

# THERMOREGULATION



Homeostasis



Body temperature

- Temperature of periphery – poikilothermic regulation
- Temperature of core – homoiothermic regulation

Social thermoregulation



HEAT INTAKE

THERMOREGULATION

HEAT LOSS

HEAT PRODUCTION

T.BEHAVIOUR

HEAT OUTPUT

## HEAT INTAKE

- Radiation (irradiation, without touch, IR)
- Convection (temperature gradient, touch)

## HEAT PRODUCTION

- Depends on energetic exchange (10% of BM - 1°C)
- Difference between rest and exercise (increases muscle rate – up to 90%)
- Shivering and **nonshivering** thermogenesis (voluntary and non-voluntary thermogenesis)
- **Brown adipose tissue** ( $\beta_3$  adrenoreceptors, NA, lipolysis, expression of lipoproteinlipase and thermogenin, uncoupling of oxidative chain)

## HEAT „CONVECTION“

- Inner heat convection (between inner organs and skin)
- Outer heat convection – **heat output**

## HEAT LOSS (OUTPUT)

- Heat **radiation**

*no touch*

- **Convection** of heat to environment (wind) *touch*

- **Evaporation** – **sweating** perspiratio sensibilis,

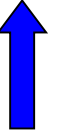


p. insensibilis (sweating glands, diffusion)

*1 litre of evaporated sweat – 2428 kJ*

Temperature limit: **33°C** at high humidity

*Piloerection and horripilation. Tachypnoe.*

up to **36°C**

<b>WAY OF OUTPUT</b>	<b>% (at 21°C)</b>	<b>Higher temperatures</b> 
radiation and convection	70	
evaporation	27	
breathing	2	-
excrements	1	-

# THERMOREGULATORY MECHANISMS

<b>ACTIVATED BY COLD</b>	<b>Increase of heat production</b>
Muscle <b>shivering</b>	+
Hunger	+
Increase of <b>intentional</b> movements	+
Increase of CA secretion	+
	<b>Decrease of heat output</b>
Skin vasoconstriction	+
Twisting	+
Horripilation	+
<b>ACTIVATED BY HEAT</b>	<b>Increase of heat output</b>
Skin vasodilatation	+
Sweating	+
Increase of ventilation	+
Loss of appetite, apathy, inactiveness	<b>Decrease of heat production</b>

# CONTROL OF THERMOREGULATION

**Afferentation:** TRP channels – 2 types (TRPM8-cold, TRPV1-hot)

- Central thermoreceptors
- Peripheral thermoreceptors (skin – cold)

**Mediators:**

- NA – mechanisms activated by heat
- Serotonin – m.a.cold

**Mechanisms:**

- Vegetative
- Somatic
- Endocrine (CA, thyroxin, TSH)
- Modification of behaviour

**Thermoregulatory centres – CENTRAL THERMOSTAT:**

- Posterior hypothalamus – reaction to cold
- Anterior hypothalamus – reaction to heat
- Upper part of middle brain - ?

<b>Temperature (C)</b>	<b>Symptoms</b>
28	muscle failure
30	loss of body temperature control
33	loss of consciousness
37	normal
42	central nervous system breakdown
44	death

*Constitution hyperthermia*  
*Malignant hyperthermia*

*Hypothermia*

