Measurement of body temperature

Body temperature depends on the place of measurement.

Superficial (skin) temperature is seriously influenced by external surroundings, particularly on the peripheral parts of the body. For instance, in temperature of environment of 20 °C the skin temperature on the palm is around 28 °C, while in temperature of environment of 35 °C the temperature on the palm is around 31 °C. Superficial temperature is influenced by an extent of blood perfusion what gives us the information about vasoconstriction or vasodilation of skin vessels and about the ability to control the heat management.

Profound (deep) temperature is a temperature of deep structures located e.g. in chest or abdominal cavity. Their temperature is not significantly influenced by the temperature of environment, but is dependent on metabolic activity of the tissues, working activity of muscles, distance from the body surface, blood flow, heat characteristics of neighbouring structures (fat), as well as on the phase of the day (the lowest temperature in early morning, the highest temperature in the afternoon) or on the phase of ovarial cycle (progesterone increases body temperature after ovulation).

The body temperature elevates in physical activity due to heat produced by working muscles, as well as in emotional stress due to hormone-conditioned increase of the metabolism and higher tone of striated muscles. Increase in body temperature accelerates the metabolic processes so that each increase in body temperature of 1 °C elevates the metabolism of 10-13%. On the other hand, decreasing body temperature slows down the metabolism and reduces oxygen consumption.

Body temperature can be measured on various places of the body by different types of thermometers which are adjusted for the measurement of deep or superficial temperature.

The most reliable places for measurement of deep temperature are rectum (rectal temperature), oral cavity (oral/sublingual temperature) and armpit (axillary temperature), eventually the area of tympanic membrane and external auditory meatus (tympanic temperature). The average oral temperature is 37 °C. The rectal and ear temperatures are of about 0.5 °C higher than the oral temperature while the axillary and forehead temperatures are about 0.5 °C lower than the oral temperature.

Physiological values of the body temperature may vary according to the used type of the thermometer.

Figure 1 shows some examples of a classical mercury/non-mercury thermometer (a), a digital contact thermometer (b), a non-contact forehead thermometer (c) and a ear/tympanic thermometer (d).

a) b) c) d)

Table 1 shows a range of physiological body temperature on various places of the body.

Place of measurement	Lowest temperature (°C)	Highest temperature (°C)
Rectum	36.2	37.7
Oral cavity	35.7	37.3
Axilla	35.2	36.7
Ear	35.8	36.9
Forehead	35.8	36.9

Principles of measurement of body temperature:

Measurement of rectal temperature:

This most precise measurement is particularly suitable for measurement in sucklings, in low external temperature or in inflammatory processes on skin or around mouth. The rectal temperature can be measured by digital thermometers with flexible tip or with classical thermometers. For appropriate measurement, the tip of thermometer should be placed about 1-1.5 cm deep in anus. After the use, thermometer should be carefully cleaned nad disinfected.

Measurement of axillar temperature:

In adults, this method serves just for an orientational adjustment of the temperature. The axillar temperature can be measured by digital or classical thermometers. After insertion of classical thermometer into the armpit, the thermometer adapts to the temperature of surroundings within the first minute, for appropriate results we should wait for at least 5 minutes.

Measurement of oral temperature:

This method is more precise than the above mentioned measurement of axillar temperature and it is suitable for older children and adults. Oral temperature can be mesured by digital or classical thermometers. Tip of thermometer should be inserted under the tongue in permanent contact with oral mucosa in closed mouth. Innappropriate values can be detected after drinking, eating, smoking, chewing, or inhaling cold or warm air.

Measurement of tympanic temperature:

Tympanic temperature is measured by infrared sensor. Tip of thermometer is gently inserted into the external auditory meatus and the result is automatically displayed within several seconds. Because of gentle, fast and relatively precise mesurement, this type of thermometer is used especially in sucklings and small children.

Measurement of forehead temperature by non-contact thermometer:

Infrared sensor of non-contact thermoemter should be placed in the distance of 3 - 5 cm from the middle of the forehead, eventually you can move slowly from the middle of the forehead towards temporal areas. The result is automatically displayed within several seconds and additionally, the display may change the colour (as an indicator of increased body temperature).

Purpose of the practical task:

To learn the methods of proper measurement of body temperature by different types of thermometers.

To compare temperature on various places of the body (axilla, oral cavity, forehead, external ear, cubital fossa, palm etc.).

Needs:

Different types of thermometers, disinfection solution, paper wool for cleaning.

Methods:

Measure the body temperature on different places by different thermometers (according to their technical properties). In measurement by classical thermometer, keep the minimum time for appropriate measurement of 5 min. Other thermometers will indicate the end of measurement by a sound signal.

Protocol:

1. Write down your measured values into the table below:

Type of thermometer	Armpit (°C)	Oral cavity (°C)	Ear (°C)	Forehead (°C)	Cubital fossa (°C)	Palm (°C)
Classical thermometer						
Digital thermometer						
Non-contact thermometer						
Ear thermometer						

2. Compare the values of body temperature between boys and girls (in girls, comparison according to the ovarial cycle may be done), before/after physical exercise (30 knee-bends within 40 s) etc. Explain what are the reasons for found differences.