Ready to learn in warm and hot weather

Heat, learning and behaviour: the facts

- Optimum learning temperatures for children are around 20°C – lower than for adults (slightly higher temperatures may be more suitable for very small or less mobile children)[i].
- A study on disruption to children's learning experience in Southampton, UK, found that summer heat had the largest detrimental impact of the nine factors studied[ii].
- Government research suggests that there is a cognitive impairment risk in 66% of classrooms, rising to 92% by 2050 with no adaptation[i].
- Impacts worsen as indoor temperatures increase. Research shows a 2% improvement in task speed per 1°C reduction from 25°C to 20°C[iii].
- One study found that taking an exam on a 32°C day leads to around 10% lower likelihood of passing compared to a 22°C day[iv].
- High temperatures affect behaviour, cognition, health (both physical and mental) and attendance[iii].
- All forms of learning, particularly complex tasks, are negatively impacted by warm and hot weather[i].
- During hot weather, both adults and children are likely to be more lethargic, irritable and to have impaired decision making, reducing quality and quantity of learning and increasing risk of conflict[v].
- Children have a lower comfort temperature and higher sensitivity to temperature changes[i], so a room that is comfortable for a teacher may not be for a child or teenager. Individuals will all have different tolerances to heat.
- Around 80% of window operation is carried out by teachers, who have a higher comfort temperature than children[i].
- Some students are particularly susceptible to high temperatures – see 'Respond to student needs in warm and hot weather' information sheet[iii].

Managing thermal comfort

Most research is focused on temperature levels, and it is important for schools to do what they can to manage temperatures, humidity and airflow, but there is a limit to how much can be achieved with existing school buildings and limited budget.

Thermal comfort is a person's satisfaction with their surrounding thermal environment, generally defined as feeling neither too hot nor too cold. It is influenced by the environmental factors mentioned above (air temperature, humidity, airflow) but also many factors which schools can influence at low or no cost:

- Physical activity – intense activity in hot weather decreases thermal comfort
- Adaptive measures – individuals can adjust their position, clothing etc. to maintain thermal comfort. Young children may need support to be able to adapt, and schools can facilitate older students to adapt by having rules and procedures which recognise the benefits of students being comfortable.
- Clothing – appropriate clothing, and individual ability to have a degree of choice over this, significantly impacts thermal comfort.
- Psychology – having a sense of being listened to and having control has positive benefits for satisfaction, intrinsic motivation and wellbeing, including thermal comfort[vi]

Effective communication, behavioural adaptations and allowing a degree of student autonomy has the potential to have a positive impact on school priorities. This has low or no cost and thermal comfort can be improved even if changes to temperature cannot be achieved.

Tips for improving thermal comfort and learning in hot weather

1. Manage the school buildings and grounds to reduce heat as much as possible

See the 'Managing summer temperatures on your site' information sheet.

2. Empower teachers to make considerate and informed changes

- Making changes to the set-up, content and timing of classes can have a significant impact on thermal comfort at low or no cost.
- Students report that whilst some teachers make changes to improve their thermal comfort, others are unclear about what they are allowed to do or don't act:
  - ✓ Support teachers to understand thermal comfort and how it impacts on learning and
  - ✓ Empower teachers to act to manage their classroom environment and improve thermal comfort with clear guidance and protocols (see resources: 'Teacher classroom actions' and 'Template heat protocol').

3. Use timetabling, buildings and grounds to your advantage

- Late starts or early finishes should generally be avoided during hot weather. Travel will be cooler in the early morning, and schools are likely to be the safest place for students as the day warms.

- Schools may wish to consider being more lenient with lateness if public transport is particularly busy due to extreme weather.
- Temporary, or even more permanent, changes to timetabling to account for higher temperatures and student needs can provide benefits to health, learning outcomes and wellbeing:
  - ✓ Primary schools may find it relatively easy to move physically and mentally demanding subjects to cooler times of the day, and to implement longer breaks in the morning and a shorter lunchtime in hot weather (or for the whole or part of a summer term).
  - ✓ More permanent changes could include rescheduling sporting events to mornings in the summer term, or to typically cooler times of year to avoid summer heat altogether.
- Have a rota for the use of shaded outdoor spaces for teaching – consider if you can use local parks outside of school during summer.
- Know which rooms are hotter and colder and consider rotating classes between rooms.

4. Adapt lesson content in warm weather

- Many schools plan lighter and enjoyable content for the late summer term, but students suggest that not all schools or teachers do so, with PE, food tech and school trips being raised as particular issues:
  - ✓ Switching to lower energy PE lesson options (e.g. walks, yoga) or those that can be carried out in cooler parts of the building or grounds can reduce the impact of hot outdoor temperatures.
  - ✓ Consider planning for summer food tech lessons that teach students how to make food that requires minimal heat and energy.
  - ✓ Consider school trips that are in woodland or other cooler locations.

5. Dress for the heat – uniform codes

- Uniform styles, colours, fabrics and flexibility impact on students' thermal comfort.
- Strict "one size fits all" approaches to uniform or relaxation only in extreme heat are often resented by students, result in students being less ready to learn in hot weather and run the risk of having a disproportionately negative impact on the wellbeing of students with health and sensory needs.

Consider:

- ✓ having official summer uniform items which can be worn all summer (e.g. shorts, short sleeves), or always active uniforms which are designed with comfort, sensory needs and activity in mind and are likely to be more comfortable in hot weather.
- ✓ allowing students not to wear jumpers or blazers once temperatures are above optimum learning temperatures (around 20°C) or during the whole summer term.

- ✓ allowing teacher discretion to vary rules in warmer than average classrooms.
- ✓ exemptions or alternative requirements for students with sensory or health needs (although this may draw unwelcome attention to the students).

6. Water and hydration

- If water access points or times are limited, or students (and staff) feel they are unable to use the toilet as needed, dehydration and heat-related illnesses are more likely.
- Lack of access to water has been raised by Sheffield students at several schools, with reports of insufficient time or facilities to fill water bottles and of at least one school reported to have turned off the water supply for the whole school in response to water fights.
  - ✓ Students and staff should have adequate access to drinking water at all times of year, particularly during warm and hot conditions.
  - ✓ Jugs can be provided in classrooms to minimise disturbance to lessons.
  - ✓ Consideration should be given to the needs of students whose circumstances mean that they may lose, forget or not have access to water bottles – for example water cups or bottles available in class or bottles that can be borrowed.

7. Engage and communicate effectively with students and families

- Involvement in planning changes to rules etc, and clear communication, can help students and families to feel a sense of agency and to know that school is a safe place to be in hot weather.
- Effective communication and engagement will particularly support SEND students and carers, for whom increased temperatures and changes to routine may have a bigger impact.
- Reasoning for changes can be included in learning activities – for example during discussions about climate change or personal health.

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[i] A multi-dimensional approach to thermal resilience for UK schools: quantifying cognitive, comfort and heat strain impacts due to overheating - ScienceDirect

[ii] (PDF) Overheating Risk Evaluation of School Classrooms

[iii] Extreme Heat Exposure is Associated with Lower Learning, General Cognitive Ability, and Memory among US Children - PMC

[iv] Park, J (2018) Hot Temperature and High Stakes Exams: Evidence form New York City Public Schools, JEL Codes: I21, O18, Q54, Q56

[v] (Anderson, 1989; Almås et al., 2019) Almås, Ingvild, Maximilian Auffhammer, Tessa Bold, Ian Bolliger, Aluma Dembo, Solomon M Hsiang, Shuhei Kitamura, Edward Miguel, and Robert Pickmans. "Destructive Behavior, Judgment, and Economic Decision-Making under Thermal Stress", NBER Working Paper No. w25785, 2019. Anderson, Craig A. "Heat and Violence", Current Directions in Psychological Science, 10 (2001), 33–38. — "Temperature and Aggression: Ubiquitous Effects of Heat on Occurrence of Human Violence", Psychological Bulletin, 106 (1989), 74.

[vi] The role of autonomy in school and adolescent wellbeing - ePrints Soton