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Switched On

Lighting for learning in the
secondary school classroom

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CENTRE FOR DESIGN**

Lighting can have a positive impact on pupil wellbeing and achievement in the secondary school classroom. However many educators are unaware of the benefits that better lighting can bring to adolescent learning.

This is partly due to the fact that much of the knowledge about lighting the classroom can only be found in technical papers aimed at engineers, architects and electricians. Schools also face budget constraints in relation to managing their buildings.

***Switched On* is a lighting guide written specifically for secondary school teachers and leaders. Based on the findings of a two-year research study, *Lighting for Learning*, it aims to equip those on the frontline of education with some simple principles and ideas about how to harness the power of light — both natural and artificial — to improve wellbeing and performance in the classroom.**

Changing the light

Over the past 50 years there have been enormous changes in how pupils are taught and how they learn in the secondary school classroom. There have been huge changes too in how classrooms are designed — and in the furniture, layouts and equipment that they use.

But one thing that hasn't changed is the artificial lighting of the learning environment, despite the widespread adoption of new technologies as part of the educational process.

According to a new research study, *Lighting for Learning*, this is a missed opportunity. Better lighting can do a lot to support the needs of teachers and pupils in secondary schools and more attention should be paid to developing alternative ways to light the classroom that consume less energy.

Most current lighting solutions for schools are based on economic and technical considerations — and are dictated by rigid and inflexible lighting codes. As one expert put it, 'They are treating light as a dose in intensity and spectral composition.'¹ The *Lighting for Learning* study gives a different perspective, one that takes a more humanistic approach and considers the biological and psychological needs of both pupils and teachers.

A variety of research methods were used as part of the study: a review of literature on school design, light, health and educational technologies; interviews with experts in the field; site visits and observations conducted at schools in London, Norway and Hong Kong; participatory workshops held with teachers and pupils; and, finally, a series of practical lighting experiments in a London classroom

to collect feedback. This body of work has informed the ideas discussed in this publication.

The *Lighting for Learning* study was conducted by Research Associate Amanda Buckley at The Helen Hamlyn Centre for Design, Royal College of Art, with the support of the Megaman Charity Trust Fund.

The Helen Hamlyn Centre for Design, Royal College of Art

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www.hhcd.rca.ac.uk

Megaman Charity Trust Fund

Megaman Charity Trust Fund was established in 2008 in recognition of the role played by the private sector in meeting the social needs of the community. Its support focuses on two key areas: education and environmental protection. It is funded by Neonlite International Holdings Ltd, the parent company and owner of the Megaman trademark which is renowned for its innovative energy-efficient lighting products.

www.megamanlighting.com/en

For more information on *Lighting for Learning* please contact: hhcd@rca.ac.uk

Impact on wellbeing

Lighting can have a profound impact on mood, motivation and behaviour.

When it comes to the classroom, studies show that lighting conditions can have positive and negative effects on pupil performance.² Lighting affects mood, motivation and behaviour, all of which underpin the learning process. So we need to take it seriously.

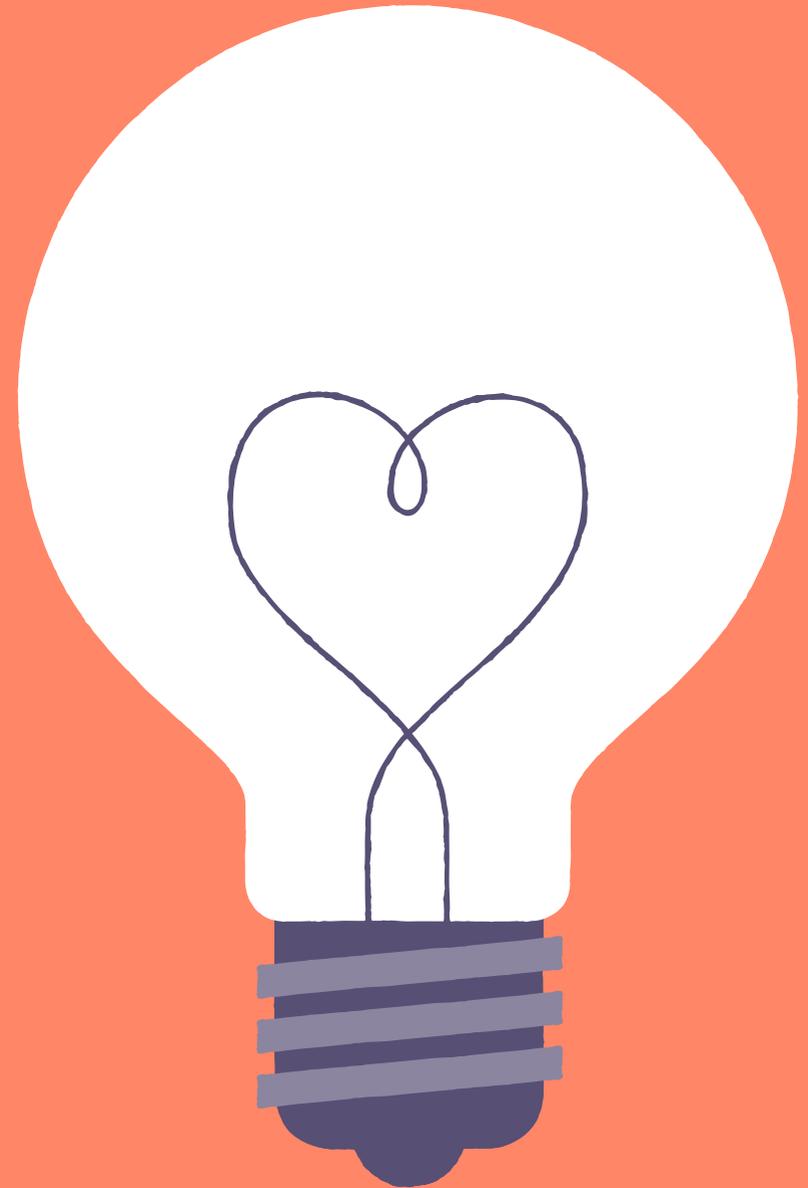
Lighting has a profound impact on human health, not only from a visual standpoint but also from a biological one. Light enters the eye and stimulates the retina, sending nerve signals to the brain; these signals are sent to both the visual and non-visual centres of the brain. The non-visual centres control basic biological functions such as hormone secretion, core temperature, metabolism, reproduction, memory and emotion.³ Light exposure is also what sets our circadian rhythms —

our internal clock that tells us what time it is and whether we should be awake or asleep.

The circadian rhythm of an adolescent is different to that of an adult. Adolescents tend to go to sleep much later; therefore when they rise early for school, their sleep-wake cycle is being disrupted. It is estimated that 70 per cent of adolescents get insufficient sleep; this can lead to depression, behavioural problems and poor performance in school.⁴

Shade is the counterpart of light. Without one, you can't have the other. Light and shade together create visual texture. The effect of texture is often overlooked but is an important visual cue that helps people make sense of their physical space and promotes mental stimulation. This affects mental attitude, which in turn influences attentiveness and performance.

It is also important to keep in mind that both adults and adolescents occupy the same space in classrooms and, due to age differences, have different visual needs.⁵



Work with natural light

Bring as much natural light into the classroom as possible.

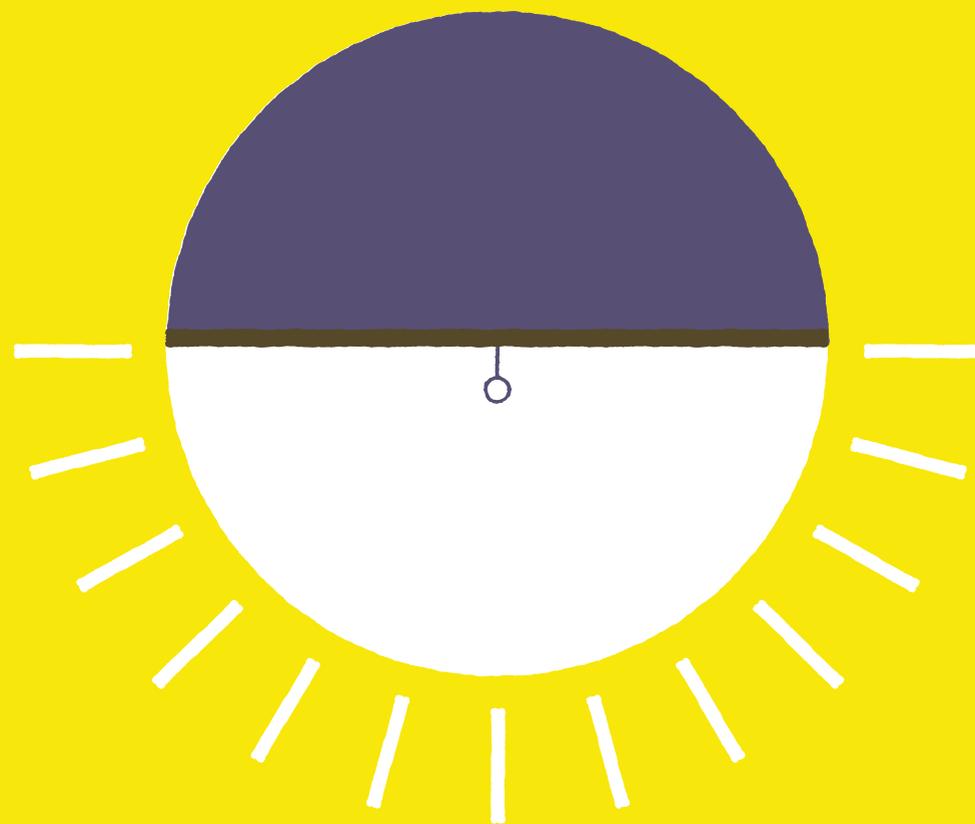
There are two types of light: natural light and artificial light. The main difference between the two is that natural light is ever changing, while artificial light is static. Natural light has a considerable effect on our overall wellbeing. It drives our circadian rhythms and some people can be badly affected when they are deprived of natural light over long periods of time, which can result in depression.

It is important to bring in as much natural light into the classroom as possible. In our research, both pupils and teachers expressed how important external views are and how they value natural light, as this provides a visual connection to the world outside. Many pupils indicated that natural light is a key aspect

of their classroom that gives them more energy.

In a lot of the classrooms that we visited, we found the same scenario — the electric lights are on and the blinds are drawn, blocking out natural light. This is usually a reaction to the low visibility of information being projected at the front of the room. Most classrooms today use reflective whiteboards and information and communication technologies such as projectors and smart boards. When these are used with natural light, glare and reflections as well as drastically reduced contrast makes information very difficult for pupils to see.

It is important to recognise both the need for natural light and the problems its introduction can cause. Window dressings should be selected with both in mind. One possible solution could be to use window treatments that filter natural light and reduce glare. This will help reduce the use of electric lighting, resulting in lower energy costs.⁶



Set-up and re-set

Teachers can play a big role in making the learning environment work effectively.

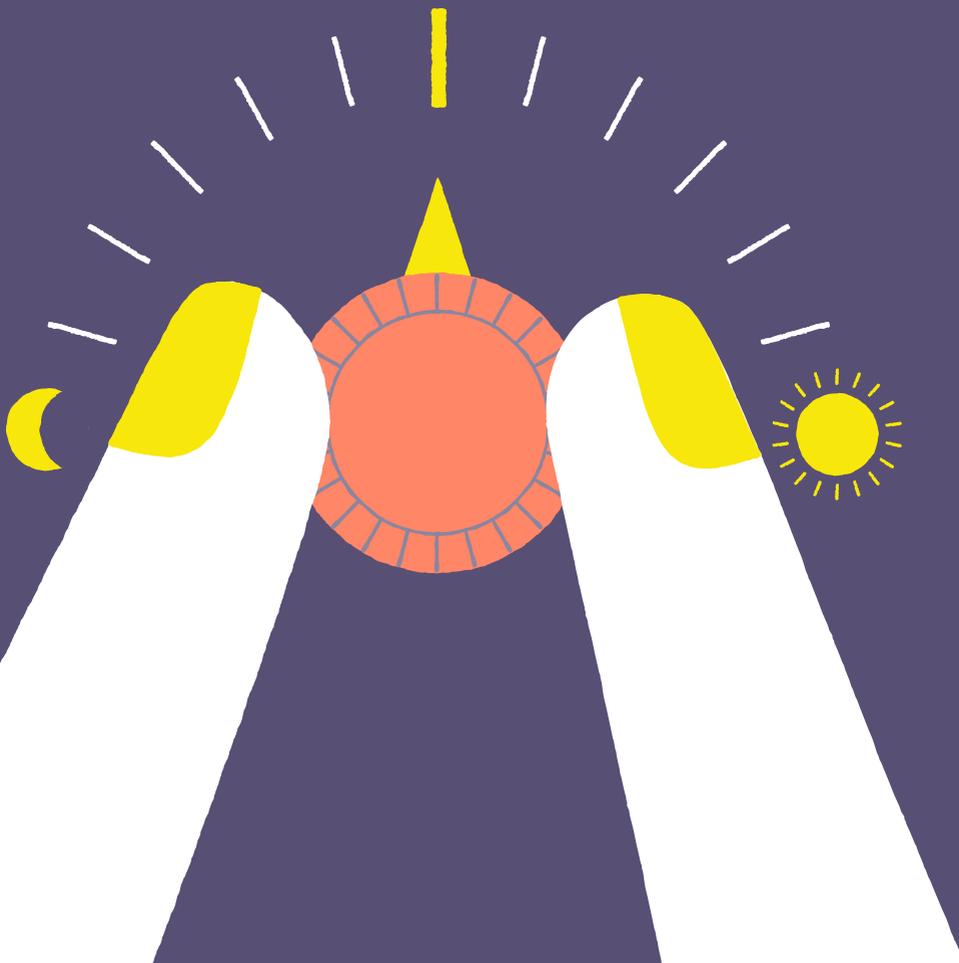
How the teacher perceives the classroom environment is critical to understanding the relationship between pupil behaviour and the space in which learning takes place.⁷ Taking a proactive attitude to making the environment work better for the learning process is important.

During our research in classrooms, we found that typically the only time teachers altered the natural and artificial light was when it was causing problems. Usually this resulted in turning the lights off or blocking out natural light. This approach meant that when they entered a room and prepared to teach in it, teachers did not usually adjust the lighting. They left the lighting as they found it regardless

of the activities that were about to take place there. The next lesson would do the same thing and so the cycle would continue over the school day.

Today's teachers have incredibly demanding jobs; they are busier than ever and don't always have time to think about optimising their environment. However it is recommended that at the end of each class, projectors and smart boards are switched off or put on to sleep mode so that they are not emitting light. Window blinds should be raised or opened so as much natural light as possible is allowed in, and electric lights should be turned off.

By doing this, the classroom is being 're-set'. This will ensure that when the teacher comes in or the next lesson starts, they will 'set-up' by making the adjustments they need, based on the displays and technologies being used and activities taking place. Implementing protocols like this can also help reduce energy use.



Caution: low visibility

Technology and lighting need to be considered together otherwise pupils will miss out.

New technology is playing a transformative role in the classroom landscape — in how teachers communicate information and how pupils learn. Yet most technology isn't installed in the classroom with any consideration of educational needs, layout or how the room is lit.

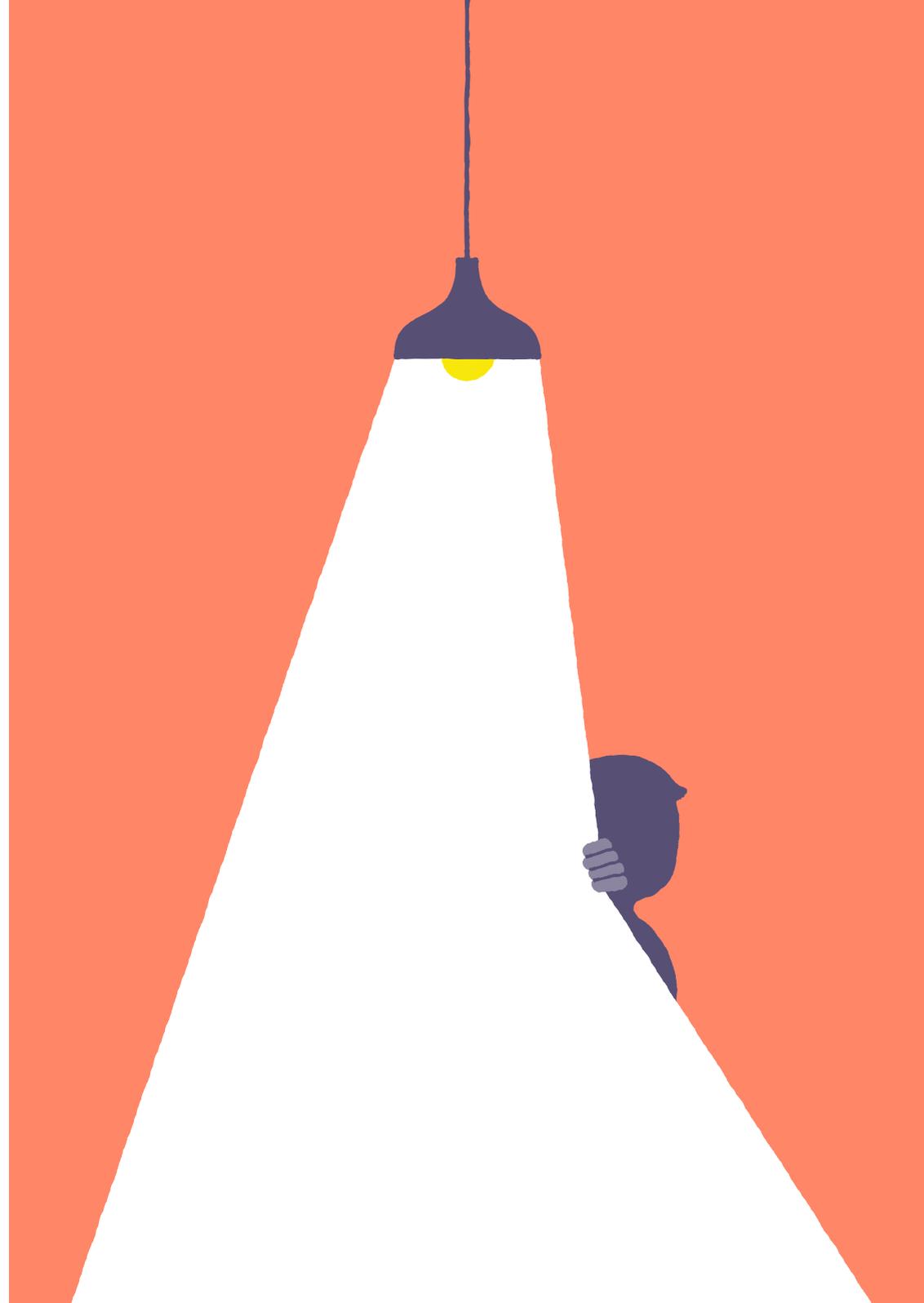
During our research, teachers and pupils repeatedly told us that lighting glare on whiteboards was a huge issue and made it very difficult to see information. Similarly, visibility and contrast of content projected onto screens over long distances was reduced significantly by light.

Multiple information display tools are often used simultaneously and yet each has different lighting needs in order to make information

visible. We also observed that lighting actually affects the way teachers adopt technology as a teaching and learning tool, and that those teachers with a command over the display technologies being used at the front of the room seemed better able to engage pupils.

We saw a number of different technologies being used in the classroom in combination with a variety of lighting solutions, from downlights to fluorescent tubes and LED tubes. But what we didn't see was an approach in which educational technologies and lighting were considered with each other in mind. There seemed to be a big disconnect between the two.

This needs to change or educational needs will suffer. Technology is advancing faster than the built environment can accommodate; therefore lighting solutions should be designed for flexibility and control, and limits should be set on display surfaces and screens to reduce glare, reflections, visual discomfort and the inability to see information.



Inclusivity and group work

With collaborative learning on the rise, it is becoming more important to light people.

There is a shift in the classroom from independent learning towards more engaging and collaborative learning. This means that there is more pupil-to-teacher and pupil-to-pupil interaction. Teachers are also using less didactic styles of teaching and engaging more with pupils, moving around the classroom while they teach.

While individual learning remains significant and ever-present, this shift towards a more collaborative and group learning environment has implications for lighting. In particular it is increasingly important to light people and faces, and to light the environment appropriately to support interaction.

In every classroom we observed, the ceiling plane was made up of an indiscriminate, unvaried grid of lights; but in

most classrooms the desks and pupils are arranged in groups. This inevitably results in some pupils sitting in under-lit areas of the classroom. Within collaborative learning environments, the traditional lighting grid starts to create areas of exclusivity – some pupils are adequately lit while others are not. This makes it difficult for some pupils to read facial cues and permits others to hide and disengage from the lesson.

In a classroom lighting experiment we conducted, a light was placed over each group of pupils. Both teachers and pupils found this preferable as it created ‘learning hubs’ and helped focus the attention of pupils.

In order to create a more inclusive learning environment that supports group work, the traditional lighting grid should be reconsidered as part of school building renovations. As a more short-term measure, teachers may want to consider the arrangement and layout of the room, placing groups of pupils under the existing lights where possible. It is also important to make sure the teacher’s own work area in the classroom is lit appropriately.



Raise the bar

Setting standards allows the focus to be put on learning.

The classroom environment can be directly linked to pupil performance; if planned and designed well, it can increase learning progression by up to 25 per cent.⁸ The built environment also has a direct effect on behaviour and lighting can be a big factor in this, especially in relation to how much stimulus is provided.

We conducted workshops with secondary school pupils to better understand their perceptions of light in the classroom. Common issues that emerged were flickering of lamps, glare on whiteboards, poor colour rendering and lights being too bright, resulting in headaches, fatigue, boredom and lack of engagement.

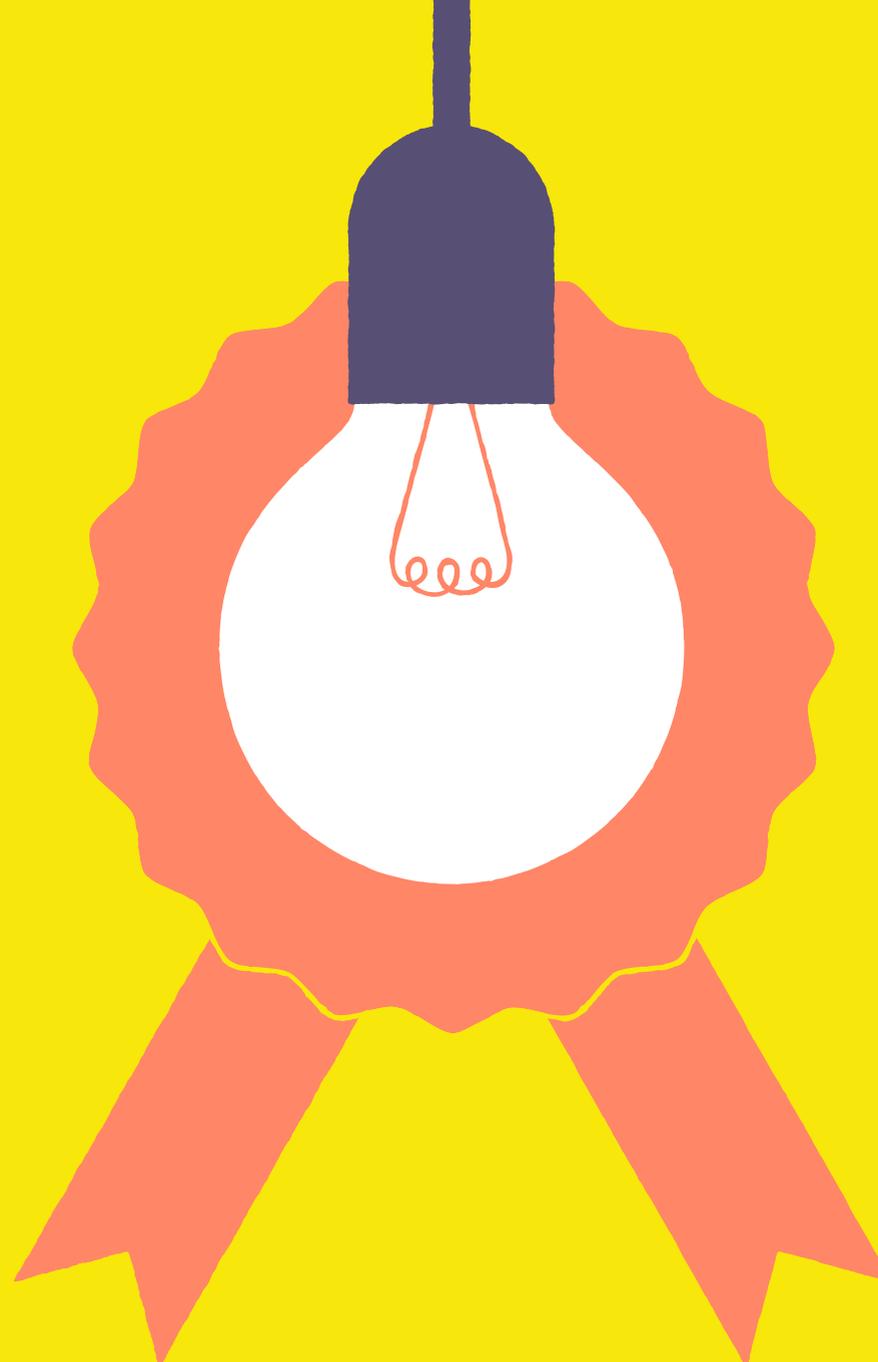
Lighting clearly presents a number of barriers to learning. Therefore it is important to set standards for what is acceptable in classrooms and what is not.

Here are some elements for which basic standards should be set:

- Window treatments
- Technology displays
- Lamp and fixture specifications (including colour temperature, colour rendering, lumens, control gear, etc)
- Lighting controls
- Surface materials (high reflectivity and low reflectivity)
- Location of displays such as whiteboards and technology in relation to architectural elements.

It is also important to carry out regular maintenance on the lighting as well as other elements in the classroom, for instance: replacing burnt out lamps and lamps that flicker; fixing control gear that buzzes; making sure the window curtains or blinds are functioning properly; and ensuring technologies are working to their fullest potential.

Setting standards does not mean that each classroom has to have the same solution. Rather, it is about following lighting guidelines and holistic principles that will allow pupils and teachers to focus on what is really important — learning.



Things to remember



Here are some key points to improve lighting for learning.

When teaching in the classroom:

- Set-up and re-set: at the end of each class, raise or open the blinds and turn the lights off
- Let natural light in
- Make sure pupils are well lit, and no one is left in the dark
- Adjust natural and artificial light to suit the activities taking place and the technologies being used.

When specifying elements for the classroom:

- Set standards and make sure they are known to teachers and other key staff, including maintenance staff
- Use window treatments that filter light or reduce glare
- Install window treatments that are easy to use and quick to open and close
- Place a lamp over the whiteboard, preferably with a diffused cover; this is especially important if it is used in conjunction with long-throw projectors

- Specify display screens with non-reflective surfaces — this includes whiteboards, projection surfaces and electronic display screens as well as computer screens
- Consider controls to provide long term flexibility — daylight and motion sensors are a good strategy for saving energy but are often inappropriate for classroom activities, whereas dimming controls are ideal
- Lamps should be specified that have the required lumen output, luminous efficacy, colour properties, lumen maintenance and life; it is also preferable to use diffusing covers to disperse light and shield the glare from bare lamps.

When maintaining elements in the classroom:

- Set up a maintenance schedule for regular inspections
- Set up strategies for repairs and replacements
- Set up a communication channel between teachers and those in charge of maintenance, so that issues can be resolved in a timely manner.

To adopt an activity-based lighting strategy, here are some examples to help you make the right choices.

Individual and/or group work without displays*

Activities might include but are not limited to exam taking, discussion, reading and writing.

Natural Light: Since whiteboards and information and communication technologies are not being used, natural light is unlikely to create any conflicts, so the more natural light let into the room and views to the outside the better.

Artificial Light: If electric lights are adjustable with controls or switches, the lights should be adjusted to supplement and balance the natural light, while still providing good working light for all pupils.

Displays and Technology: Display technologies that emit light, such as projectors, smart boards and computers, should be switched off while not in use.

Here's a scenario: A teacher enters the classroom to teach English Literature; today the pupils will be taking an exam. The blinds are fully open and the lights are turned off.

The pupils' tables are arranged in groups, so the teacher re-arranges them in rows to support individual focus work. Since no displays will be used at the front of the room or elsewhere during the exam, they are all turned off. The row of lights at the front is left off while the others are turned on to provide good working light. At the end of the class the teacher raises the blinds all the way and turns all of the lights off.

Individual and group work with displays*

Activities might include but are not limited to activities, discussion, reading, writing.

Natural Light: Let as much natural light in providing views to the outside as possible. But also, in considering the displays and technologies being used, try to avoid reflections, glare or reduced contrast of projected information.

Artificial Light: Electric light should be used to supplement natural light. However lights above display screens should be adjusted to maximise visibility and minimise visual discomfort.

Displays and Technology: When multiple display screens are being used (this includes static whiteboards and electronic display screens, as well as projectors) they should be lit appropriately as they will require different lighting conditions. Information on all display screens, whether static

or electronic, should be made easily visible to all pupils.

Here's a scenario: A teacher enters the classroom to teach maths; today the pupils will be working in groups of three on maths puzzles. The blinds are fully open and the lights are turned off. The teacher turns on the projector and smart board to display lesson-related information to assist the pupils. Then the teacher turns on the light above the whiteboard that will also be used in today's lesson. The teacher then turns on the main classroom lights. But the contrast of the projected information is too low to see clearly, so the row of lights at the front, where the screen is located, is dimmed. The blinds are pulled down part of the way to minimise reflections on the whiteboard and glare on the smart board. The rest of the lights in the classroom are left on so that pupils have good working light for the activity at hand and so they can see each other as they collaborate on the maths problem they are trying to solve. At the end of the class the teacher raises the blinds all the way and turns all of the lights off.

Display-focused work*

Activities might include but are not limited to watching films or media clips.

Natural Light: Let as much natural light in as possible while providing good visibility for the display media.

Artificial Light: If adjustable, the lights should be dimmed or turned off in some areas. Note: the room should still be lit to a degree and not completely dark.

Displays and Technology: The displays or screens in use should be the primary focus.

Here's a scenario: A teacher enters the classroom to teach history; today the pupils will be watching a short film on the industrial revolution and then working in small groups to answer questions about it. The blinds are fully open and the lights are turned off. The teacher turns on the projector and smart board in preparation for the film. The teacher then turns all of the lights on to welcome the pupils into the classroom and introduce what they will be doing today. The teacher asks one of the pupils to pull the blinds down partially and asks another pupil to dim the lights low but not off. After the film is over, the teacher asks two pupils to raise the blinds most of the way and turn the lights up.

A worksheet is handed out for the pupils to work on. The projector and smart board are left on so clips of the film can be replayed as needed. At the end of the class the teacher raises the blinds all the way and turns all of the lights off.⁹

*** Displays might include whiteboards, smart boards or projected images and video**

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