

# Indoor microclimate and air quality

## 1. What is an Indoor Microclimate?

The indoor microclimate isn't just about the temperature on the thermostat. It is a complex interaction of physical factors that determine human comfort.

### The Four Pillars of Thermal Comfort:

1. **Air Temperature:** The most obvious factor, usually kept between 20°C and 24°C.
2. **Relative Humidity:** The amount of moisture in the air. Ideally, this should stay between **30% and 60%**.
3. **Air Velocity:** How fast the air is moving (drafts). High velocity can cause cooling, while zero movement can feel "stuffy."
4. **Mean Radiant Temperature:** The heat emitted from surfaces like windows or walls.

## 2. Indoor Air Quality (IAQ)

While the microclimate covers how you *feel*, IAQ covers what you *breathe*. Poor IAQ is often referred to as "Sick Building Syndrome."

### Common Indoor Pollutants:

- **Carbon Dioxide (CO<sub>2</sub>):** Exhaled by humans. High levels lead to drowsiness and poor concentration.
- **Volatile Organic Compounds (VOCs):** Chemicals emitted from paints, cleaning supplies, and new furniture (e.g., Formaldehyde).
- **Particulate Matter (PM<sub>2.5</sub>):** Tiny dust, smoke, or soot particles that can enter the bloodstream.
- **Biological Contaminants:** Mold spores, dust mites, and pet dander.

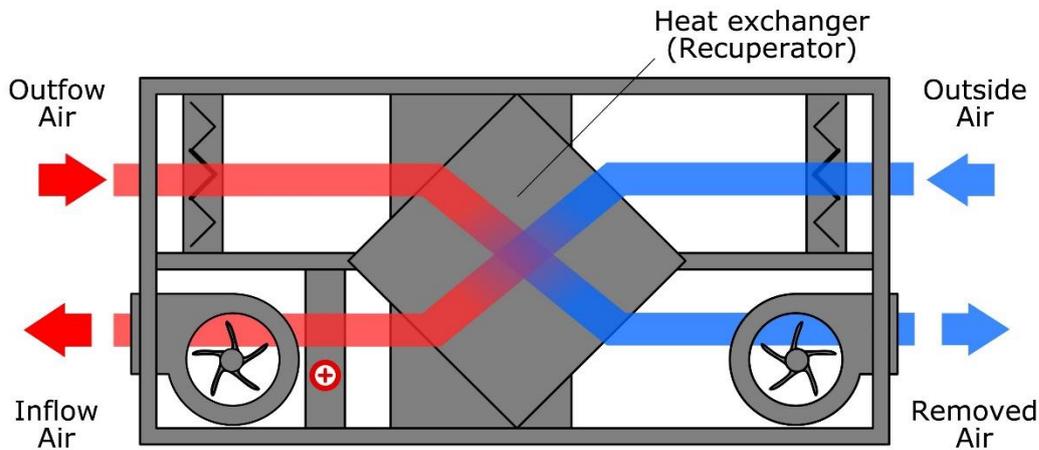
## 3. The Role of Ventilation

Ventilation is the process of "bleeding" stale indoor air out and bringing fresh outdoor air in. There are three main types:

Type	How it Works	Pros/Cons
<b>Natural</b>	Opening windows and doors.	Free, but hard to control and loses heat.
<b>Mechanical</b>	Using fans and ducts (HVAC systems).	Consistent, can be filtered, but uses energy.
<b>Hybrid</b>	A mix of both natural and mechanical.	Energy-efficient and adaptable.

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## VENTILATION CIRCUIT WITH RECUPERATION



In heating, ventilation and air conditioning systems, HVAC, recuperators are used to reuse spent heat from exhaust air, usually expelled to the atmosphere. The heat from the exhaust air flow is transferred into the supply air flow.

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### 4. How to Optimize Your Environment

To maintain a healthy indoor microclimate, you can follow these evidence-based steps:

- **The "Cross-Breeze" Rule:** Open windows on opposite sides of a room for 10 minutes to completely flush out pollutants.
- **Monitor Humidity:** Use a hygrometer. If humidity is >60%, you risk mold growth; <30%, and your respiratory membranes may dry out.
- **Plant Power:** While plants don't replace a good vent, species like Snake Plants or Peace Lilies can slightly reduce VOC levels.
- **Source Control:** Avoid "masking" odors with candles or sprays, which actually add more VOCs to the air. Instead, find the source of the smell and remove it.

### Knowledge Check

**Did you know?** Indoor air is often **2 to 5 times more polluted** than outdoor air because pollutants become trapped in confined spaces without proper exchange.

## Indoor Microclimate: The Glossary

### 1. Thermal Comfort (noun)

- **Definition:** A subjective state of mind that expresses satisfaction with the surrounding thermal environment (not feeling too hot or too cold).
- **Example:** "The architect focused on **thermal comfort** by installing triple-glazed windows to prevent heat loss."

### 2. Relative Humidity (noun)

- **Definition:** The amount of water vapor present in air expressed as a percentage of the amount needed for saturation at the same temperature.
- **Example:** "When **relative humidity** drops below 30%, many people experience dry eyes and itchy skin."

### 3. Volatile Organic Compounds / VOCs (noun)

- **Definition:** Organic chemicals that have a high vapor pressure at ordinary room temperature, meaning they "off-gas" or evaporate into the air easily.
- **Example:** "We chose a 'low-VOC' paint to ensure the **air quality** in the nursery remained safe for the baby."

### 4. Particulate Matter / PM (noun)

- **Definition:** A mixture of solid particles and liquid droplets found in the air, such as dust, dirt, soot, or smoke.
- **Example:** "The air purifier is designed to filter out fine **particulate matter** like pollen and smoke."

### 5. Stagnant Air (adjective + noun)

- **Definition:** Air that is not moving or flowing, often becoming foul or "stuffy" due to a lack of circulation.
- **Example:** "Without proper ventilation, the office became filled with **stagnant air**, making the employees feel drowsy."

### 6. Off-gassing (verb/gerund)

- **Definition:** The release of chemicals from manufactured items (like carpets or furniture) into the air.
- **Example:** "New memory foam mattresses often undergo a period of **off-gassing** where they release a strong chemical smell."

### 7. Cross-Ventilation (noun)

- **Definition:** A method of cooling or refreshing a room by opening windows on opposite sides to create a breeze.
- **Example:** "In the summer, we rely on **cross-ventilation** rather than air conditioning to keep the house cool."

## QUIZ

1. What are the four physical factors that primarily define an indoor microclimate?
  - a) Barometric pressure, altitude, wind speed, and precipitation
  - b) Temperature, humidity, air velocity, and mean radiant temperature
  - c) Oxygen levels, carbon dioxide levels, nitrogen, and argon
  - d) Light intensity, sound levels, room dimensions, and furniture layout
2. Which range of relative humidity is generally considered ideal for both human comfort and the prevention of mold growth?
  - a) 70% – 90%
  - b) 30% – 60%
  - c) Exactly 50% at all times
  - d) 10% – 20%
3. What is the primary source of Carbon Dioxide ( $CO_2$ ) in a standard office or classroom environment?
  - a) Leaking refrigerant from AC units
  - b) Off-gassing from office furniture
  - c) Photocopiers and laser printers
  - d) Human respiration
4. Volatile Organic Compounds (VOCs) are often found in which of the following household items?
  - a) Distilled water and LED light bulbs
  - b) Ceramic tiles and natural stone
  - c) Paints, cleaning supplies, and new carpets
  - d) Stainless steel cutlery and glassware
5. Why is 'Source Control' considered more effective than using air fresheners to improve air quality?
  - a) Odors are not actually a sign of poor air quality.
  - b) Air fresheners use too much electricity.
  - c) Source control is always cheaper than buying sprays.
  - d) Air fresheners only mask odors and often add more VOCs to the air.

**KEY:**

Question	Correct Answer	Key Takeaway
<b>1. Four Pillars</b>	A	Thermal comfort is a balance of temperature, humidity, air speed, and radiant heat from surfaces.
<b>2. Humidity Range</b>	B	<b>30% – 60%</b> is the "Goldilocks" zone—not too dry for your throat, not too damp for mold.
<b>3. \$CO_2\$ Source</b>	B	<b>Humans</b> are the main source; high \$CO_2\$ is a signal that you need to open a window.
<b>4. VOC Sources</b>	A	Modern synthetic materials (paints, carpets) "off-gas" chemicals into the air.
<b>5. Source Control</b>	A	Adding "fragrance" usually adds more chemicals; it's better to remove the pollutant itself.

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