

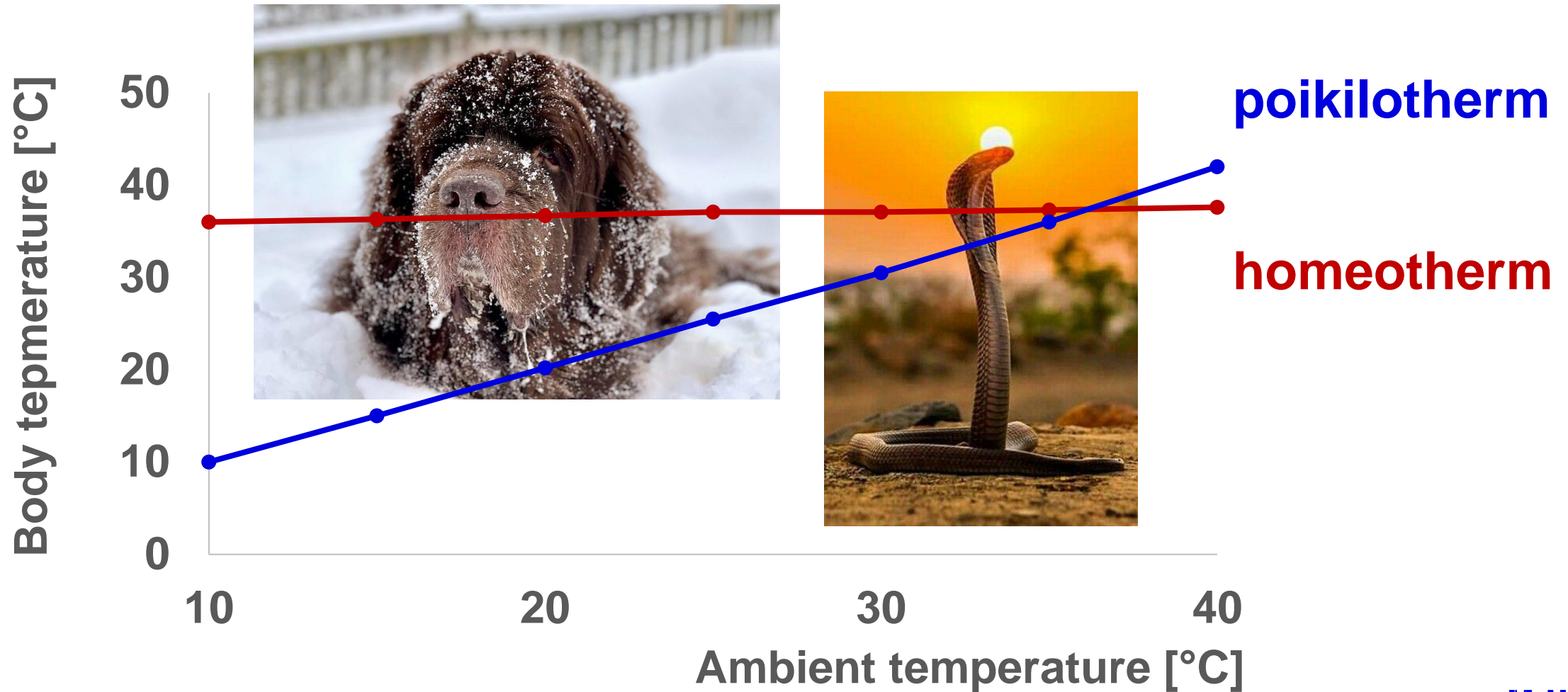
A role of the sympathetic nervous system in thermoregulation

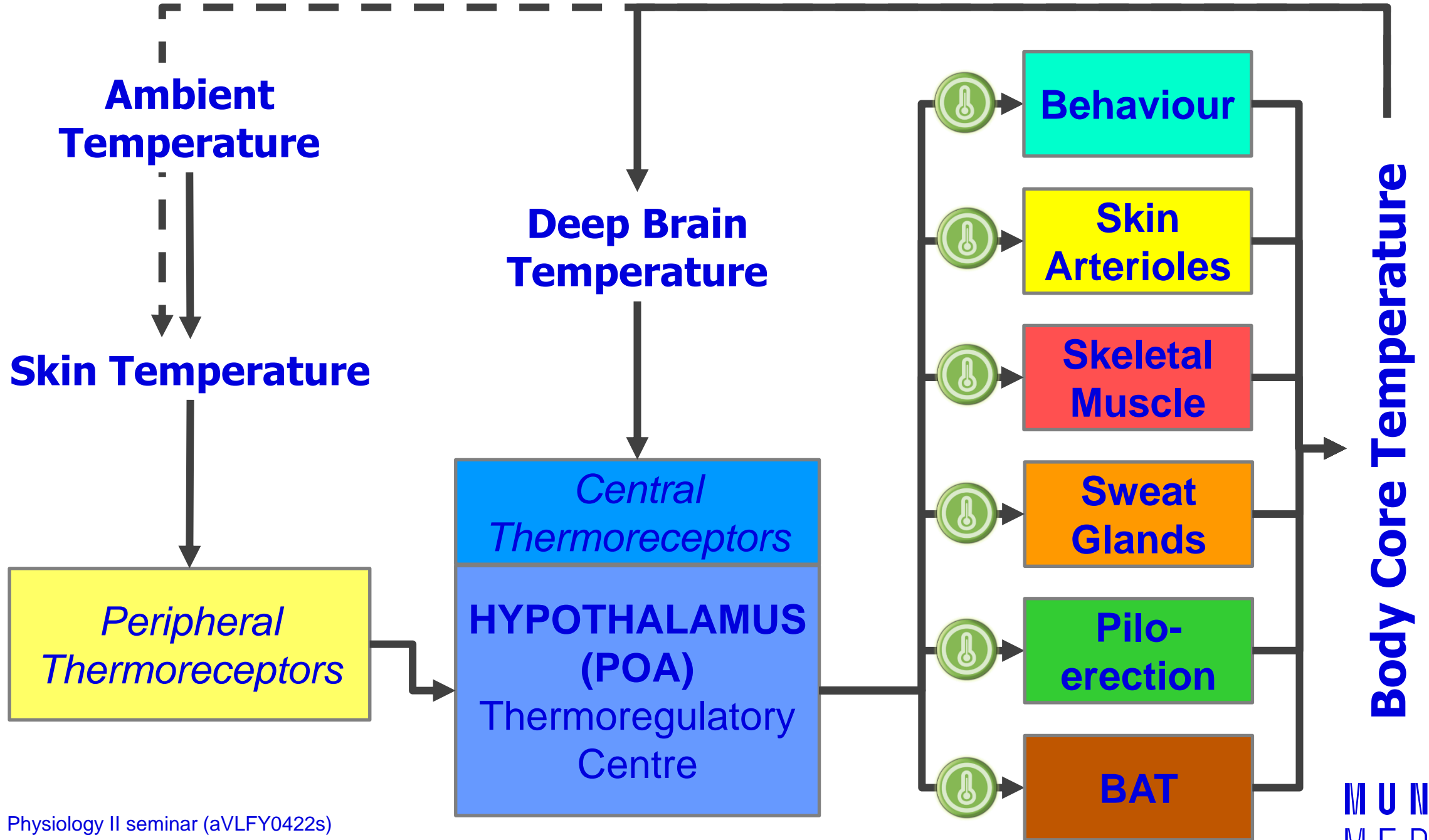
Physiology II seminar (aVLFY0422s)

Tibor Stračina

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Homeotherms vs. poikilotherms





Sympathetic pathways to thermo effectors

- Skin circulation (vasomotor activity)
- Sweat glands (sweating)
- Brown adipose tissue (non-shivering thermogenesis)

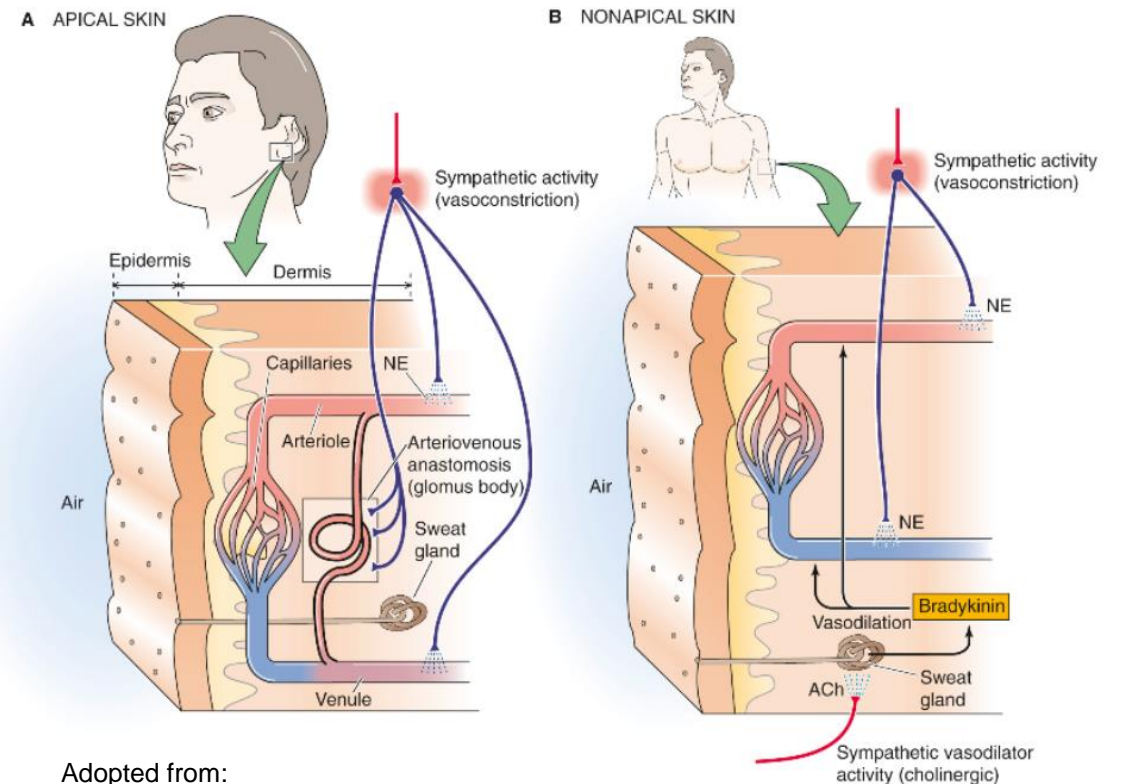
Skin circulation – apical vs. non-apical skin

Apical skin

- a-v anastomoses
- Vasoconstriction: SNS (NA: α 1R)
- Vasodilatation: passive

Non-apical skin

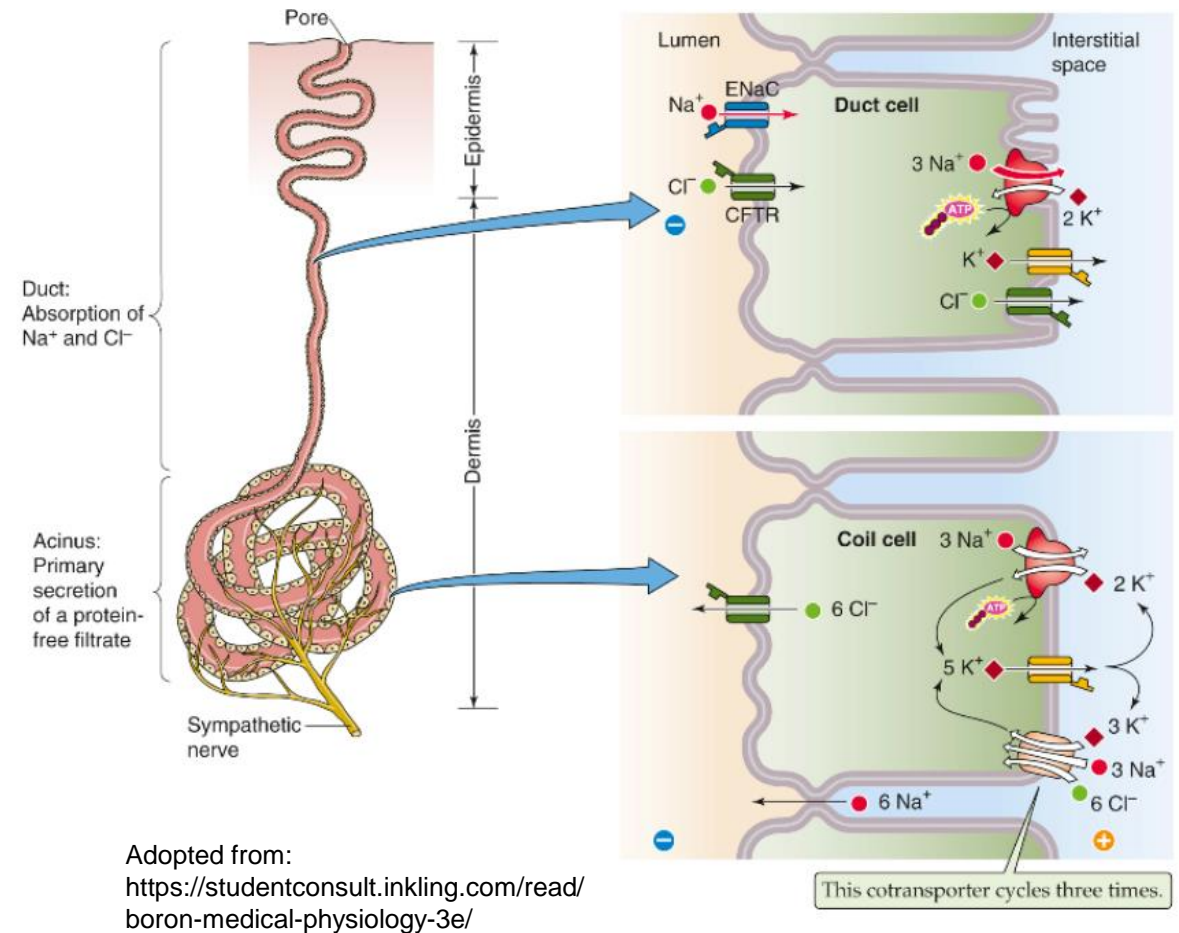
- Vasoconstriction: SNS (NA: α 1R)
- Vasodilatation: SNS (ACh-?)



Adopted from:
<https://studentconsult.inkling.com/read/boron-medical-physiology-3e/>

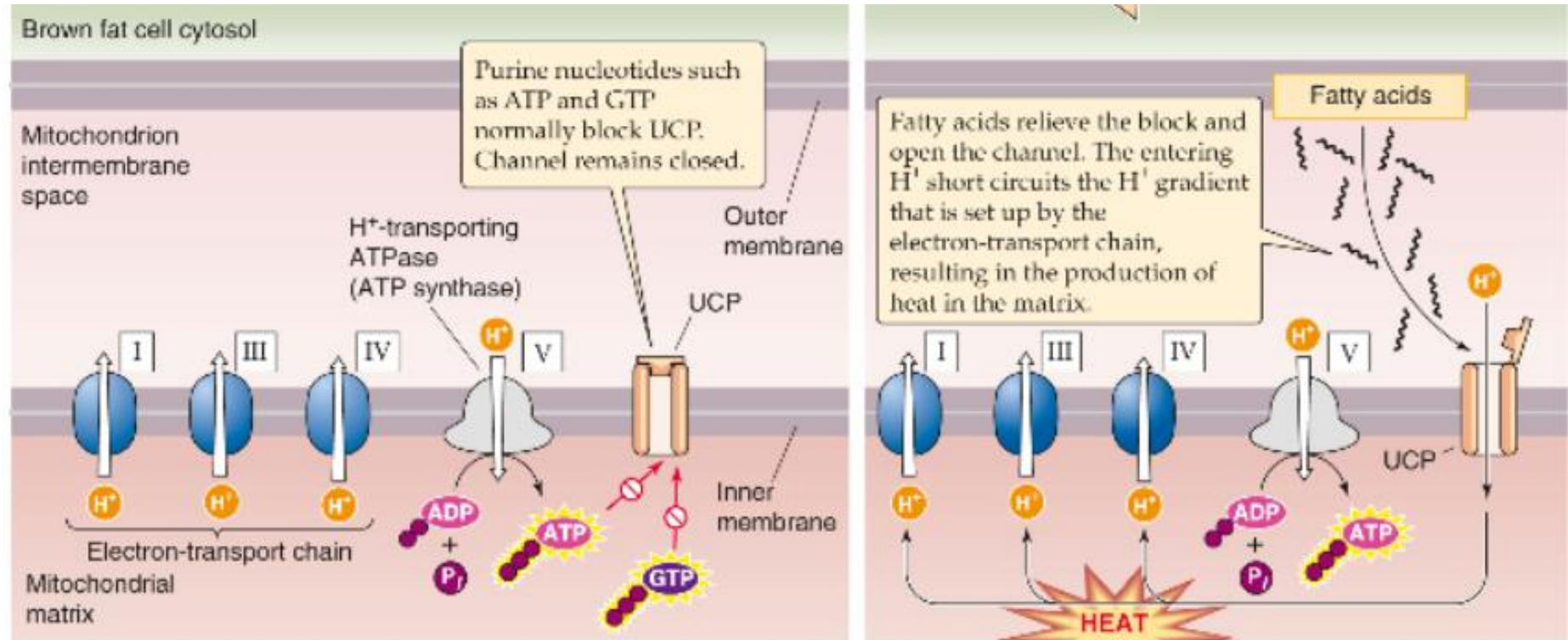
Regulation of sweat secretion

- Eccrine sweat glands
- Sweating reflex
- Efferent p. = sudomotor nn.
- sympathetic cholinergic fibers (Ach)

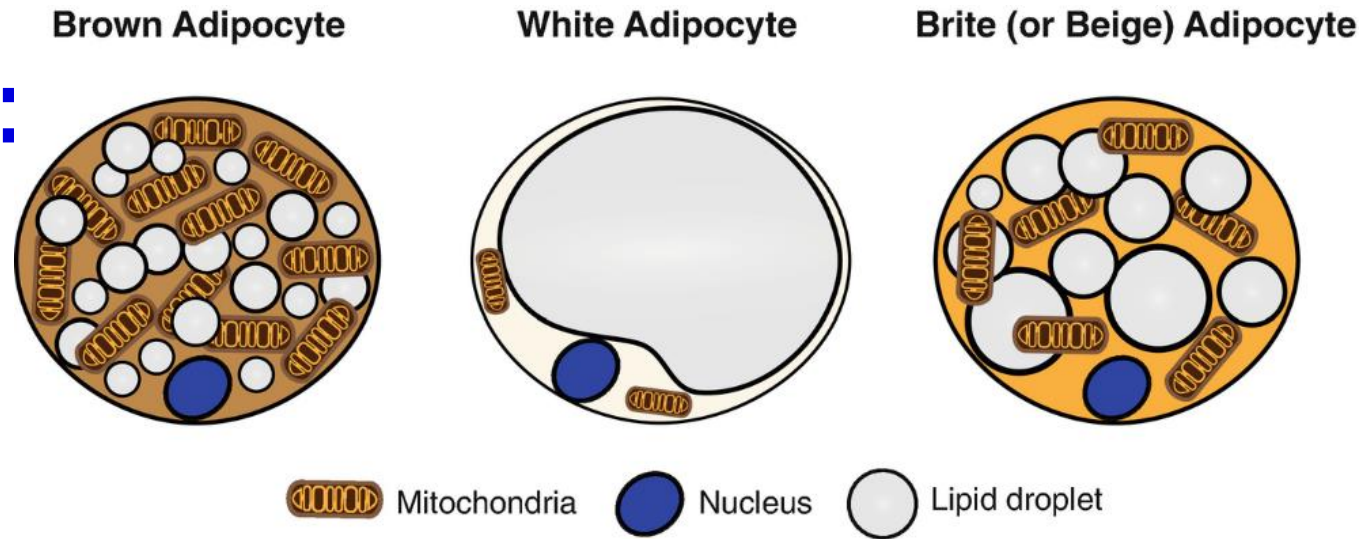


Activation of brown adipose tissue

- SNS – NA: β 3R
- UCP1

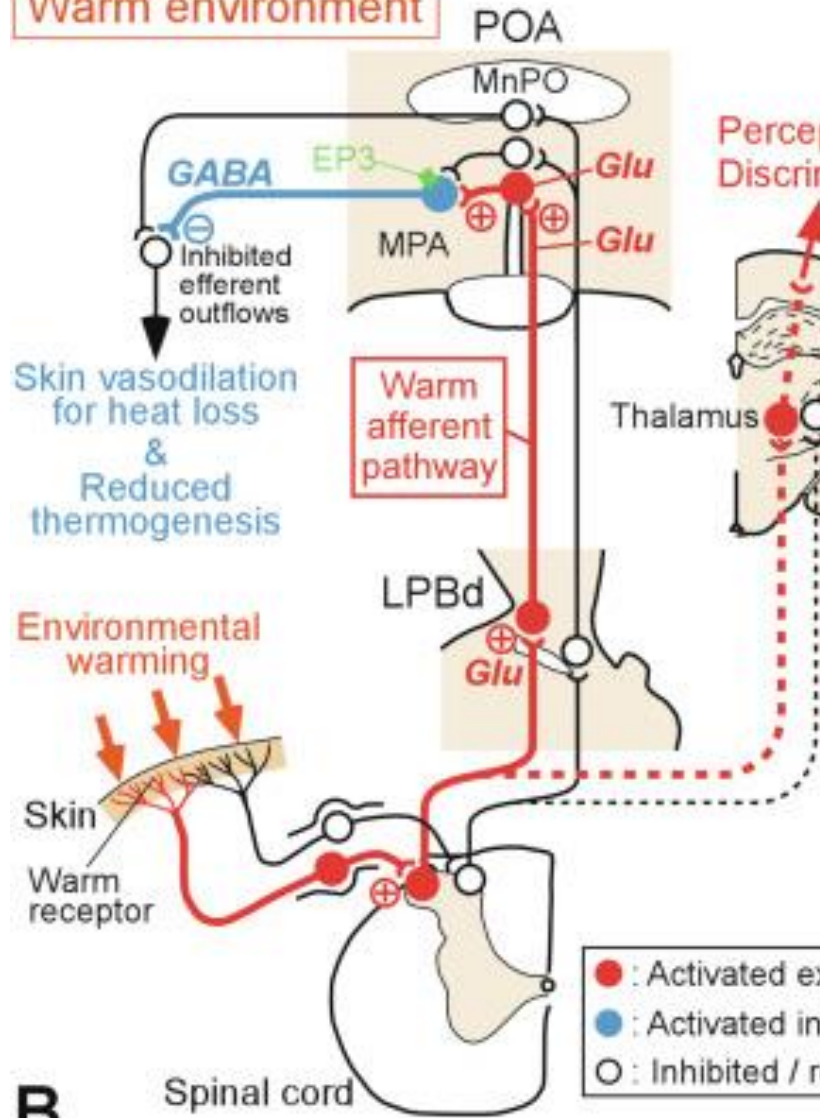


Adipose tissue: brown, white and beige

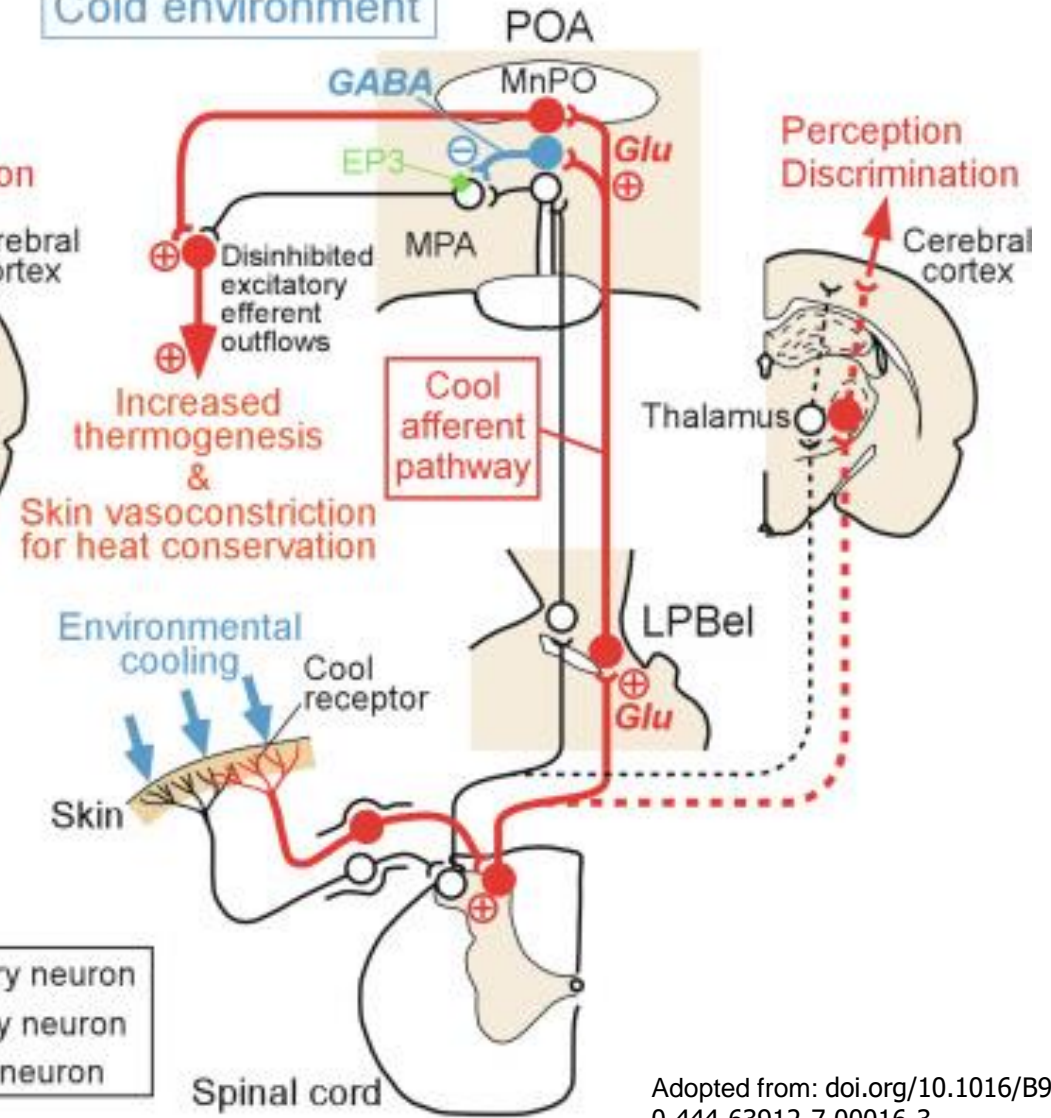


	<i>Brown</i>	<i>White</i>	<i>Brite/beige</i>
UCP1 Expression	Positive	Negative	Positive
Mitochondrial Density	High	Low	Medium
LD Morphology	Multi-locular	Uni-locular	Multi-locular
Primary Function	Thermogenesis Endocrine	Energy storage Endocrine	Thermogenesis? Endocrine?

Warm environment



Cold environment



● : Activated excitatory neuron
● : Activated inhibitory neuron
○ : Inhibited / resting neuron

B

Spinal cord

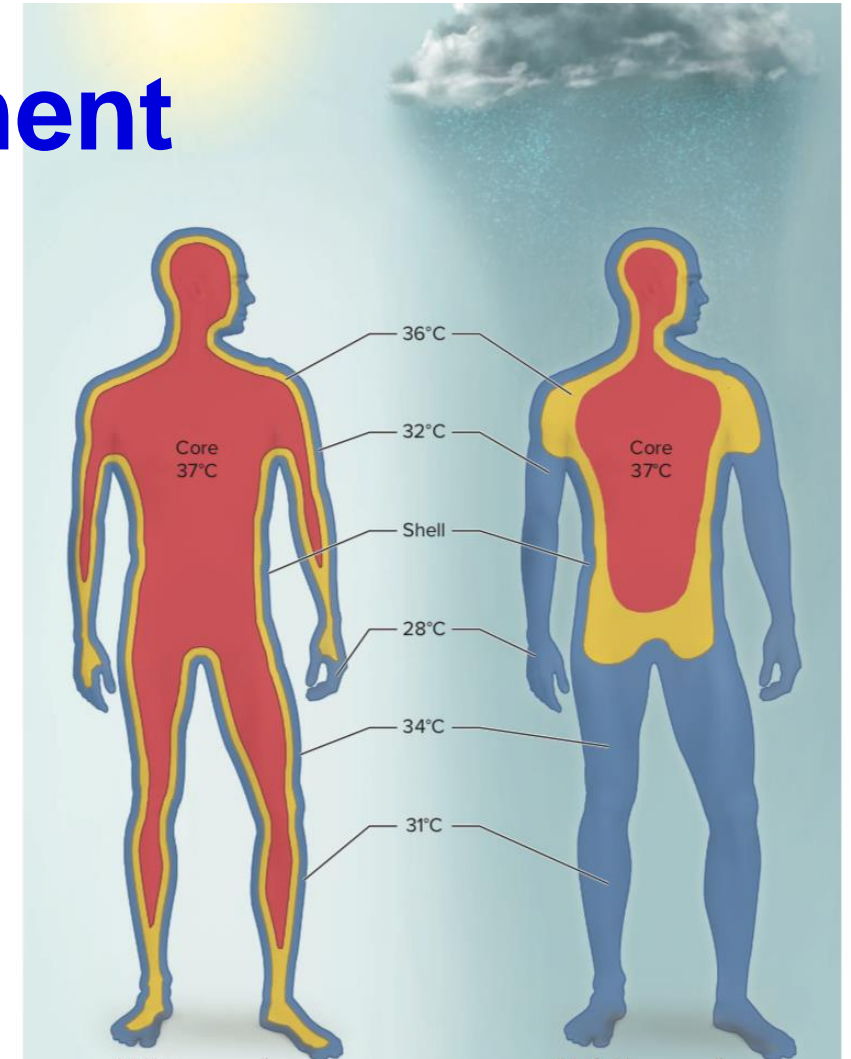
Spinal cord

Adopted from: doi.org/10.1016/B978-0-444-63912-7.00016-3

Body temperature measurement

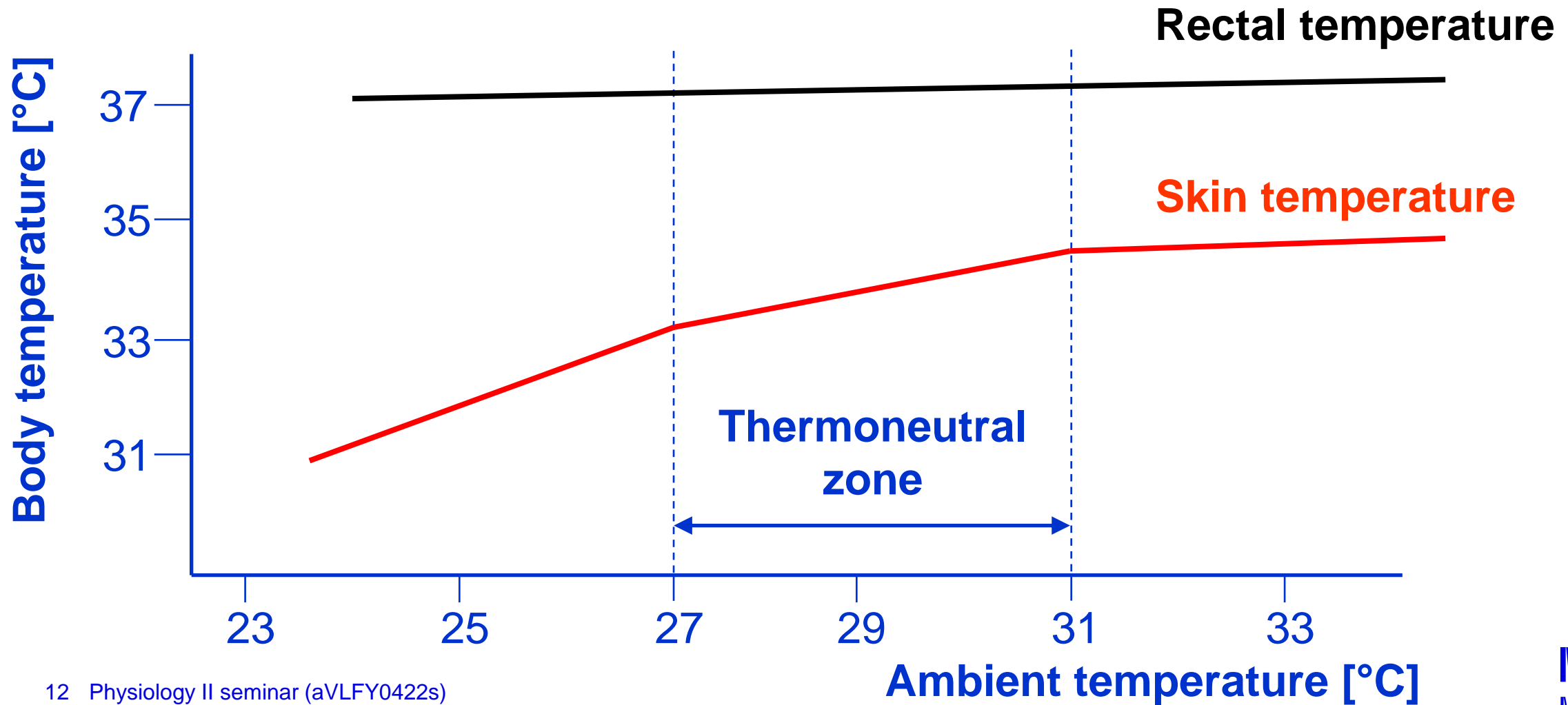
Where and how?

- Arm pit
- Oral cavity (sublingual)
- Rectum
- External auditory tube
- Skin over temporal artery

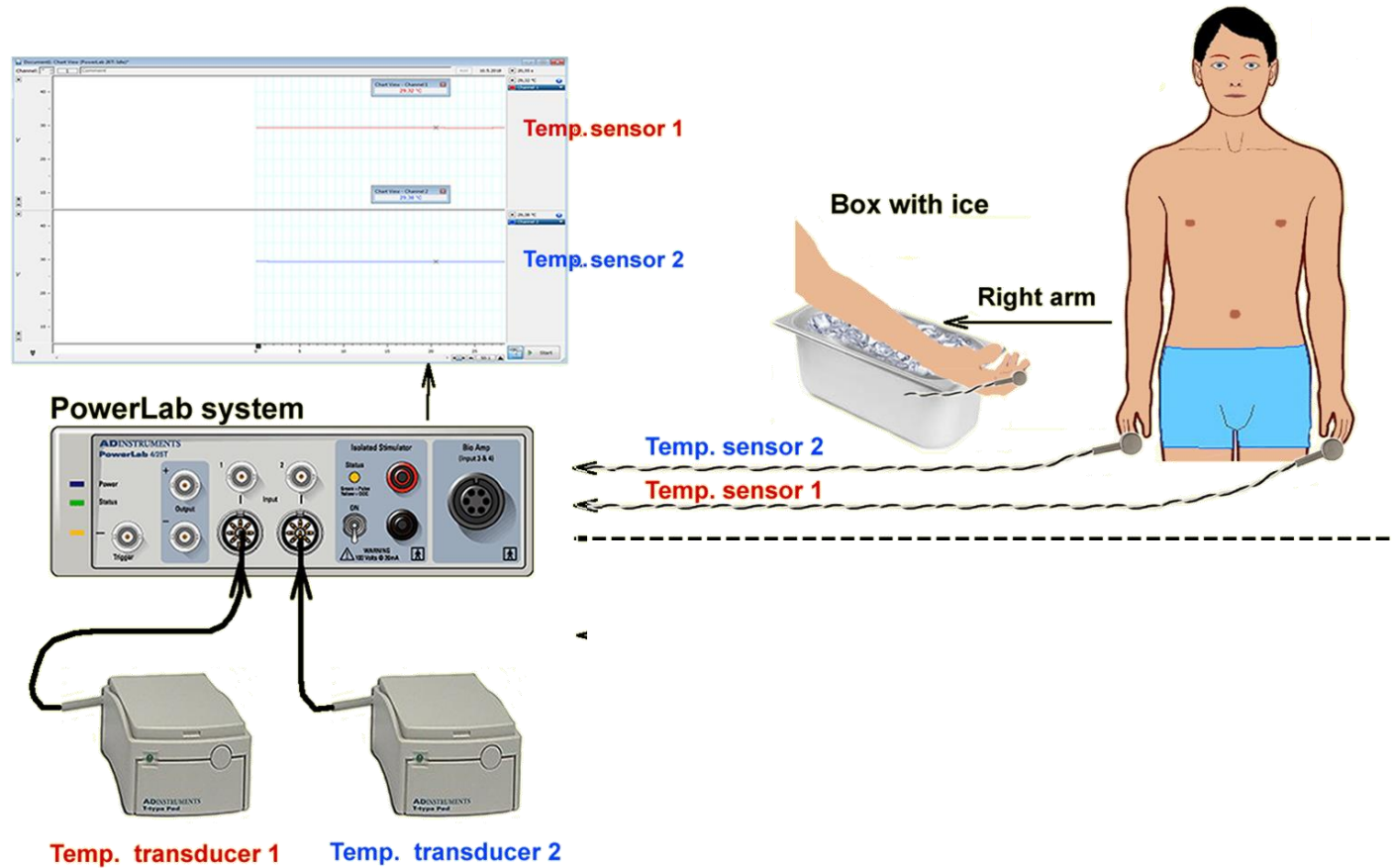


Adopted from: K.S. Saladin, *Anatomy & Physiology—The Unity of Form and Function*, 8th ed. (McGraw-Hill, 2018)

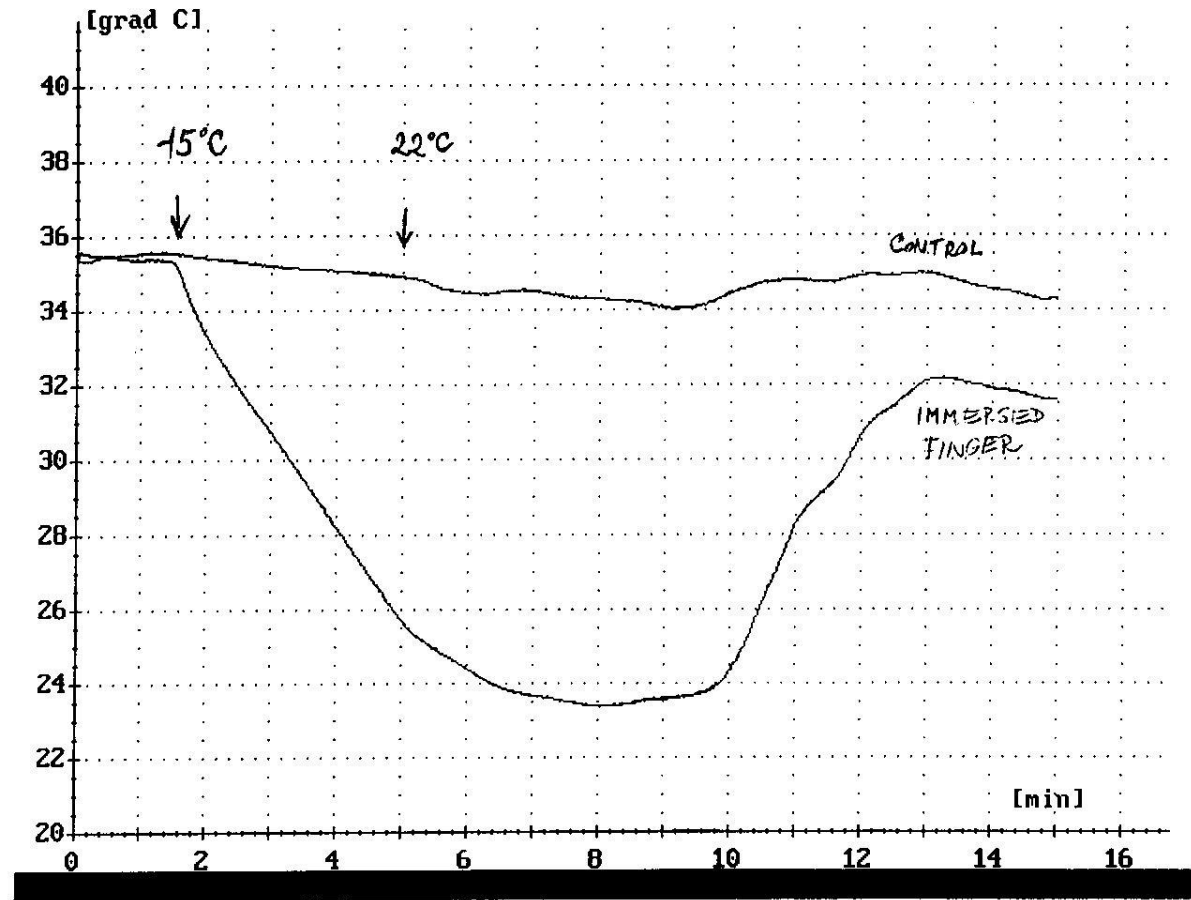
Rectal vs. skin temperature



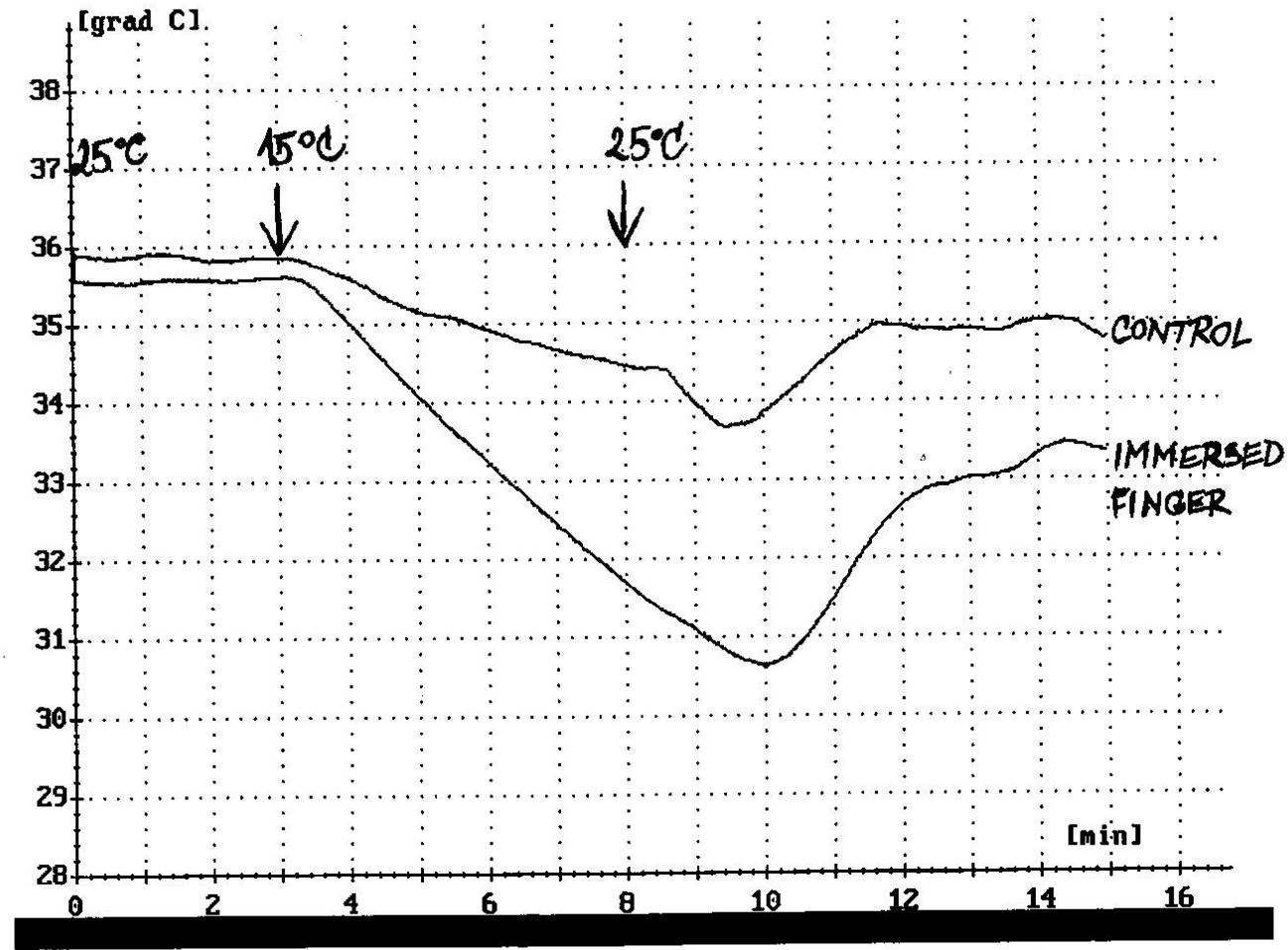
EXPERIMENT 1: Local cold exposure affects skin temperature



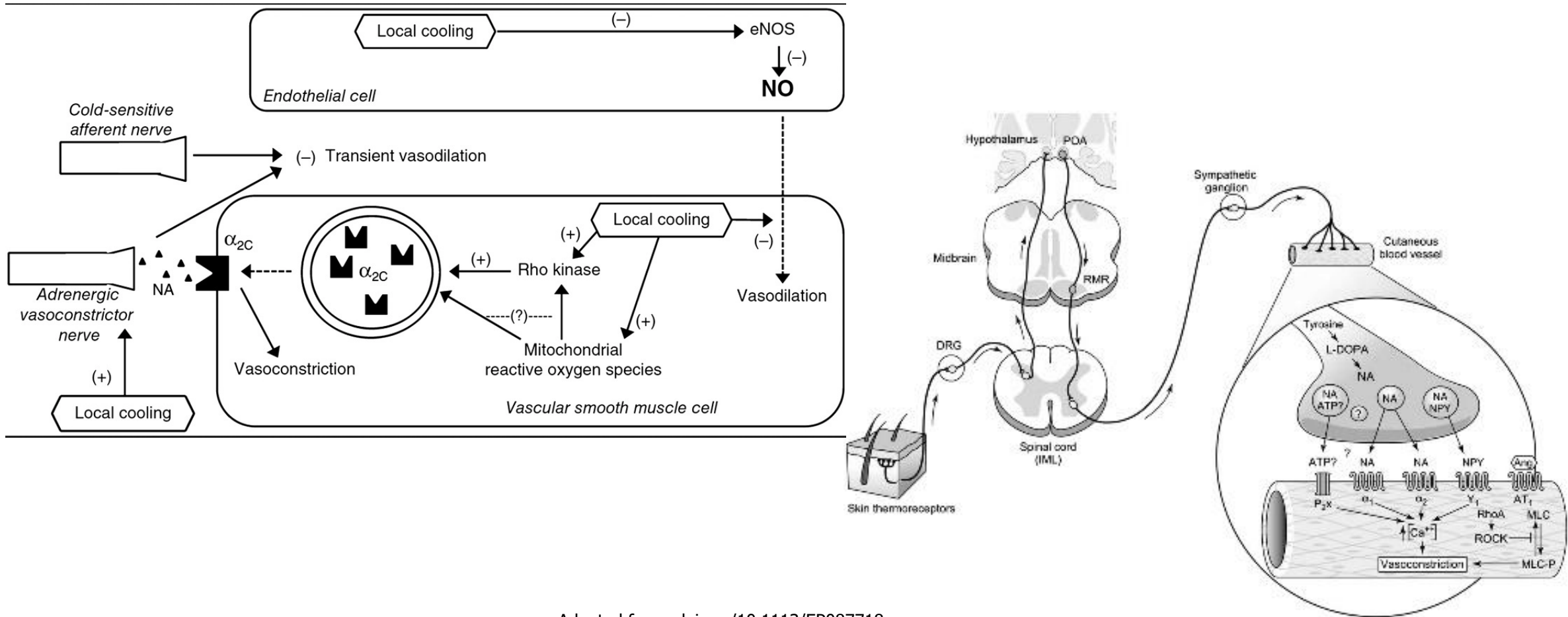
Result 1



Result 2

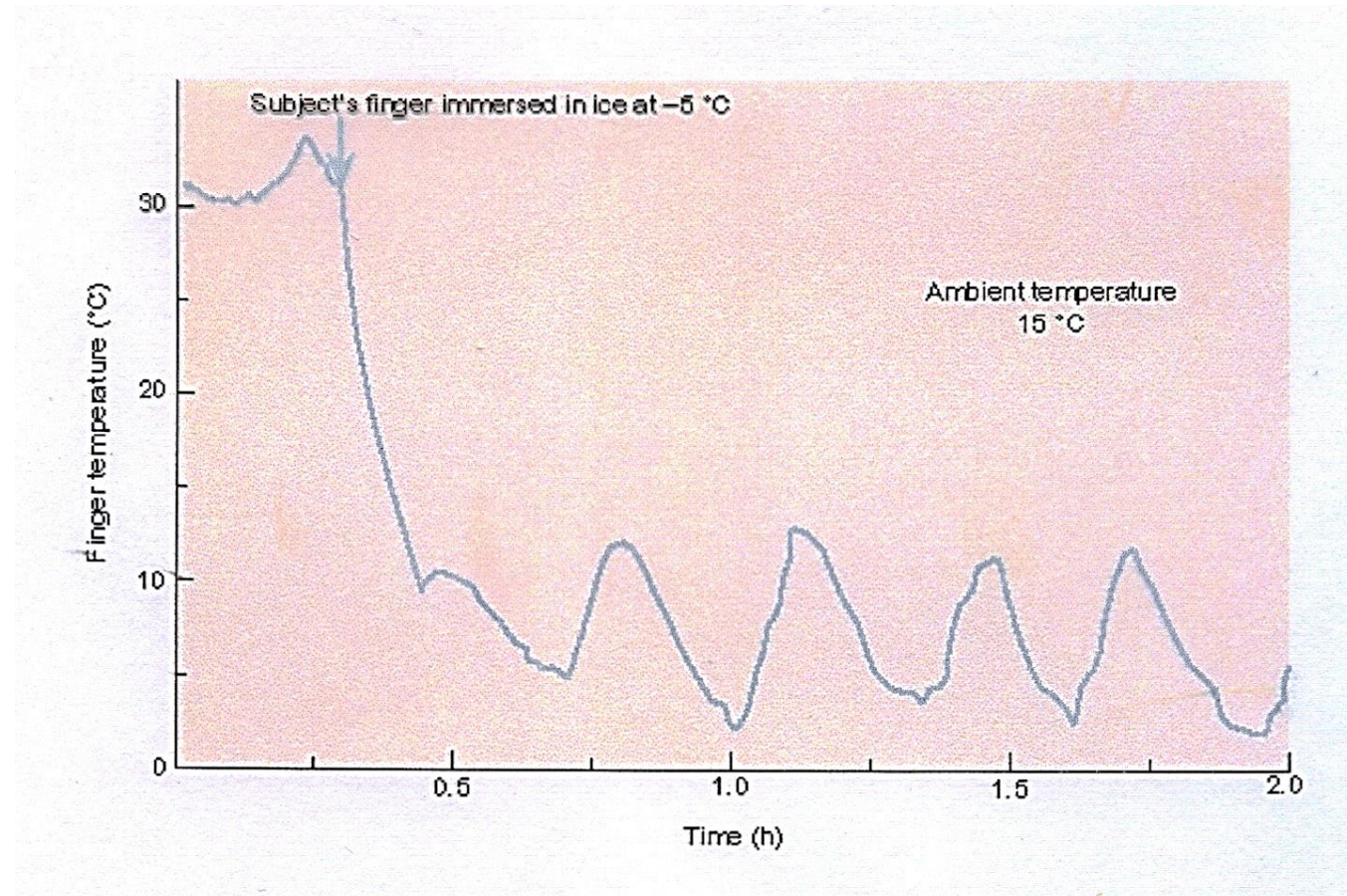


Cold-induced skin vasoconstriction



Adopted from: doi.org/10.1113/EP087718

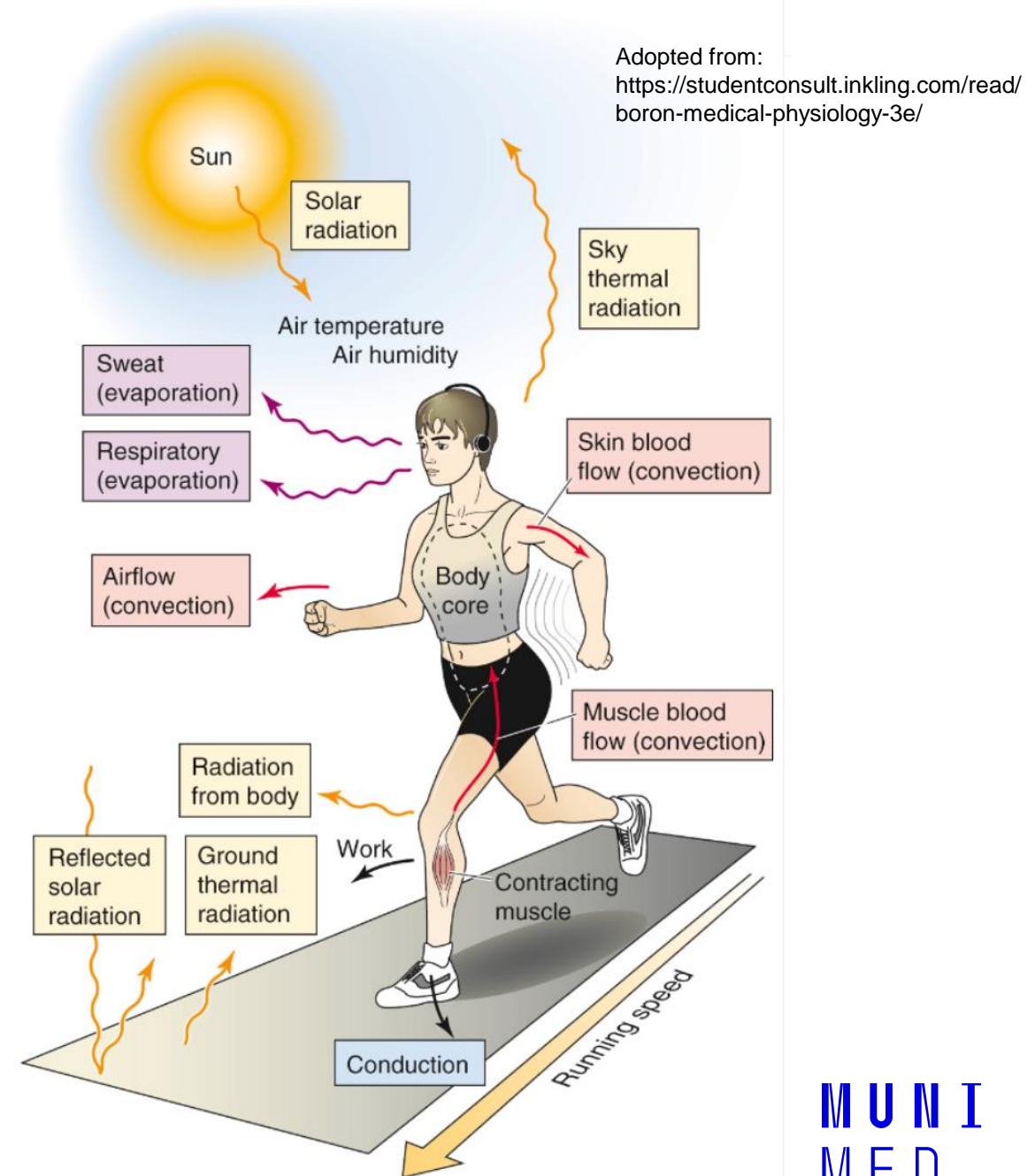
Cold-induced vasoconstriction vs. hypoxia: Hunting reaction (Lewis, 1930)



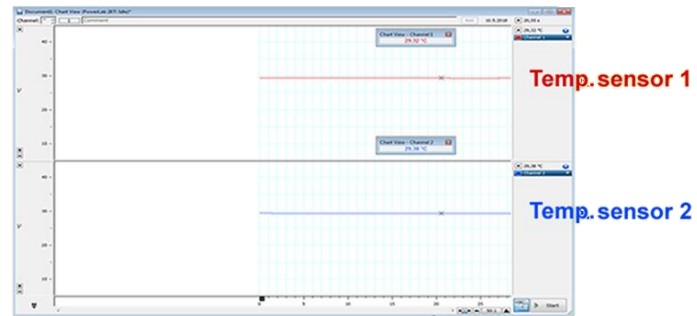
Heat exchange during exercise

- Conduction
- Convection
- Radiation

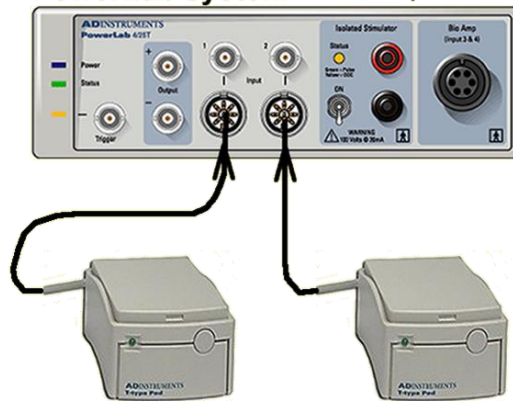
- Evaporation



EXPERIMENT 2: „Central“ vs. „peripheral“ skin temperature during exercise

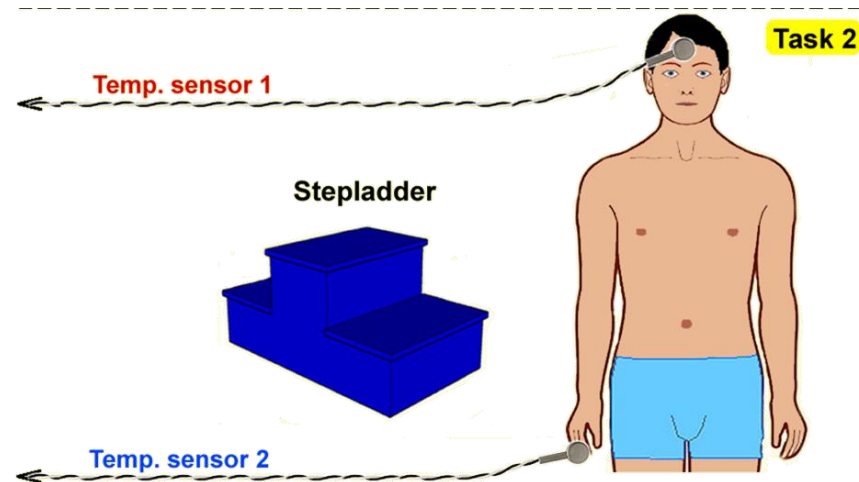


PowerLab system



Temp. transducer 1

Temp. transducer 2



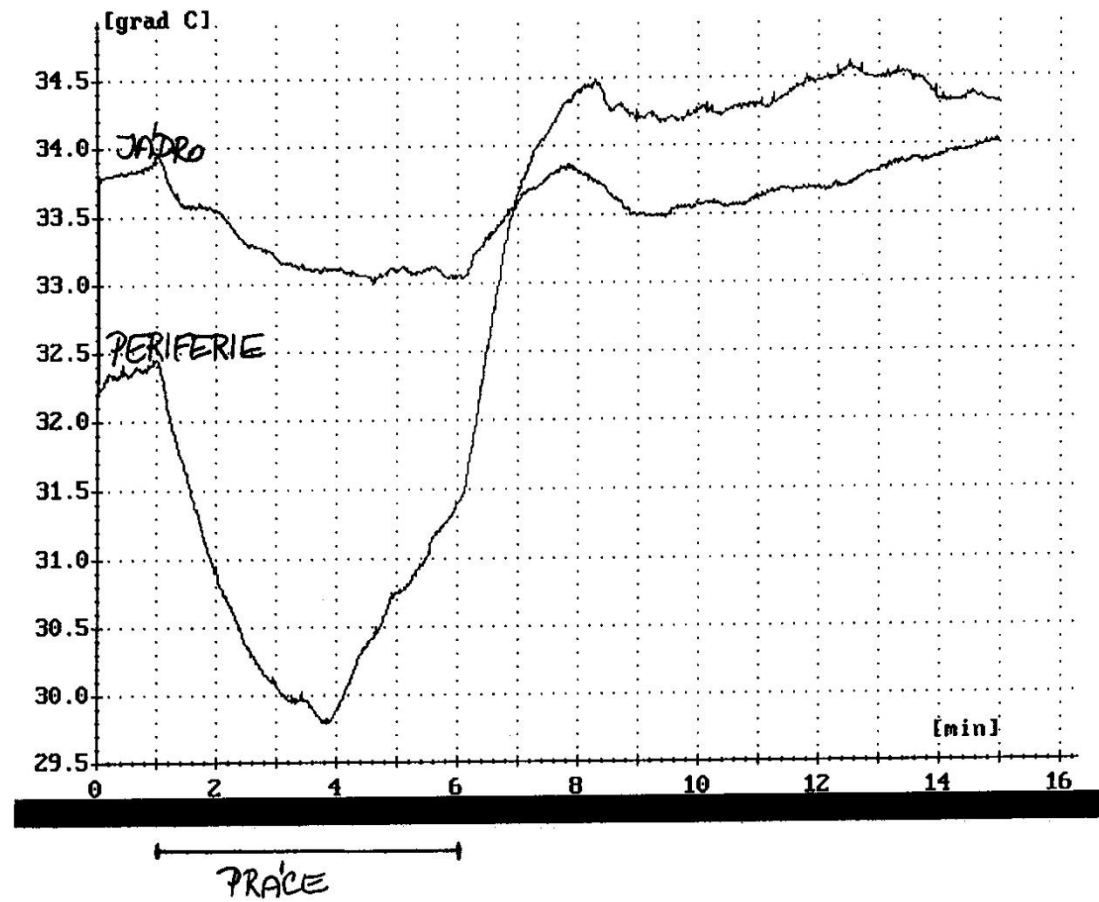
Standardised workload

- Ergometry
- Exactly: W/kg
- Comparatively: MET – metabolic equivalent
 - Actual metabolic rate / resting metabolic rate in sitting position
 - 1 MET = consumption of 3.5 ml O₂/kg.min
 - sleeping ≈ 0,9 MET; slow walking ≈ 3-4 MET; fast running, sprint ≈ 16 MET
 - (+) simplicity; (-) inaccuracy

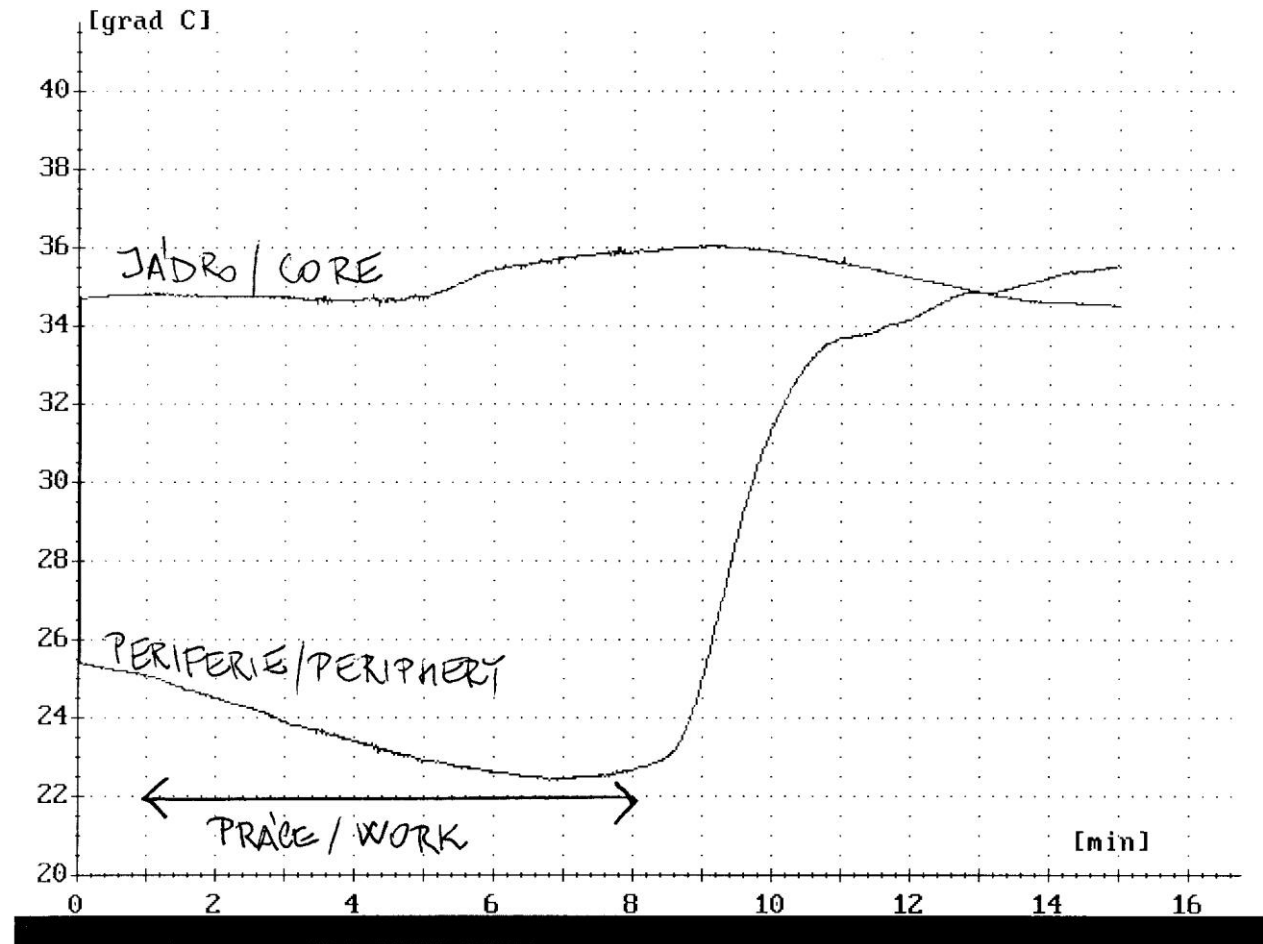
Indexes of fitness

- W_{170} [W/kg]
- $V_{O_2 \max}$ [mL O_2 / (min x kg)]
- Aerobic / anaerobic threshold

Result 1

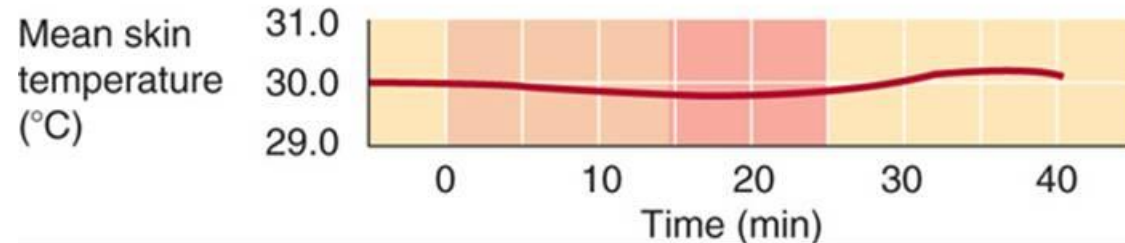
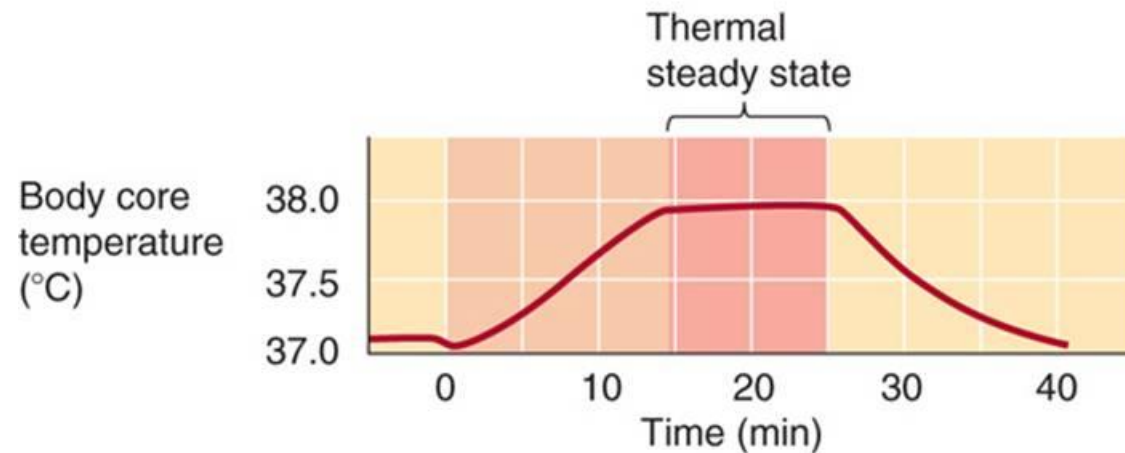
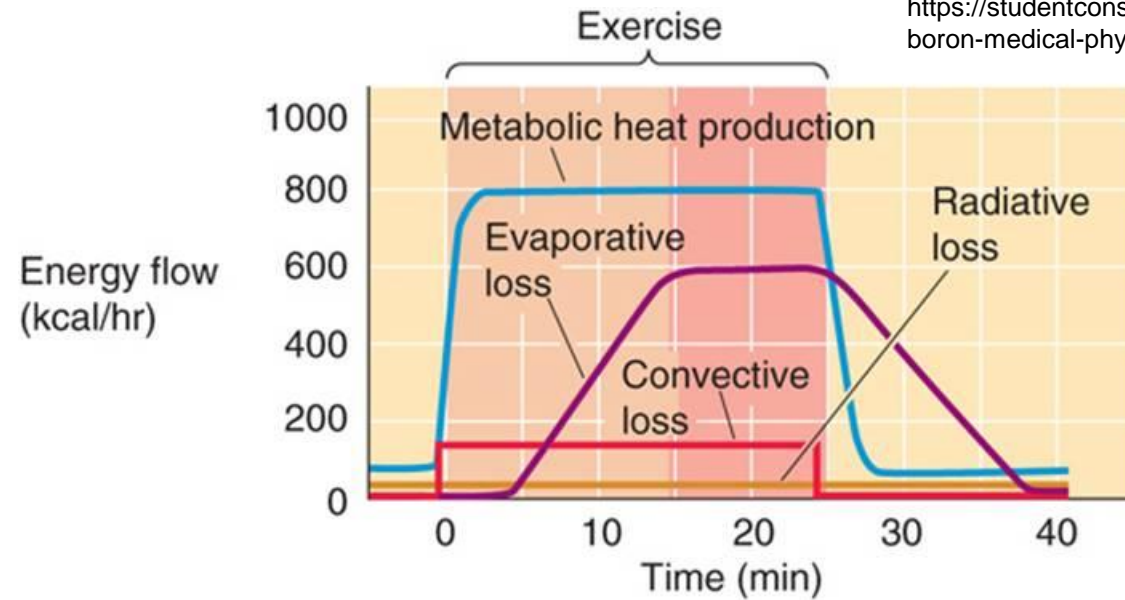


Result 2



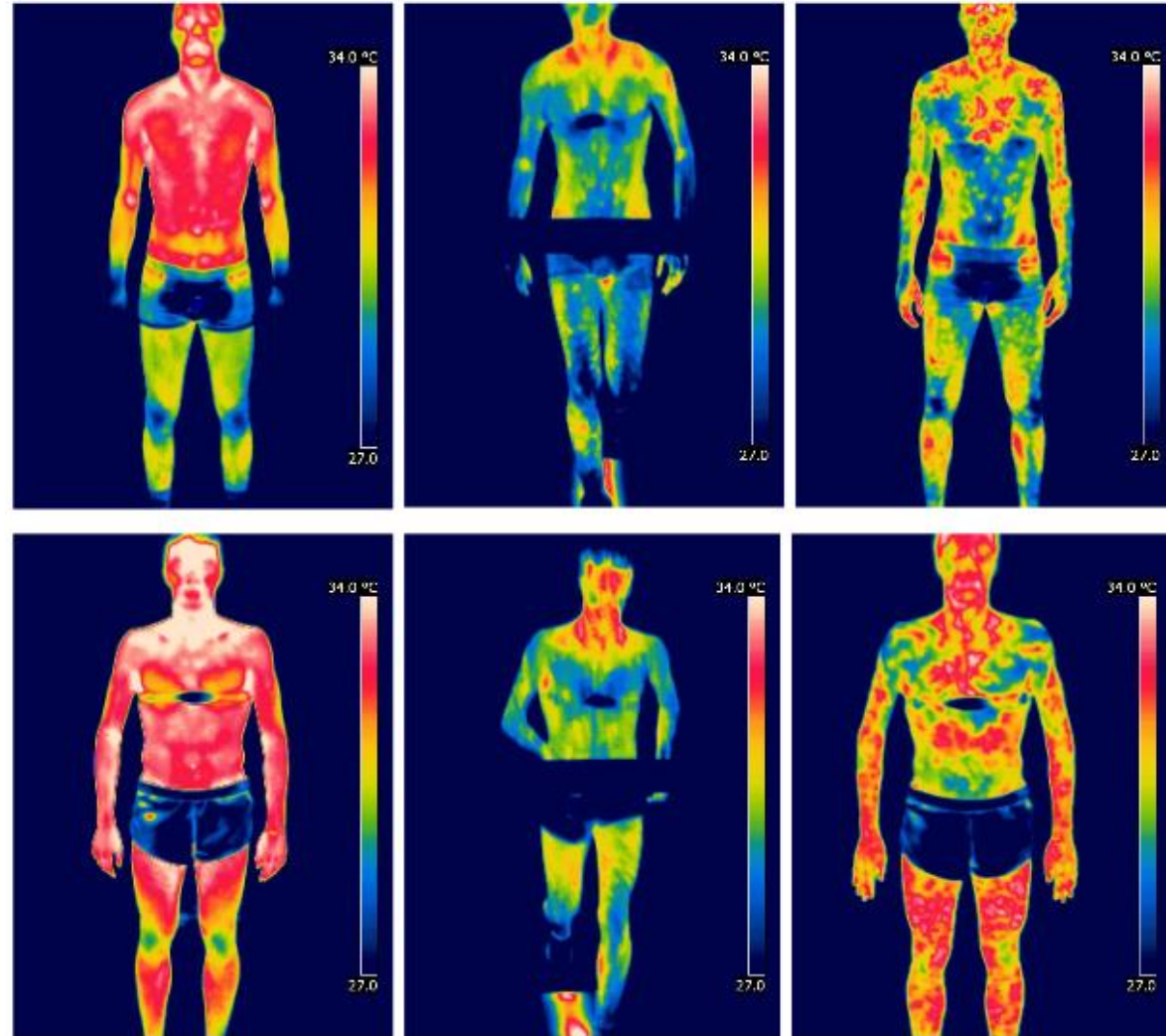
Heat exchange during exercise

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Skin temperature before, during and after exercise

– Infrared thermography



Adopted from:
doi:10.1088/1742-6596/655/1/012062