The Ministry of Health Care and Social Development
The Volgograd State Medical University
The Chair of hygiene and ecology

LECTURE

Climate and weather. Physical properties of the air, the microclimate of the premises and its hygienic value. Hygienic aspects of acclimatization.

Physical indicators of the air.

Physical indicators of the air include

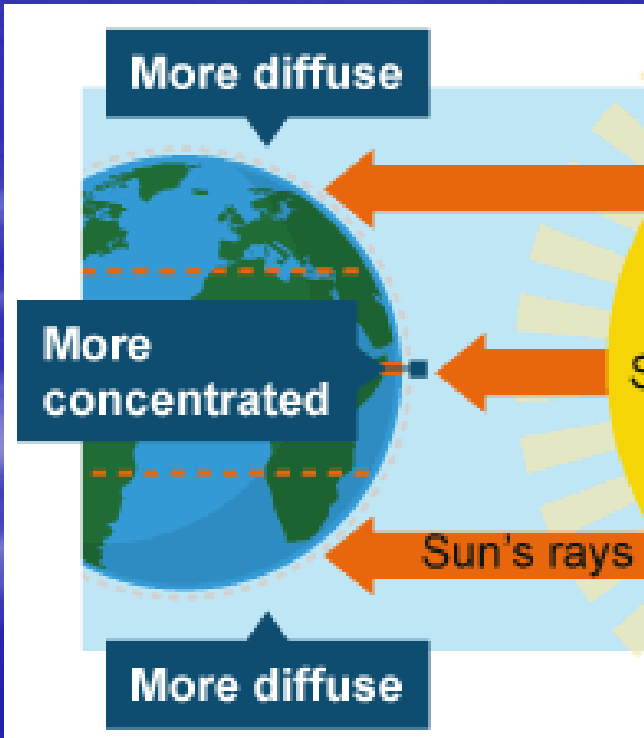
- **the temperature of air,**
- **air humidity,**
- **air velocity,**
- **intensity of solar radiation,**
- **ionization of air,**
- **intensity of electromagnetic fields,**
- **static electricity and others.**

The temperature of air in any point of the Earth

1. **It depends on the geographical latitude of the area.**

Locations that are further north receive less concentrated energy from the Sun. The equator lies directly underneath the Sun and so countries that fall on the equator receive the strongest solar energy.

This means that in the Northern Hemisphere, the Sun's energy becomes less concentrated and therefore the temperatures become cooler as you travel north.



2. Altitude (a measure of an area´s height above sea level) and the relief of the area (for example, if there are mountains, forests in the area)

- Temperatures decrease with altitude. There is a 1°C drop in temperature for every increase of 100 m in height. This is because the air is less dense in higher altitudes

3. **Distance from the sea**

- Coastal areas are most affected by the sea. The sea takes longer to heat up and cool down than land. So in the winter the sea keeps coastal areas.

4. **Ocean currents**

- The effect that **ocean currents** have on the temperature depends on whether the ocean current is hot or cold.

- *Britain is on the same latitude as Siberia and parts of Russia, yet it does not suffer the same long, harsh winters. Britain's mild climate is partly due to the Gulf Stream, a large Atlantic Ocean current of warm water from the Gulf of Mexico.*

The second indicator is air humidity.

Relative air humidity means the percentage of water vapors in a unit of air volume.

Air humidity is determined by:

the geographical latitude of the area;

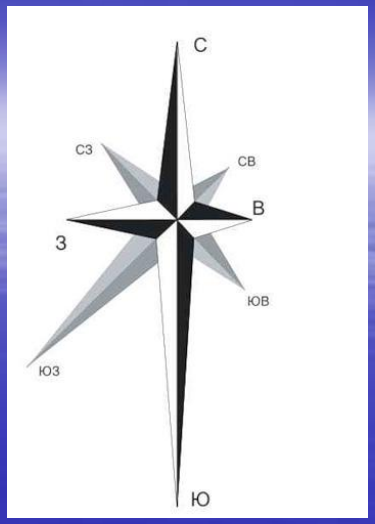
the proximity of the seas and oceans;

the climatic conditions.

The third indicator is air velocity.

In hygienic practice the movement of the air is characterized in two ways: by its direction and its velocity.

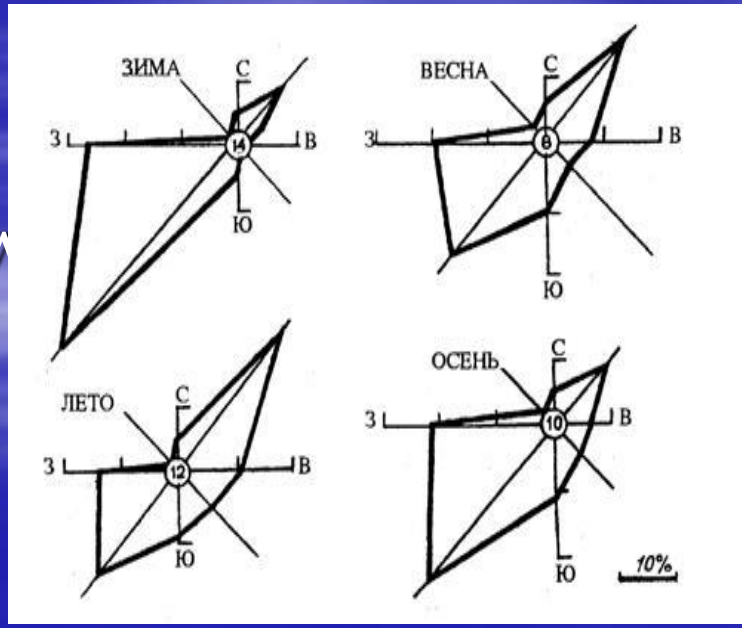
- **The wind rose** is a graphic representation of the frequency of winds according to compass points.



<u>The readings of the wind rose are considered:</u>

- in planning the city
- in constructing new industrial enterprises.

It is necessary to construct a new plant or a factory on the windy side so that the waste wouldn't pollute the residential area.



5. Prevailing winds (the wind direction that occurs most often throughout the year, or occurs most often at this time of year, in a certain geographical region)

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Fundamentals of human thermoregulation ion

The system of thermoregulation consists of two functional components: production of heat and emission of heat.

Production of heat: that is production of thermal energy in the body when the intensity of oxidation & reduction processes changes.

It means that thermoregulation is carried out chemically.

The production of heat is also carried out due to the muscular work.

There are three types of contractile activity of the muscles in relation to thermoregulation.

1. Thermoregulation tone is an involuntary contraction of muscles under the influence of low temperatures.

2. If the person is exposed to low temperatures for a long time, the second mechanism is triggered, that is cold muscular shivering.

3. If the exposure to low temperatures continues and the thermal energy produced earlier has been utilized, the third mechanism begins to work. The person begins to perform physical exercises, for example, to jump, to slap on his sides, etc.

1. Thermoregulation tone

- is an involuntary contraction of muscles under the influence of low temperatures.
- *Exposure to low temperatures makes our muscles contract and as a result heat which provides energy in the amounts of 600 – 800 kcal is released.*

2. Cold muscular shivering

If a person is exposed to low t for a long time, the second mechanism is triggered, that is cold muscular shivering.

It is a kind of muscular work which participates in the production of heat.

As a result, thermal energy in the amount of 500 – 600 kcal is released.

Involuntary Response to Cold Stress

- Shivering in adults

- Nonshivering thermogenesis in infants until 3-6 months of age

Nonshivering thermogenesis

- Muscle contraction is not the only process controlled in temperature-regulating reflexes.
- In most experimental animals, chronic cold exposure induces an increase in metabolic rate (heat production) that is not due to increased muscle activity and is termed **nonshivering thermogenesis.**

Nonshivering Thermogenesis

- Temperature sensors are in the skin (in newborns particularly the face), the spinal cord and the hypothalamus.
- Temperature information is processed in the hypothalamus. Norepinephrine (NE) is released in response to cold stress.
- **Result: Vasoconstriction and increased metabolic activity.**

Physical thermoregulation or emission of heat

The physiological basis of physical thermoregulation is the ability of the human body to change the lumen of superficial vessels of the skin and subcutaneous fat.

There are four main forms of the emission of heat.

- 1. Convection
- 2. Conduction
- 3. Perspiration
- 4. Radiation

1. Convection is the release of heat from the body surface to the layer of air adjoining the skin

The intensity of convection depend on:

- the temperature of the air.

The higher the temperature of air, the less the convection is. Consequently, in summer when the temperature of the air is 30 and more degrees above zero, the convection stops.

- the air humidity.

The higher the air humidity, the more intensive the convection is.

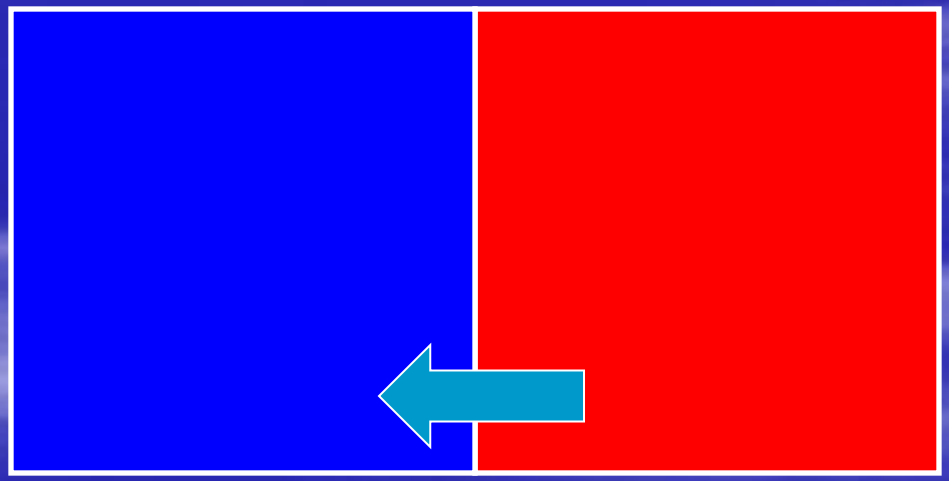
- the air velocity (the speed of the movement of the air).

The higher the air velocity, the more intensive the convection is.

- if weather conditions are characterized by a combination of a relatively low temperature, high air humidity and wind, **convection** will be the major form of the emission of heat in these conditions.

2. Conduction is the release of heat from the surface of the human body to the thing (object) which is in contact with the body.

- Heat transfer by conduction is the transfer of heat through direct contact.



The intensity of conduction depend on:

- **the temperature of the contact surface.** The lower the temperature of the contact surface, the more intensive the conduction is

- **the area of the contact surface**

- **the thermal capacity of the things which are in contact** with the human body. When the human body comes into contact with the wood, the conduction is low because the wood has a low thermal capacity. And vice versa when the human body gets into contact with metals, the conduction is high because metals have a high thermal capacity.

3. Perspiration (production and evaporation of sweat) is the release of heat as a result of evaporation of sweat from the surface of the skin and mucous membranes.

It is the most powerful way of fighting against overheating.

The intensity of perspiration depend on:

- the temperature of the air.

The higher the temperature of the air, the more intensive perspiration is.

- the air humidity.

If the air humidity is high, the evaporation is less. It is due to the fact that moistened air is saturated with water vapours and, consequently, can absorb less amounts of sweat.

- the air velocity.

The higher the air velocity is, the more intensive perspiration & evaporation.

4. Radiation is the emission of thermal energy from the internal organs and muscles.

The intensity of radiation depend on:

- the temperature of protecting surfaces (temperature of the walls, floor, ceiling, glass, etc.) and that of the surrounding s
- the thermal capacity of the surrounding surfaces and things.
- the distance between the human body and the surface.

The greater the distance, the less the radiation is.

Radiation is the most dangerous kind of cooling of a person.

There is no mechanism which can counteract radiation cooling.

The danger consists in the inability of a person to feel cooling caused by radiation.

In radiation cooling the thermal receptors in the skin do not respond to cold. The person will feel cooling when it effects the thermal receptors in the vessels of the internal organs. But it is what we call overcooling.

Peculiarities of temperature homeostasis in children

- Newborns thermoregulatory system is well developed, but in newborns different condition of temperature exchange and present some peculiarities of thermoregulation.
- Children have ***another than adults ratio of body surface and weight.***

MICROCLIMATE -

- is a thermal state of spatially restricted environment conditioned by a variety of physical factors such as the temperature of the air, air humidity, air velocity, radiant heat, etc. which affects heat exchange.

Principles of hygienic rating of microclimatic parameters in living and public locations

1. Hygienic rating of the optimal and permissible microclimatic parameters should consider the circadian and seasonal dynamics of the variation of physiological functions .

2. should be different for different age groups of people.

3. should consider the level of energy expenditure (physical activities of people staying inside a building) and the level of heat retention properties of the clothes of the corresponding groups of the population.

4. should also consider the types of diseases treated in a setting and the nature of treatments and procedures performed by the medical staff.

Types of a microclimate

- OPTIMAL
- PERMISSIBLE
- HEATING
- COOLING

AN OPTIMAL MICROCLIMATE

is referred to as the conditions of the indoor environment in which the person of a certain age, health condition, etc. feels thermal comfort.

PERMISSIBLE MICROCLIMATE

is referred to as the conditions of the indoor environment which can cause some *changes in the functional and thermal state of a person*

- **HEATING MICROCLIMATE** is referred to as the conditions of the indoor environment which can cause physiological changes and sometimes result in the development of *pathological conditions and diseases* (overheating, heat stroke).

COOLING MICROCLIMATE

is referred to as the conditions of the indoor environment which can cause overcooling, pathological state and diseases associated with it.

- **THERMAL STATE** is a functional state of a person exposed to certain microclimatic factors.
- **THERMAL COMFORT** is well-being of a person in certain microclimatic conditions that produce the optimal functional state of the body.

Classification of human thermal states

- *An optimal state*
- *A permissible state*
- *A maximum permissible*
- *An impermissible state*

- ***An optimal state*** is characterized by the absence of generalized and/or localized uncomfortable thermal sensations, minimal activation of thermoregulatory mechanisms.
- It is a prerequisite of sustained high working capacity.

- ***A permissible state*** – is characterized by insignificant generalized and/or localized uncomfortable thermal sensations, maintenance of thermal stability of a person for the whole working day and involves moderate activation of thermoregulatory mechanisms.
- A temporary decline in working capacity may occur but it does not impair a person's health.

- ***A maximum permissible state*** is characterized by pronounced generalized and/or localized uncomfortable thermal sensations; it cannot ensure that thermal homeostasis and health are maintained, restricts working capacity.

- ***An impermissible state*** is characterized by excessive activation of thermoregulatory mechanisms which results in impaired health.

The following indicators can be used to evaluate a thermal state of a person

- body temperature
- topography of skin temperatures
- temperature gradient of trunk and limb skin
- water loss value
- thermal sensations
- heart rate.

Definite combinations of temperature, humidity, speed of air movement form such concepts as climate and weather.

Weather is a set of physical properties of a near earth layer of an atmosphere in a short interval of time (hours, day, weeks).

Climate – is a long-term mode of weather repeating in the given area regularly.

So the weather is a changeable phenomenon, but the climate is a stable one.
Meteotropic reactions can occurred in some people due to the influence of weather. People who are sensitive to changes of weather – are celled weather (or meteo) sensitive people. The numb of such people varies from 10 to 80 %. Unfavorable changers of weather cause different disturbances of health in weather sensible people.

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Weather conditions influence many diseases

- For example 70 % of the patients, suffering with cardiavascular diseases, notice that their state (condition) becomes worse due to weather changes.

- People with chronic non-specific lung diseases are very sensitive to unfavorable (bad) weather.

- Patients with rheumatic diseases suffer from hypersensitivity to weather conditions. Rheumatic pains in the joints before or during the change of weather are good examples of a weather sensitive reaction.
- Patients with a diabetes, diseases of the nervous system, psychic disorders, are also sensitive to weather changes.