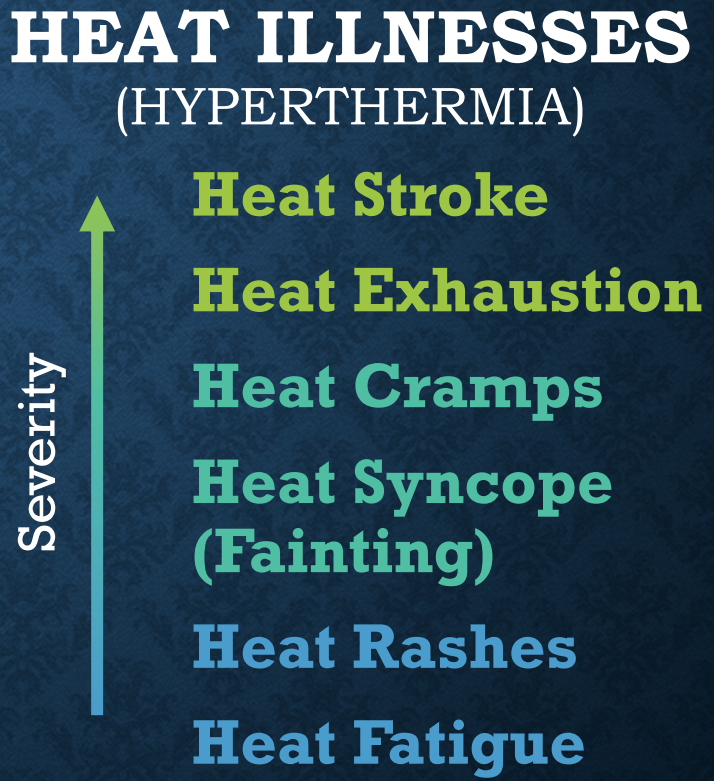
60% increase

over the decade.



WHAT IS HEAT STRESS?

- Heat stress is the name given to several illnesses caused when the body heats up and cannot cool down.
- These range from the more minor heat fatigue to the life-threatening heat stroke.



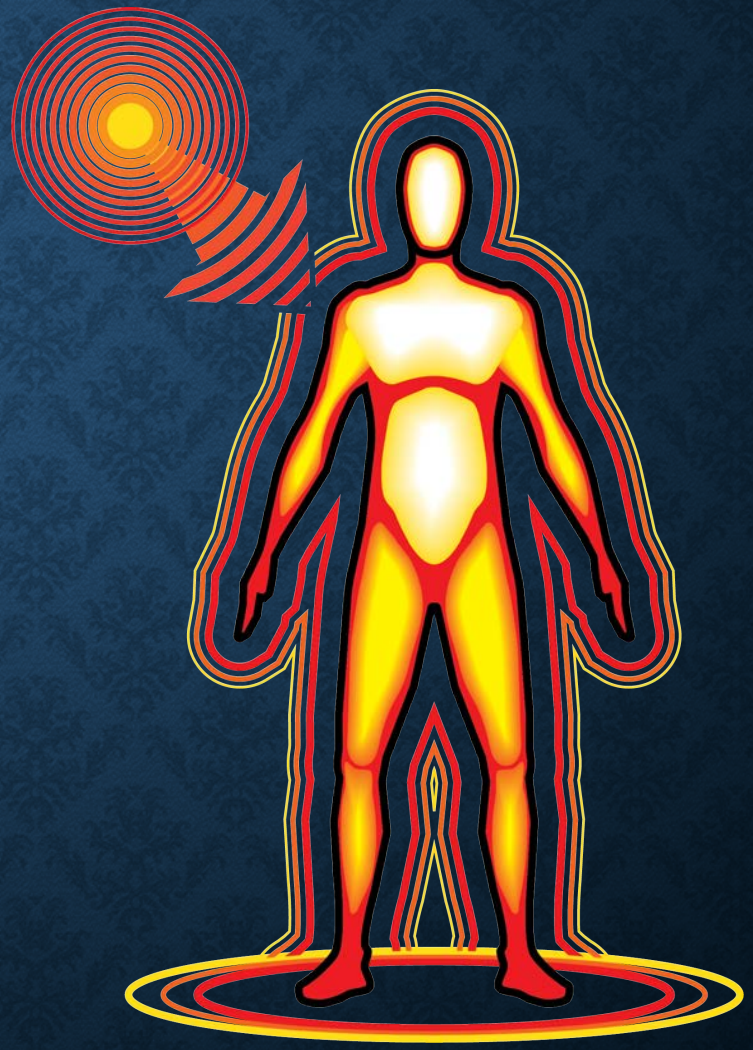
HEAT GAIN

Body temperature increases due to:

- Internal heat generated within the body by muscle activity and other body functions.

- Direct radiation from the sun's rays.

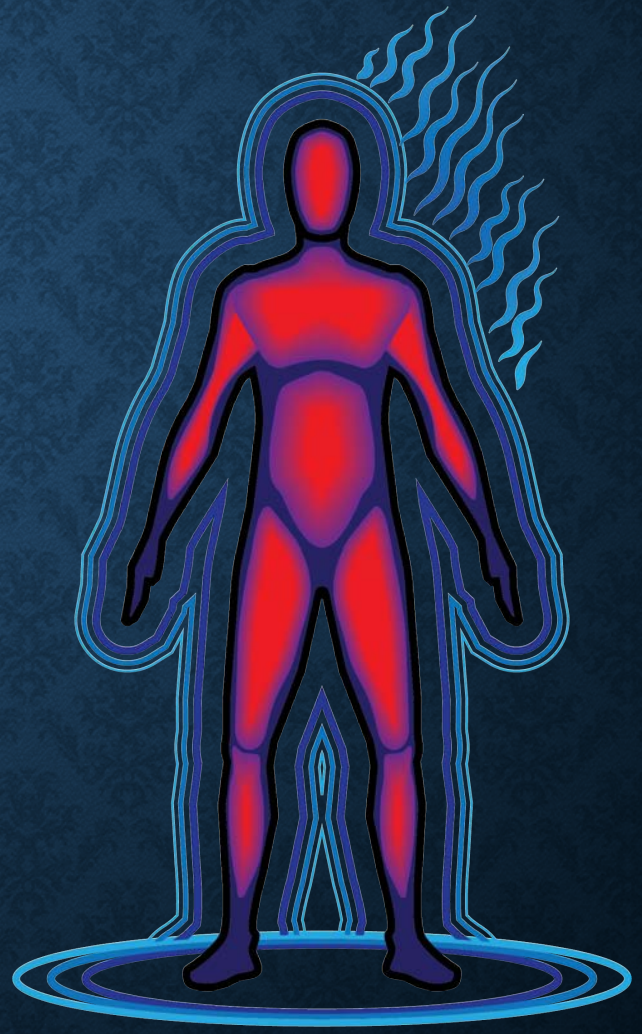
- Heat transfer from the environment (Air, Ground, Equipment).



HEAT LOSS

Body temperature can decrease through:

- Evaporation of sweat
- Radiation of heat outwards from the body
- Breathing
- Urination

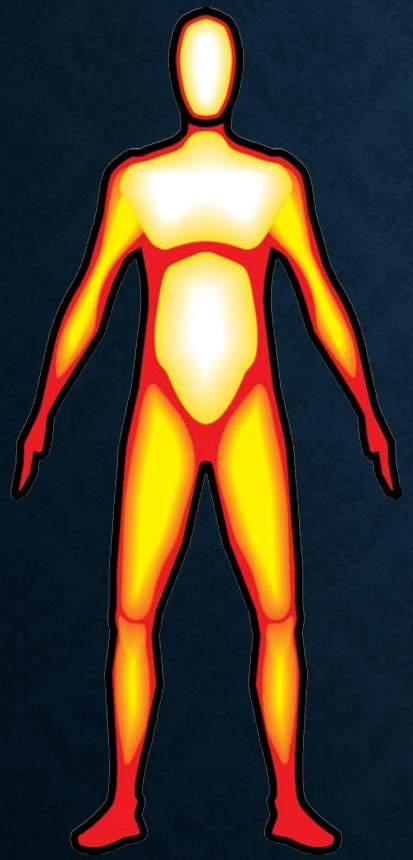


HEAT STRESS PROGRESSION

After 1-2 hours:

- Core temperature rises
- Heated blood is pumped to the skin's surface
- Body heat is transferred to the environment if cooler
- Heat needs to be released
- Sweating occurs
- Sweat evaporates to cool

HEAT STRESS PROGRESSION



The longer a body sweats, the less blood there is to carry excess heat to skin or oxygen and nutrients to muscles.

After 3 Hours, a dehydrated worker may experience:

- Headaches
- Muscle Fatigue
- Loss of strength
- Loss of accuracy and dexterity
- Heat cramps
- Reduced alertness
- Nausea

HEAT-INDUCED MUSCLE CRAMPS

KNOWN CAUSES:

- Electrolyte imbalance
- Intramuscular energy imbalance
- Neurologic disruption

FOUR FAST FIXES

- Massage
- Stretch
- Cool the skin
- Rehydrate with electrolytes and fuel

COOLING AN EGG

Heat Stress is like cooking an egg in boiling water

Ways to cool eggs in a pot of boiling water:

- Add cold water [WATER]
- Turn off heat and rest [REST]
- Place in a cool environment [SHADE]

HEAT STRESS PREVENTION

www.osha.gov/heat

"And yet, OSHA does not have a federal standard that requires the breaks, shade, or water that we know can save lives.

Heat stress-related deaths are 100% preventable…" California Congresswoman Judy Chu

Not for long! ANSI A10.50 Heat Stress Standard in progress!

HYDRATION 101

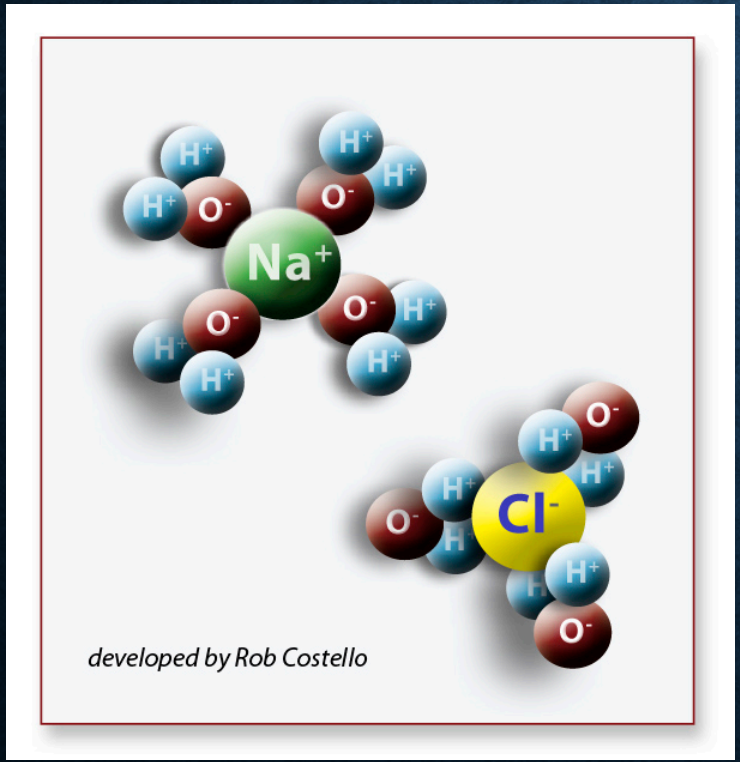
+ Review
+ Mechanics
+ What, When, How?

HYDRATION 101

ELECTRIC ATTRACTION

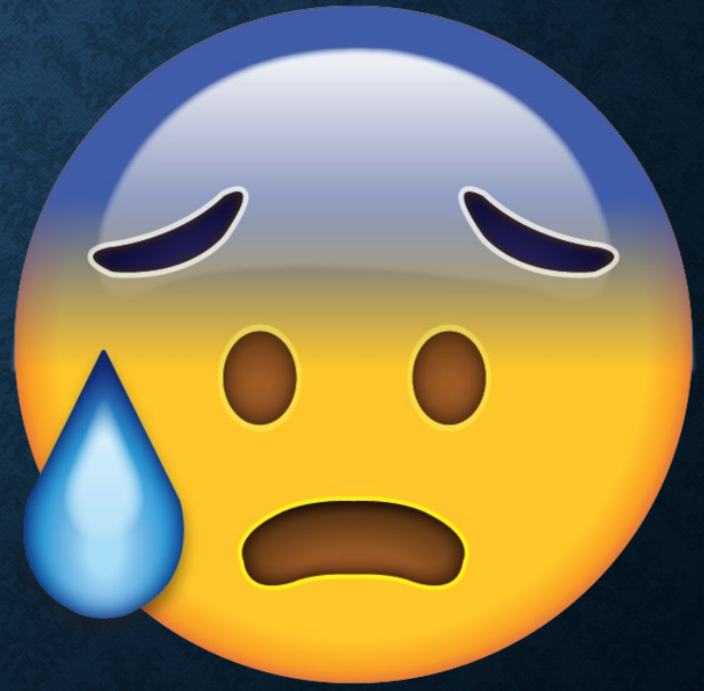
In our bodies, water moves via:

+ concentration gradients
+ electrolytes



In the heat and during exercise, blood circulation is increased to the skin and working muscles to aid in nutrient needs and heat removal via:

Sweating



PHYSIOLOGIC FLUIDS

Total body water separated in two places:

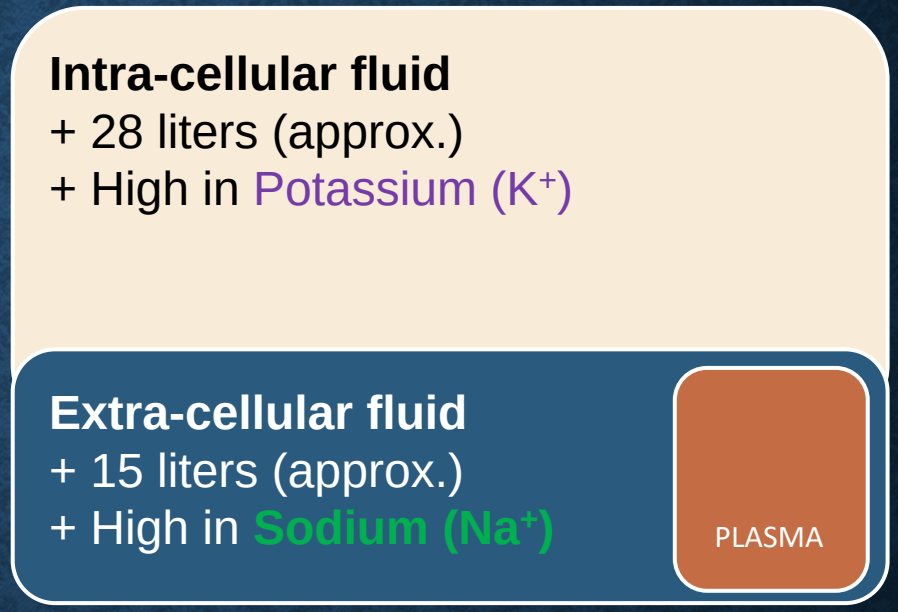
Intracellular
(inside our cells)

Extracellular
(outside our cells)

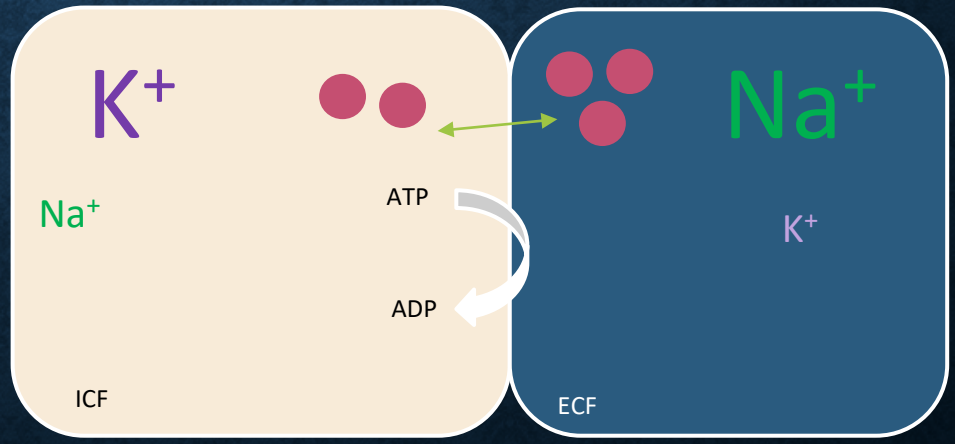
Blood volume (plasma)

Potassium – IN

Sodium – OUT



Hall, John E. (2011). *Guyton and Hall Textbook of Medical Physiology*



SODIUM VS POTASSIUM ELECTROLYTES

Potassium electrolyte beverages hydrate slower with preference on ICF reserves

Sodium electrolyte beverages hydrate most like IV fluids, focusing on ECF and blood circulation

SWEATY SODIUM

SWEAT IS

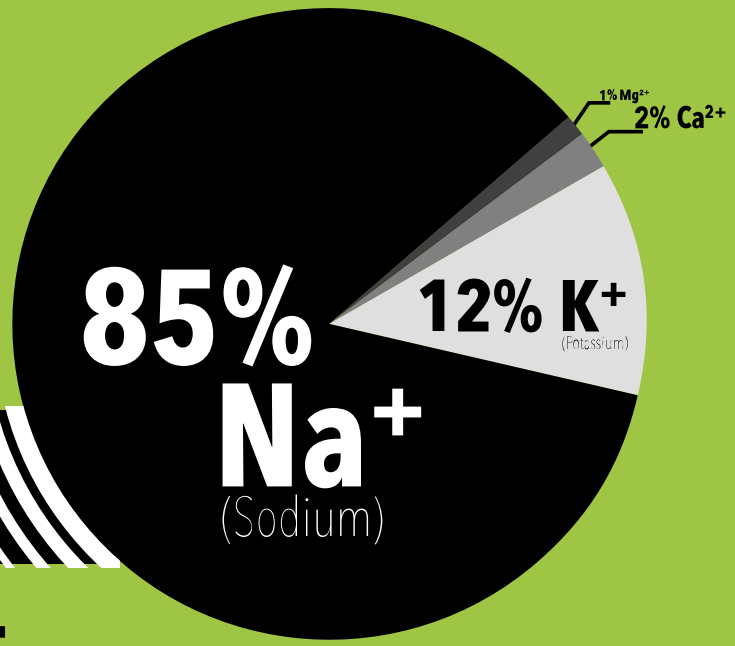
Water + Electrolytes

– – – – – – –

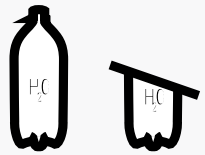
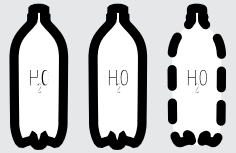
85% of the electrolytes lost in sweat are

SODIUM

+ + + + + + +



WORKING SWEAT RATES

IF YOU WORK	YOU SWEAT
IN A CLIMATE CONTROLLED WAREHOUSE	0.5 L/hr 
OUTDOORS	1.5 L/hr 
IN EXTREME CONDITIONS	2+ L/hr 

SODIUM LOST EVERY HOUR

On average, sweat contains **805mg** of sodium per Liter.

WAREHOUSE **402**mg

OUTDOORS **1207**mg

EXTREME **1610**mg

mg of sodium per hour

1-2-3 STEPS ON HOW TO HYDRATE

Less Than 1 Hour	2 Hours or more?	3 + Hours
Water	Water Sodium Electrolyte	Water Sodium Electrolyte Carbohydrates
8 fl oz every 15 minutes	8 fl oz every 15 minutes Drink to Thirst	8 fl oz every 15 minutes Drink to Thirst Have Regular Meals and Rest

HYDRATION EVALUATION

+ Tools
+ Considerations
+ Further help

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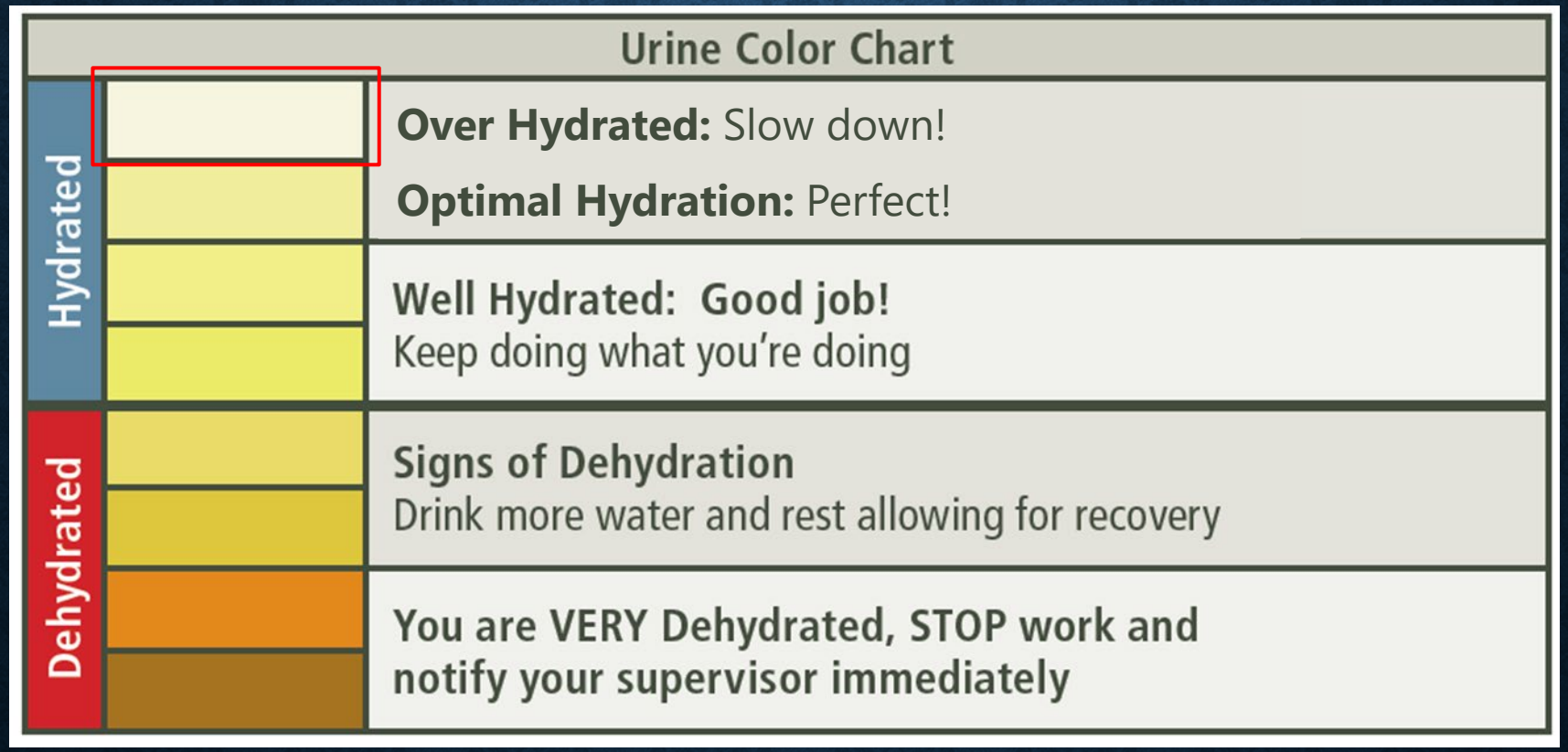

Urine Color Chart
Hydrated
Dehydrated
Over Hydrated: Slow down!
Optimal Hydration: Perfect!
Well Hydrated: Good job!
Keep doing what you're doing
Signs of Dehydration
Drink more water and rest allowing for recovery
You are VERY Dehydrated, STOP work and notify your supervisor immediately

CUSTOM FLUID REPLACEMENT PLANS

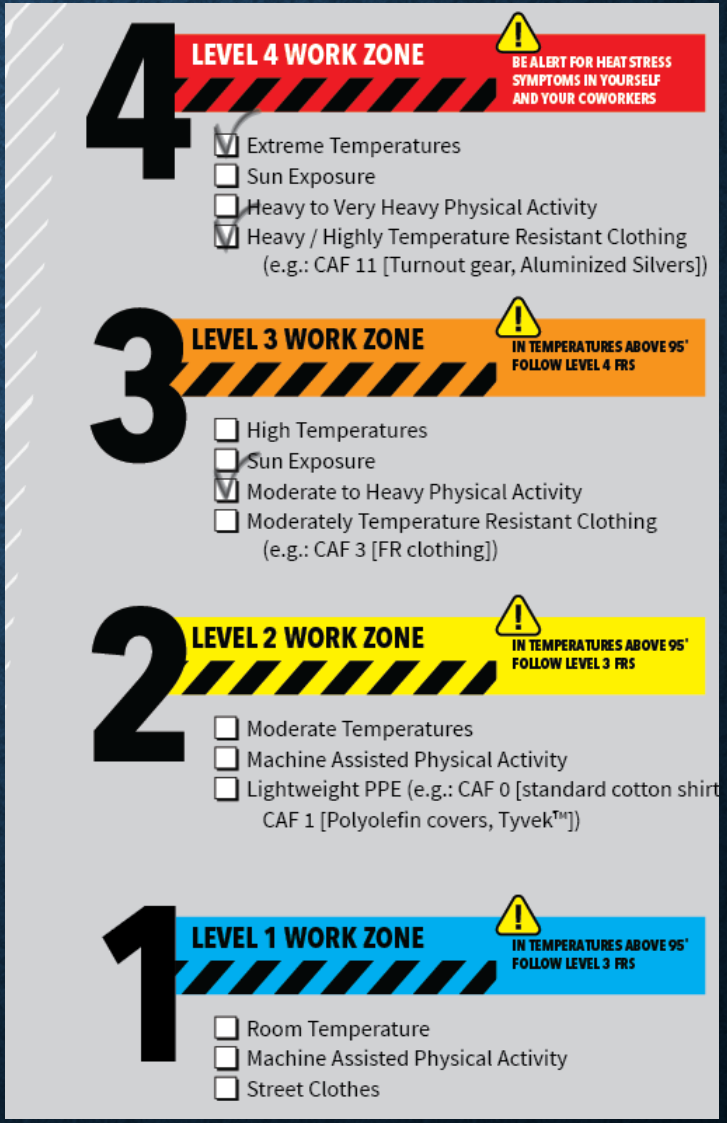
How hot is it?

What heat exposures are present?

What time of labor is happening?

How long?

What clothing/PPE is being worn?



SWORD®
PERFORMANCE

QUESTIONS?

APPENDIX

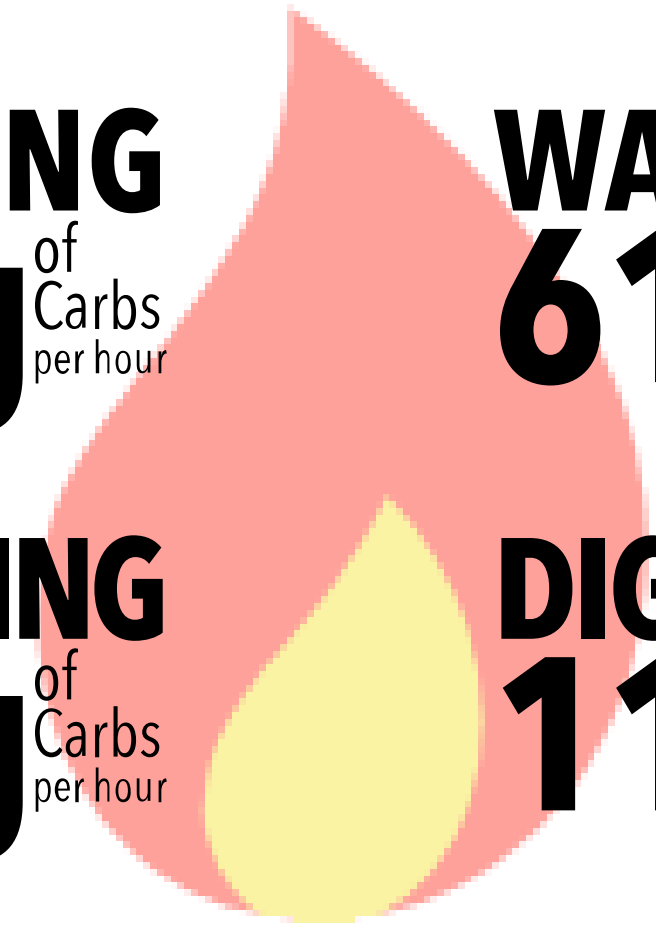
BERRY

PINEAPPLE
MANGO

ORANGE

LEMONADE

CARB BURN RATES



RESTING
13g of Carbs per hour

WALKING
61g of Carbs per hour

PUSHING
85g of Carbs per hour

DIGGING
117g of Carbs per hour

Your body wants to burn carbs.

approximately **80%**

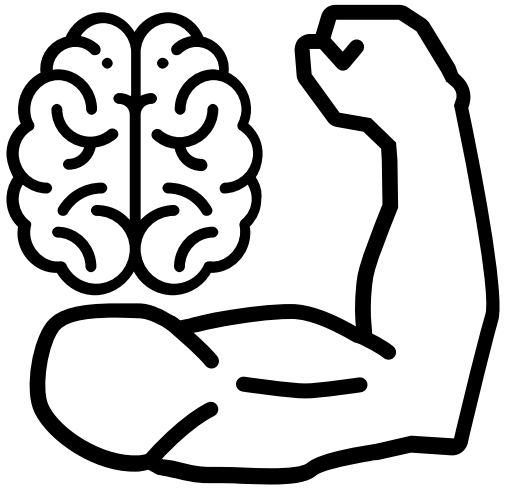
of calories burned by the body come from

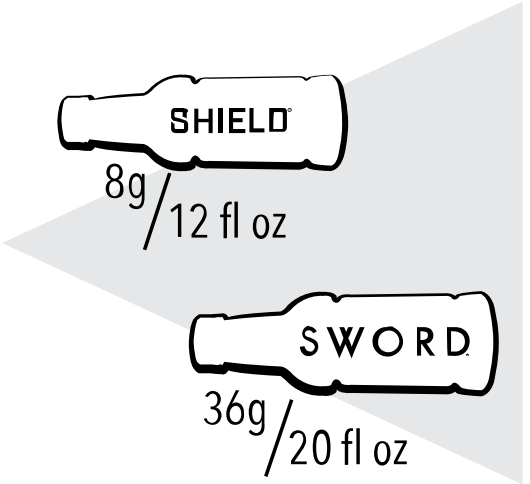
carbohydrates

WORKPLACE RISK FACTORS

- Ambient temperatures
- Sun exposure
- Humidity
- High frequency, duration or intensity of physical activity
- Requirement for use of personal protective equipment and clothing (may increase humidity levels and prevent airflow across the skin)

A steady supply of carbohydrates keeps your brain and muscles fueled and helps you stay safe and productive.





SPORTS DRINKS OR SOFT DRINKS?

INGREDIENTS

WATER, HIGH FRUCTOSE CORN SYRUP, LESS THAN 0.5% OF: CITRIC ACID, NATURAL FLAVORS, SALT AND MAGNESIUM CHLORIDE AND CALCIUM CHLORIDE AND MONO-POTASSIUM PHOSPHATE (ELECTROLYTE SOURCES), MODIFIED FOOD STARCH, GLYCEROL ESTER OF ROSIN, CALCIUM DISODIUM EDTA (TO PROTECT COLOR), MEDIUM CHAIN TRIGLYCERIDES, VITAMIN B3 (NIACINAMIDE), VITAMIN B6 (PYRIDOXINE HYDROCHLORIDE), VITAMIN B12 (CYANOCOBALAMIN), RED 40, ASCORBIC ACID (TO PROTECT TASTE).

POWERADE® FRUIT PUNCH - ELECTROLYTE SPORTS DRINK | POWERADE®

Nutrition Facts

2.5 servings per container

Serving size	12 fl oz (360 mL)
Amount per serving	
Calories	**80**
	% Daily Value*
Total Fat 0g	0%
Sodium 150mg	6%
Total Carbohydrate 21g	7%
Total Sugars 21g	
Includes 21g Added Sugars	41%
Protein 0g	
Potassium 35mg	
Vitamin A 0mcg	0%
Vitamin C 0mg	0%
Niacin	15%
Vitamin B6	15%
Vitamin B12	35%
Magnesium 0mg	0%

* Not a significant source of saturated fat, trans fat, cholesterol, dietary fiber, vitamin D, calcium, iron and potassium.

INGREDIENTS

CARBONATED WATER, HIGH FRUCTOSE CORN SYRUP, CARAMEL COLOR, PHOSPHORIC ACID, NATURAL FLAVORS, CAFFEINE.

Coca-Cola® Original | Coca-Cola®

Nutrition Facts

1 serving per container

Serving size	1 Can
Amount per serving	
Calories	**90**
	% Daily Value*
Total Fat 0g	0%
Sodium 30mg	1%
Total Carbohydrate 25g	9%
Total Sugars 25g	
Includes 25g Added Sugars	50%
Protein 0g	

* Not a significant source of saturated fat, trans fat, cholesterol, dietary fiber, vitamin D, calcium, iron and potassium.

Caffeine Content: 21 mg / 7.5 fl oz

INGREDIENTS FOR SHOW – NOT GO

- Artificial Colors
- Artificial Flavors
- Highly Processed Sugars
- Artificial Sweeteners
- Artificial Preservatives

- Gastrointestinal Distress
- Blood sugar spikes and crashes
- Headaches
- Insufficient Hydration

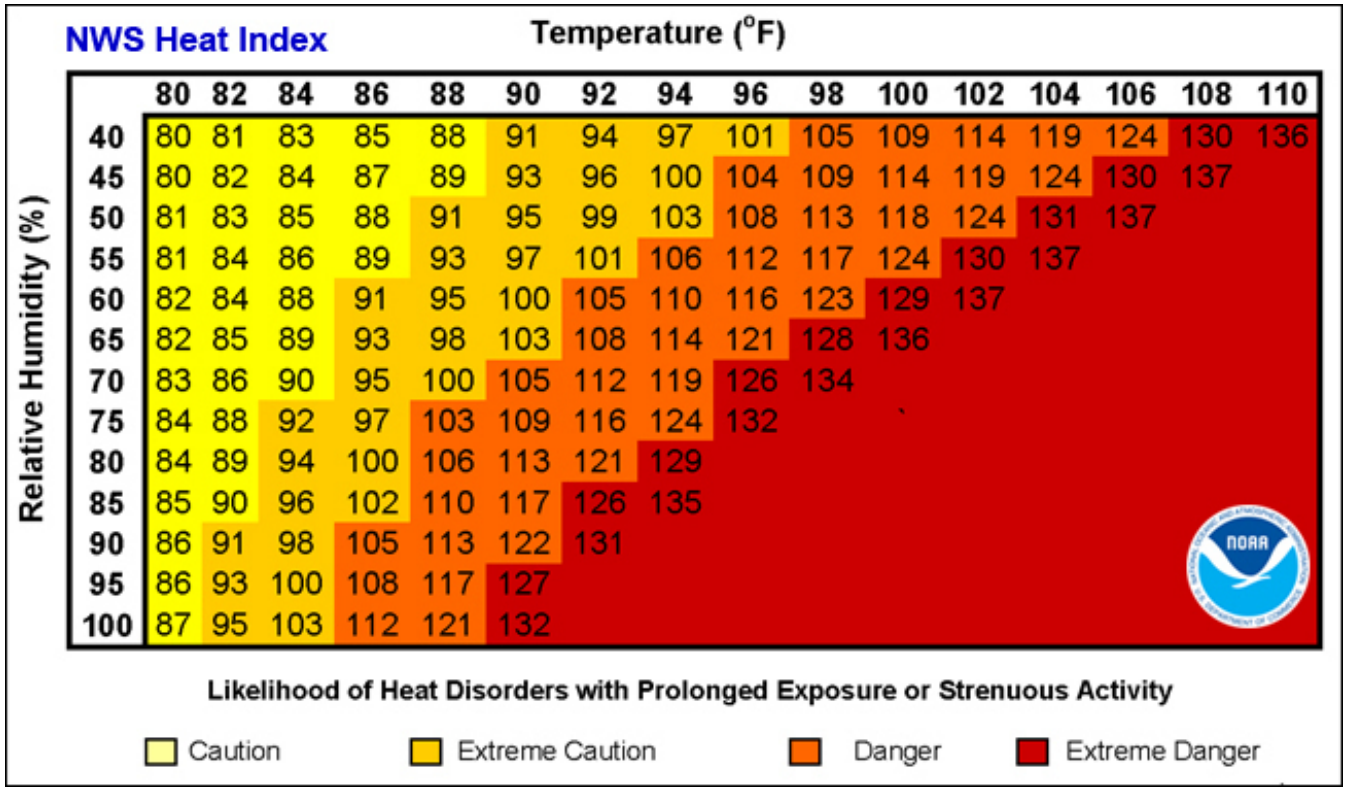
HEAT INJURY FIRST AID

- Rest worker in the shade or a cool environment.
- Remove outer clothing
- Reduce temperature as fast as possible by applying wet towels or pouring water on the body
- If conscious, rehydrate by drinking fluids with sodium electrolytes and carbohydrates
- If unconscious with no heartbeat or breath, resuscitate with CPR (if unsure about correct CPR techniques, get someone who does know.)

HEAT STROKE IS LIFE THREATENING, SEEK MEDICAL ATTENTION

KNOW YOUR ENVIRONMENT

Risks can change from day to day, plan accordingly.



EXTREME DANGER	Heat index values were devised for shady, light wind conditions, **exposure to full sunshine can increase heat index values by up to 15°F.** Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.
DANGER	Sunstroke, muscle cramps, and/or heat exhaustion likely. Heat Stroke possible with prolonged exposure and/or physical activity.
EXTREME CAUTION	Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.
CAUTION	Fatigue possible with prolonged exposure and/or physical activity.

https://www.weather.gov/safety/heat-index

HYDRATE REVISITED

Hydration level is fundamental to the body's natural cooling processes.

Good sources of hydration have sodium electrolytes and carbohydrate fuel

- ***BEFORE*** **-** Begin hydrating 2 hours before your shift
- ***DURING*** **-** While working, hydrate every 15-20 minutes in small to moderate amounts, according to a pre-established **Fluid Replacement Schedule**.
- ***AFTER*** **-** Continue to hydrate for 2 hours after shift