# Living Space

## Understanding Indoor Environments

**Action Project**
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| | Temperature | Relative Humidity | Carbon Dioxide | Light | Background Noise |
|---|---|---|---|---|---|
| Metric Unit of Measurement | Celsius (ºC) | % (water vapor in air compared to what it can hold at that temperature) | ppm (parts per million) | Lumens (lm): Total quantity of visible light<br><br>Lux ($lm/m^2$) : Light on surface[i] | Decibels (dB) |
| Measuring tools | Thermometer | Hygrometer | Carbon dioxide meter | Lux meter | Decibel meter (noise meter, noise dosimeter) |
| Physical and mental health impacts if high | **Physical:** Heat exhaustion - dizziness, headache, thirst, fatigue<br><br>**Mental:** increased aggression, moodiness | **Physical:** Reduced sweating (do not feel as cool), more respiratory problems from dust mites, bacteria, viruses, and mold[ii] | **Physical:** Headaches, dizziness[iii], tiredness, difficulty breathing<br><br>**Mental:** poor concentration, loss of attention[iv], measureable cognitive effects[v] | **Physical:** Too bright-headaches, eye strain[vi]<br><br>**Mental:** Hard to concentrate, over-stimulation[vii] | **Physical:** increased stress, increased heart rate, increased blood pressure[viii]<br><br>**Mental:** anxiety, irritability, poor understanding of speech |
| Physical and mental health impacts if low | **Physical:** Heart issues, respiratory tract infections, cold & flu | **Physical:** Dry, itchy skin, lips and hair, scratchy throats and noses, longer duration of colds & flu[ix] | **None:** The lower the better – outdoor air is 300-350 ppm[x] | **Physical:** Too dim - eye strain, headaches[xi], sleepiness (light stops the production of melatonin, a hormone that makes people sleepy)[xii] | **Mental:** Quiet-good for doing complicated tasks, some background noise is good for memory work and creative thinking |

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| Optimal range for a classroom | 23°C - 26°C (spring, summer, fall)<br><br>20°C - 23.5°C (winter) at 50% relative humidity | 30-50% in the summer months and 30% in winter months | 800 - 1 000 ppm[xiii] | 250-500 lux[xiv] | Empty room: No more than 35 dB of background noise.<br><br>Ideal: 45 - 50 dB<br><br>Uncomfortable: 60dB and higher |
| Danger levels | Extreme heat: Hyperthermia<br><br>Extreme cold: hypothermia | >50% = more fungi, mites, chemical interactions<br><br><30% = dry mucous membranes, respiratory problems, ozone production | Long-term exposure (8 hrs): 5 000 ppm<br>Short term exposure/ceiling limit – 30 000 ppm ([xv]WHMIS)<br>1 000-1 100 - more outdoor air needed[xvi]<br>Some people sensitive to as low as 600 ppm[xvii] | Very dark: Can hit obstacles, feelings of insecurity<br><br>Very bright: Damage to eyes | Sounds that are 85 dB or above can permanently damage hearing |

[i] https://sustainabilityworkshop.autodesk.com/buildings/measuring-light-levels#flux-intensity
[ii] https://www.thealternativedaily.com/dry-heat-humidity-better-good-health/
[iii] https://www.dhs.wisconsin.gov/chemical/carbondioxide.htm
[iv] https://www.dhs.wisconsin.gov/chemical/carbondioxide.htm
[v] http://nationalpost.com/health/too-much-carbon-dioxide-may-cloud-our-thinking
[vi] https://blog.millikencarpet.com/4-key-elements-of-modern-classroom-design
[vii] http://www.independent.co.uk/news/education/schools/brightly-lit-classrooms-hamper-ability-of-pupils-to-concentrate-401510.html
[viii] http://www.berkeleywellness.com/healthy-community/environmental-health/article/sounding-noise
[ix] http://healthliving.today/low-humidity-and-your-health/
[x] https://www.osstf.on.ca/services/health-safety/information-bulletins/inadequate-ventilation-and-high-co2-levels.aspx
[xi] https://blog.millikencarpet.com/4-key-elements-of-modern-classroom-design
[xii] http://luxreview.com/article/2015/01/swedish-school-hopes-bright-classroom-lights-boost-student-performance
[xiii] https://toronto.ctvnews.ca/poor-air-quality-in-toronto-schools-could-impair-learning-environment-1.2219342
[xiv] https://www.noao.edu/education/QLTkit/ACTIVITY_Documents/Safety/LightLevels_outdoor+indoor.pdf
[xv] https://www.ccohs.ca/oshanswers/chemicals/chem_profiles/carbon_dioxide.html

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[xvi] http://www.ncceh.ca/documents/practice-scenario/carbon-dioxide-indoor-air
[xvii] https://www.osstf.on.ca/services/health-safety/information-bulletins/inadequate-ventilation-and-high-co2-levels.aspx