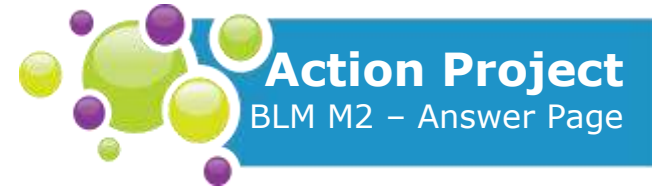


# Living Space

## Understanding Indoor Environments

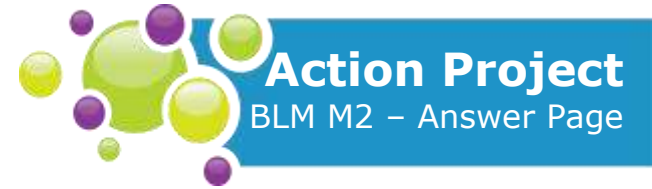


	Temperature	Relative Humidity	Carbon Dioxide	Light	Background Noise
Metric Unit of Measurement	Celsius (°C)	% (water vapor in air compared to what it can hold at that temperature)	ppm (parts per million)	Lumens (lm): Total quantity of visible light  Lux (lm/m <sup>2</sup> ): Light on surface <sup>i</sup>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



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

<sup>i</sup> <https://sustainabilityworkshop.autodesk.com/buildings/measuring-light-levels#flux-intensity>

<sup>ii</sup> <https://www.thealternativedaily.com/dry-heat-humidity-better-good-health/>

<sup>iii</sup> <https://www.dhs.wisconsin.gov/chemical/carbondioxide.htm>

<sup>iv</sup> <https://www.dhs.wisconsin.gov/chemical/carbondioxide.htm>

<sup>v</sup> <http://nationalpost.com/health/too-much-carbon-dioxide-may-cloud-our-thinking>

<sup>vi</sup> <https://blog.millikencarpet.com/4-key-elements-of-modern-classroom-design>

<sup>vii</sup> <http://www.independent.co.uk/news/education/schools/brightly-lit-classrooms-hamper-ability-of-pupils-to-concentrate-401510.html>

<sup>viii</sup> <http://www.berkeleywellness.com/healthy-community/environmental-health/article/sounding-noise>

<sup>ix</sup> <http://healthliving.today/low-humidity-and-your-health/>

<sup>x</sup> <https://www.ossf.on.ca/services/health-safety/information-bulletins/inadequate-ventilation-and-high-co2-levels.aspx>

<sup>xi</sup> <https://blog.millikencarpet.com/4-key-elements-of-modern-classroom-design>

<sup>xii</sup> <http://luxreview.com/article/2015/01/swedish-school-hopes-bright-classroom-lights-boost-student-performance>

<sup>xiii</sup> <https://toronto.ctvnews.ca/poor-air-quality-in-toronto-schools-could-impair-learning-environment-1.2219342>

<sup>xiv</sup> [https://www.noao.edu/education/OLTKit/ACTIVITY\\_Documents/Safety/LightLevels\\_outdoor+indoor.pdf](https://www.noao.edu/education/OLTKit/ACTIVITY_Documents/Safety/LightLevels_outdoor+indoor.pdf)

<sup>xv</sup> [https://www.ccohs.ca/oshanswers/chemicals/chem\\_profiles/carbon\\_dioxide.html](https://www.ccohs.ca/oshanswers/chemicals/chem_profiles/carbon_dioxide.html)



Exploring the Optimal Environmental Conditions for Life

# Living Space

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<sup>xvi</sup> <http://www.ncceh.ca/documents/practice-scenario/carbon-dioxide-indoor-air>

<sup>xvii</sup> <https://www.osstf.on.ca/services/health-safety/information-bulletins/inadequate-ventilation-and-high-co2-levels.aspx>

