Science Fair 2025-2026

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Problem - 11/28/2025

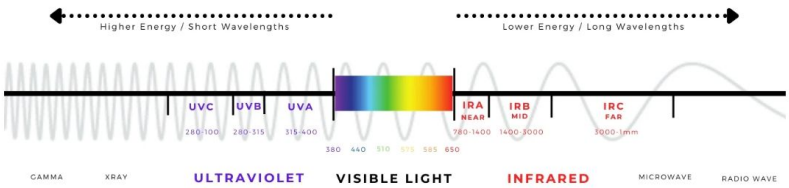
How does light and different colours of light affect your brain and how it functions?

I want to do this project because with technology and phones becoming more and more popular people are on screens more often. This causes people to be exposed to increased levels of blue light and I want to know what that does to the brain. I also wanted to know how other colours of light affect the brain for comparison and to learn more.

The light spectrum. 11/28/2025

- The light spectrum has visible, ultraviolet, and infrared light.
- Light affects our psychology, mood, and wellbeing.
- Visible light is white light and all the colours of the rainbow.
- Light affects most living beings.
- Visible light has 380 nm (nanometers) to 780 nm wavelengths.
- Visible light is the environmental cue for the circadian rhythm.
- Visible light is comprised of red, orange, yellow, green, blue, indigo, and violet light which is also white light.
- The presence of visible light dictates the circadian rhythm in animals.

A guide to the spectrums of light. Healthlighting. (n.d.). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light?srsltid=AfmBOopBfQw_zOOuk3Y72fo7Q1GiIDN4JQvM1dk5H8Pkcaar99CKhi5-



Blue light. 11/28/2025

- Affects the production of melatonin which is a hormone that regulates sleep.
- Highest amounts of blue light in sunlight is during the middle of the day.
- You need high quality blue light in order to regulate the body's circadian rhythm.
- When blue light is exposed to eyes they send a signal to the brains suprachiasmatic nucleus. The suprachiasmatic nucleus regulates the bodies internal clock. That signal tells the body not to make melatonin which keeps you awake and more alert.
- When you are exposed to less blue light the signal it causes is lessened which increases the production of melatonin to tell your body it's time to sleep.
- It's important not to expose yourself to blue light directly before bed as it can disrupt your sleep.
- Blue light has 380 nm - 510 nm wavelengths.
- Keeps our bodies in good health.
- Fundamental and necessary part of the light spectrum.
- Good during the day but bad at night and during the evening.

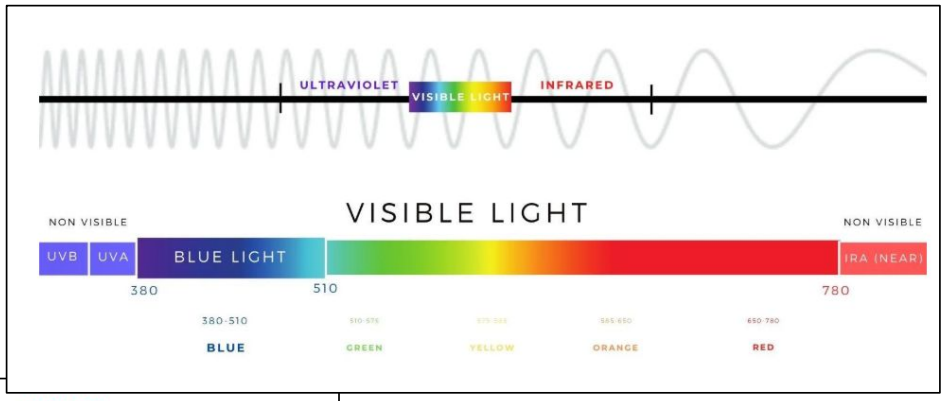
A guide to the spectrums of light. Healthlighting. (n.d.). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light?srsltid=AfmBOopBfQw_zOOuk3Y72fo7Q1GiIDN4JQvM1dk5H8Pkcaar99CKhi5-

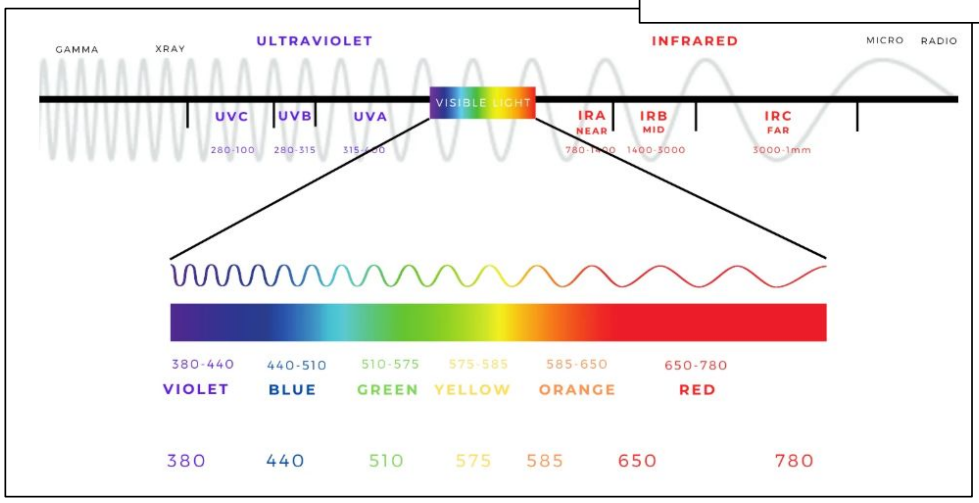
Types of blue light. 11/28/2025

- There are two types of blue light: high energy violet which is also known as blue-violet light, and blue-turquoise light.
- Blue-violet light:
  - 380-450 nm wavelengths.
  - Most of the dangers of LED lighting are because of this part of the spectrum.
  - Can cause damage to the retina.
- Blue-turquoise light:
  - “Healthier” blue light.
  - Stronger influence on the circadian rhythm.
  - 450-500 nm wavelengths.

A guide to the spectrums of light. Healthlighting. (n.d.). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light?srsltid=AfmBOopBfQw_zOOuk3Y72fo7Q1GiIDN4JQvM1dk5H8Pkcaar99CKhi5-

Images. 11/28/2025



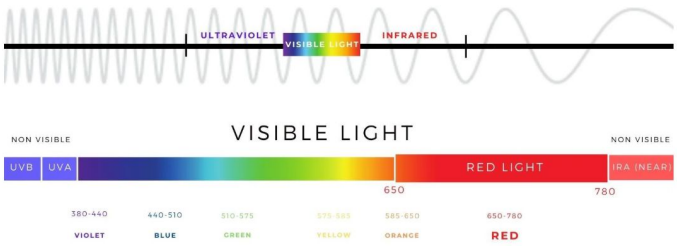


A guide to the spectrums of light. Healthlighting. (n.d.). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light?srsltid=AfmBOopBfQw_zOOuk3Y72fo7Q1GiIDN4JQvM1dk5H8Pkcaar99CKhi5-

Red light. 11/28/2025

- Longer wavelength and lower energy than blue light.
- Red light is more soothing and nourishing.
- No effect on the production of melatonin which makes it a good light for before bed.

A guide to the spectrums of light. Healthlighting. (n.d.). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light?srsltid=AfmBOopBfQw_zOOuk3Y72fo7Q1GiIDN4JQvM1dk5H8Pkcaar99CKhi5-



Ultraviolet light. 11/29/2025

- 200-400 nm wavelengths.
- Invisible light.
- Wavelengths are too short to be seen.
- Broken down into UVA, UVB, and UVC.
- Natural UVC light doesn't reach the earth's surface.
- Overexposure can damage eyes and skin.
- Balance of UV light is good for health.
- Control the synthesis of vitamin D.
- UVA light has 315-400 nm wavelengths.
- UVB light has 280-315 nm wavelengths.
- UVA light is closest to visible light and even overlaps a little bit.
- UVB has shorter wavelengths than UVA light but it also has more energy.
- Overexposure can cause skin cancer, wrinkles, and sunspots.
- UVB does more than UVA to produce vitamin D.

A guide to the spectrums of light. Healthlighting. (n.d.-a). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light

Merriam-Webster. (n.d.). *Synthesis definition & meaning*. Merriam-Webster. https://www.merriam-webster.com/dictionary/synthesis

Ultraviolet light. 11/29/2025

- Causes improved mood due to the production of serotonin which is a neurotransmitter that regulates mood and can reduce symptoms of depression and other mood disorders.
- It's important to get UV light from the sun in the morning.
- UVC has 200-280 nm wavelengths.
- UVC light can kill bacteria.

A guide to the spectrums of light. Healthlighting. (n.d.-a). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light

Infrared light. 11/29/2025, 11/30/2025

- 780 nm to 1 mm wavelengths.
- Invisible to the human eye.
- Red and near-infrared light are the only wavelengths able to penetrate skin. This promotes cell regeneration, tissue oxygenations, and overall health and energy in the cells.
- Used in various medical treatments like pain relief, muscle recovery, and wound treating.
- Infrared A light (also known as near infrared light):
    - 780-1400 nm wavelengths.
    - Range of electromagnetic radiation.
    - Used to stimulate cellular activity and to promote healing in the body.

A guide to the spectrums of light. Healthlighting. (n.d.-a). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light

Benefits of NIR/IR-A (Near infrared light). 11/30/2025

- Pain relief:
  - Increasing blood flow to pained areas.
  - Promoting the release of endorphins which are hormones that get released when you body feels pain or stress. They are produced in your brain and act as messengers in your body.
- Reduced inflammation:
  - NIR has anti-inflammatory effects which can help with conditions like arthritis and tendinitis.
- Improved circulation:
  - Increases the formation of blood vessels.
- Improved skin health:
  - Improve the appearance of skin.
  - Stimulating collagen production.
  - Reducing fine lines and wrinkles.
  - Promoting wound healing.
- Enhanced athletic performance:
  - Improve muscle recovery.
  - Reduce muscle fatigue.

A guide to the spectrums of light. Healthlighting. (n.d.-a). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light

C. C. medical. (2025, November 14). *Endorphins: What they are and how to boost them*. Cleveland Clinic. https://my.clevelandclinic.org/health/body/23040-endorphins

Infrared B and Infrared C. 11/30/2025

Infrared B

- 1400-3000 nm wavelengths.
- Used in photobiomodulation therapy since it has better tissue penetration. This makes it more effective in treating deeper tissues like bone and muscle thanks to its longer wavelengths.
- Also known as MIR

A guide to the spectrums of light. Healthlighting. (n.d.-a). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light

Infrared C

- 3000 nm to 1 mm wavelengths.
- Though not as common it is used in photobiomodulation therapy like MIR.

A guide to the spectrums of light. Healthlighting. (n.d.-a). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light

Light and memory. 12/4/2025

- Our brains are designed to learn things during the day and store it in long term memory during the night.
- Blue light promotes alertness and cognitive function.
- When exposed to dim light rather than the day/night light cycle it can impact your memory and impair your learning.
- Indoor lights are not bright enough for daytime but too bright for night time which can have impact on your brains.
- Mistimed light exposure can disrupt hormone production, lead to elevated stress levels, insomnia, and mood disorders.

Mills, B. (2021, March 11). *How does light exposure affect memory?*. Alzheimer's Drug Discovery Foundation. https://www.alzdiscovery.org/cognitive-vitality/blog/how-does-light-exposure-affect-memory

The spectrum of sunlight at different times. 12/4/2025, 12/5/2025

- Sunlight is white light with all the colours but there is more blue light in the morning and more red light in the evening. Bright white LEDs are similar with more blue light like in the morning and near mid-day. Yellowish looking LEDs have more red light like during the afternoon and evening.
- It's good to get more blue light in the morning especially from sunlight and less light in the evening and red light near sunset.
- When our bodies receive light other than what the circadian rhythm is used to it can have negative health outcomes.

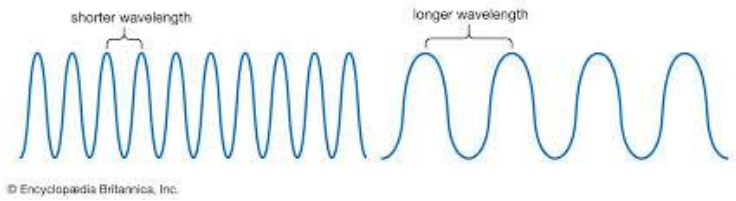
Mills, B. (2021, March 11). *How does light exposure affect memory?*. Alzheimer's Drug Discovery Foundation. https://www.alzdiscovery.org/cognitive-vitality/blog/how-does-light-exposure-affect-memory

Mills, B. (2021, March 11). *How does light exposure affect memory?*. Alzheimer's Drug Discovery Foundation. https://www.alzdiscovery.org/cognitive-vitality/blog/how-does-light-exposure-affect-memory

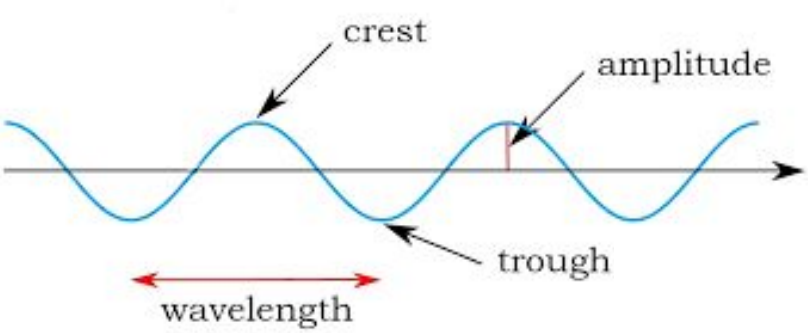
Wavelengths. 12/5/2025

- A wavelengths is the distance between two corresponding points in two waves.
- When you see the Greek letter lambda (λ) it usually is referring to a wavelength.
- Distance between crest and crest or trough and trough.

Wavelength | *definition, formula, & symbol* | *britannica*. Britannica. (2025, November 21). https://www.britannica.com/science/wavelength

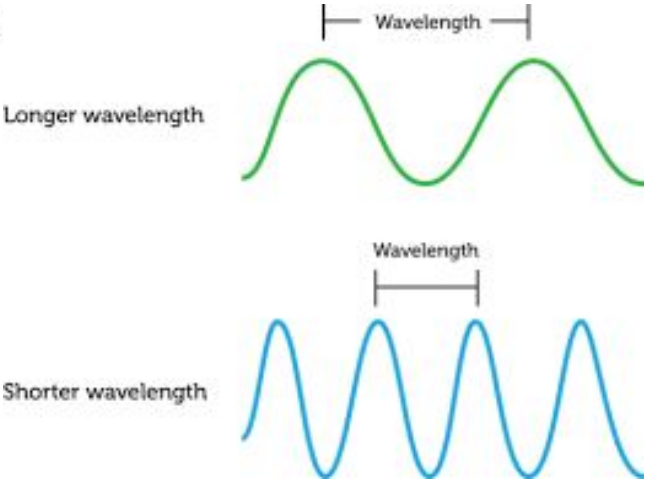


Images of wavelengths. 12/5/2025, 12/9/2025



CK12-Foundation. (n.d.). https://flexbooks.ck12.org/cbook/ck-12-middle-school-physical-science-flexbook-2.0/section/16.6/primary/lesson/wavelength-ms-ps/

Admin. (2018, May 19). *What is wavelength? explained in plain English with an illustration.* Quantum Physics Lady. https://quantumphysicslady.org/glossary/wavelength/



Can blue light shorten lifespan? 12/11/2025, 12/12/2025

- Prolonged exposure to artificial light is an increasing health concern.
- People are being exposed to more blue light from LEDs.
- Studies were done that showed that flies that were in a 12 hour blue light and 12 hour darkness cycle had a shorter lifespan than flies that were exposed to 24 hour darkness or white light with blue light blocked. Adult flies in 12 hours of blue light per day increased production of aging phenotypes, damage to retinal cells, death in nerve cells within the brain, and impaired motion.

Nash, T. R., Chow, E. S., Law, A. D., Fu, S. D., Fuszara, E., Bilska, A., Bebas, P., Kretzschmar, D., & Giebultowicz, J. M. (2019, October 17). *Daily Blue-light exposure shortens lifespan and causes brain neurodegeneration in drosophila*. Nature News. https://www.nature.com/articles/s41514-019-0038-6

Nash, T. R., Chow, E. S., Law, A. D., Fu, S. D., Fuszara, E., Bilska, A., Bebas, P., Kretzschmar, D., & Giebultowicz, J. M. (2019, October 17). *Daily Blue-light exposure shortens lifespan and causes brain neurodegeneration in drosophila*. Nature News. https://www.nature.com/articles/s41514-019-0038-6#citeas

The psychological impact of light and colour on the brain. 12/13 2025

- Light can decrease depression scores.
- When exposed to new environments our brains try to link it to an already existing memory to understand the new environment better.
- Brightness saturation and hue and the three main qualities of colour light.
- Brightness:
  - The amount of light given off by something.
  - It is recorded in lux.
  - Brighter light can intensify emotions.
  - Dim light can stabilize emotions which can make it easier to make rational decisions.
- Saturation:
  - The intensity of colour.
  - More saturated colours can have amplifying effects on emotions.
  - Muted colours can dampen emotions.
- Hue:
  - Colour or shade.
- Natural light can make you happier.
- The effect on mood caused by the colour of light vary depending on hue.

Romocean, M. (2025, November 26). *The psychological impact of Light & Color: TCP Lighting Solutions*. TCP Lighting. https://www.tcpi.com/psychological-impact-light-color/

The psychological impact of light and colour on the brain. 12/13 2025

- Brain cells tend to be the most sensitive to blue light wavelengths and least sensitive to red light wavelengths.
- Red light in the evening can improve mental health.
- Better sleep at night leads to improved cognition and overall mental wellbeing.
- Red light increases levels of melatonin.
- A disrupted circadian rhythm can affect your limbic system which regulates emotions and negatively affect your emotions.

Romocean, M. (2025, November 26). *The psychological impact of Light & Color: TCP Lighting Solutions*. TCP Lighting. https://www.tcpi.com/psychological-impact-light-color/

Light pollution and the brain. 12/13/2025

- Light pollution is disruptive to the natural environment and cycles of life here on earth.
- Light pollution could affect many systems in our bodies.
- There are also indirect positive associations between light pollution and things like depression, cancer, and sleep disturbances.
- Light pollution can disrupt the circadian rhythm.
- Disruption of the circadian rhythm can be linked to depression, insomnia, and cancer.
- Blue light can damage retinal cells.

Merced, A. D. L. (2024, April 9). *Light pollution: How it affects the brain*. Remedy Psychiatry, Inc. https://remedypsychiatry.com/light-pollution-how-it-affects-the-brain/

LED light. 12/14/2025

- LED's can cause macular degeneration and mitochondrial dysfunction (when the mitochondria isn't functioning).
- LED's are light emitting diodes.
- LED's are electronic light sources.
- LED's are white light but have lots of blue light in them.
- Blue light is the main signal that tells our body if it's day or night.
- Blue light can cause a variety of eye diseases like cataracts, dry eyes, and AMD.

The hidden dangers of leds – and the healthiest type of home lighting. Conscious Spaces. (n.d.). https://consciousspaces.com/en-us/blogs/science/the-hidden-dangers-of-leds-and-the-healthiest-type-of-home-lighting

The visible spectrum/colour. 12/14/2025

- Colour is a property of light.
- Light is a form of electromagnetic radiation.
- Light is part of the electromagnetic spectrum.
- Light is the only part of the electromagnetic spectrum that is visible.
- Infrared waves can be felt as heat.
- Colours of the spectrum are called chromatic colours.
- Nonchromatic colours which are like brown and pink.
- Achromatic colours can refer to black, grey, and white.
- The primary colours of light are red, blue, and green.

Colour - visible spectrum, wavelengths, hues | Britannica. (n.d.). https://www.britannica.com/science/color/The-visible-spectrum

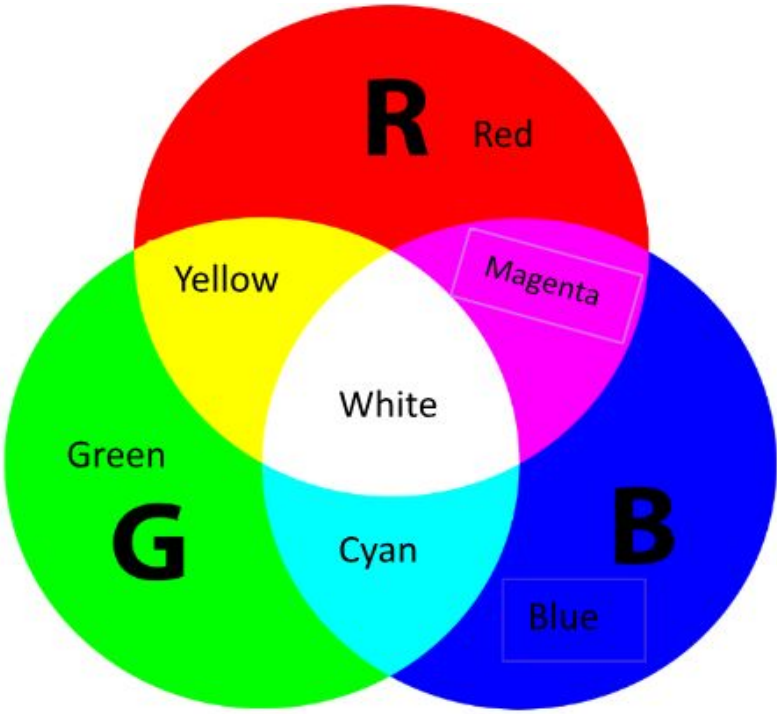
Mixing colours of light. 12/14/2025

- When the primary colours of light are added together equally they make white. The full spectrum can also make white.
- Mixing red, blue, and green light is called additive colour mixing.
- Additive colour mixture:
  - Additive colour mixing is the addition of spectral components which are colours of light visible to the human eye.
  - Occurs when beams of light are being combined
- Subtractive colour mixture:
  - Subtractive colour mixing is where colours of the spectrum get removed or absorbed from a colour of light.

Colour - visible spectrum, wavelengths, hues | Britannica. (n.d.). https://www.britannica.com/science/color/The-visible-spectrum

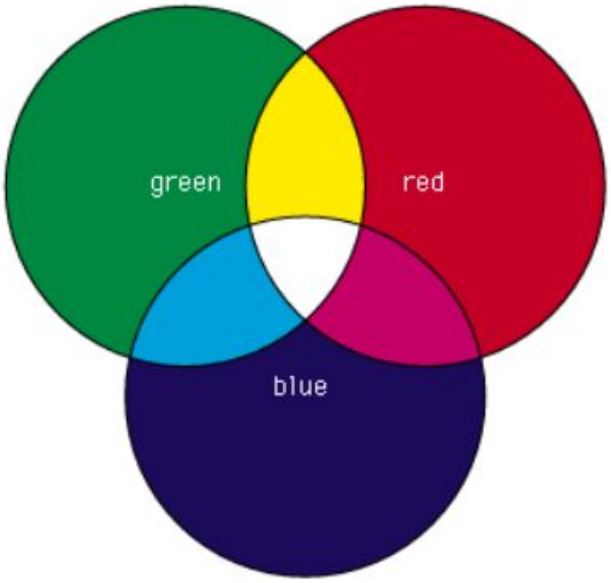
Explanations. StudySmarter UK. (n.d.). https://www.studysmarter.co.uk/explanations/physics/waves-physics/spectral-colour/

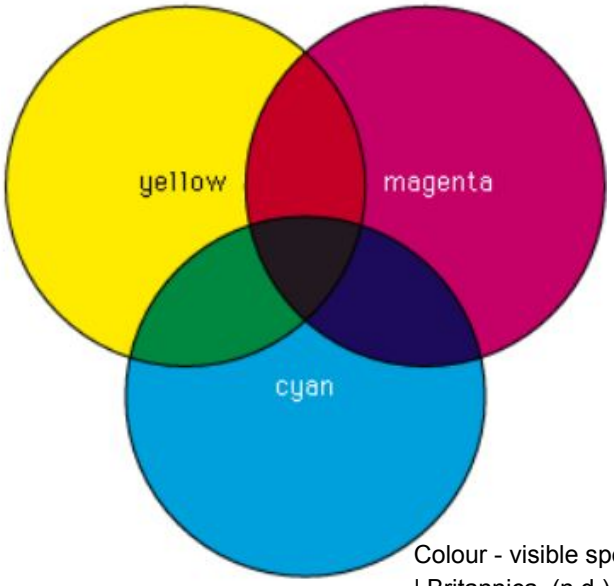
Mixing colours of light. 12/14/2025



Mixing colors of light - lesson. HelpTeaching.com - Free Printable K-12 Worksheets. (n.d.). https://www.helpteaching.com/lessons/1506/mixing-colors-of-light

Additive and subtractive colour mixing. 12/14/2025

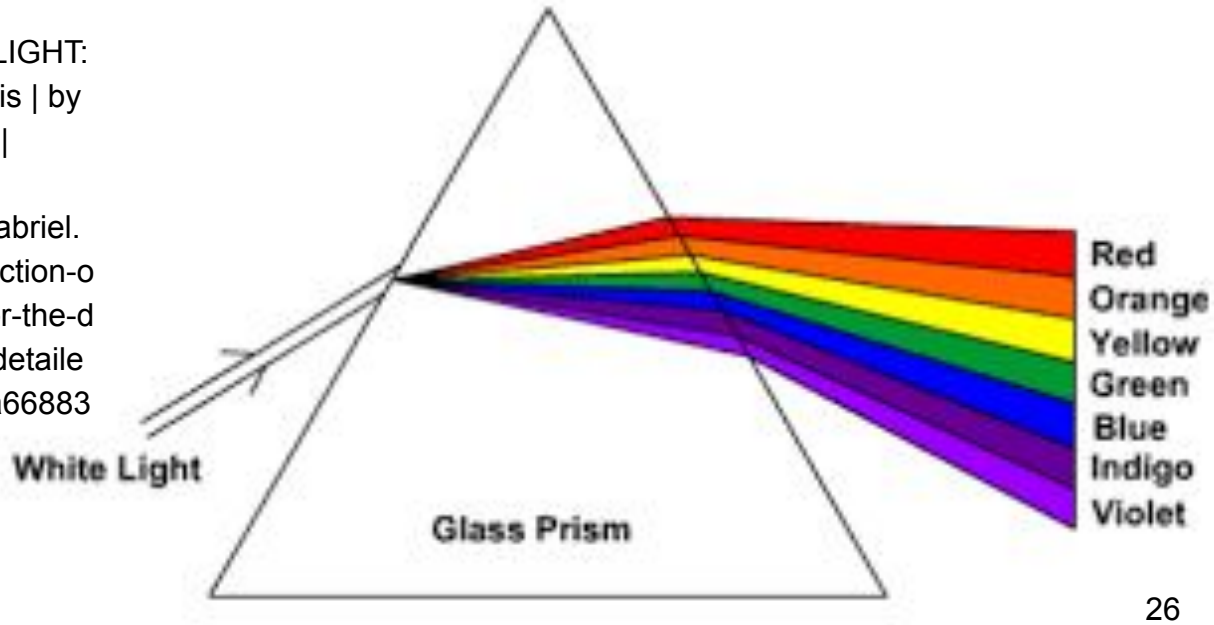




Colour - visible spectrum, wavelengths, hues | Britannica. (n.d.). https://www.britannica.com/science/color/The-visible-spectrum

Full spectrum with prism. 12/14/2025

Reproduction of Newton’s experiment for the DECOMPOSITION OF LIGHT: A detailed optical analysis | by Gabriel Borges Macedo | Medium. (n.d.-b). https://medium.com/@gabriel.macedo.brother/reproduction-of-newtons-experiment-for-the-decomposition-of-light-a-detailed-optical-analysis-9015a66883b1



Impact of light on cognitive functions. 12/19/2025

- Electric light has been causing an increasing amount of energy consumption.
- Most LEDs are white LEDs (WLEDs) which have lots of blue light.
- Blue lights can improve the mood and sleep quality of alzheimer's patients.
- Blue light blocking glasses can filter out more harmful blue light wavelengths. Those glasses specifically can improve eye strain, fatigue and dryness that can be associated with LED and excessive screen use.
- LEDs have their benefits of increasing alertness and allowing you to stay awake longer than the daylight provides although that may not always be a benefit.
- Memory performance increases after being exposed to WLEDs.

Impact of domestic white LED light on cognitive functions and amelioration of blue light blocking lens (BBL) on healthy adults. Neurobiology of Sleep and Circadian Rhythms. (2025, May). https://www.sciencedirect.com/science/article/pii/S2451994425000082

Impact of light on cognitive functions. 12/19/2025

- Exposure to blue light for 30 minutes may enhance working memory.
- Exposure to bright white light could have improvement on the brain's functions, however those benefits wear off after the light exposure. Although they wear off they leave lasting improvements in the brain.
- Blue light blocking glasses have potential risks as well as some limitations.
- Alertness is enhanced if you are exposed to WLEDs for a while. (at least 30 minutes).

Impact of domestic white LED light on cognitive functions and amelioration of blue light blocking lens (BBL) on healthy adults. Neurobiology of Sleep and Circadian Rhythms. (2025, May). https://www.sciencedirect.com/science/article/pii/S2451994425000082

Impact of light on cognitive functions. 12/19/2025

- In the experiment exposure to blue light for 30 minutes resulted in better memory. If you perform a task without prior exposure to light it does not improve alertness.

Impact of domestic white LED light on cognitive functions and amelioration of blue light blocking lens (BBL) on healthy adults. Neurobiology of Sleep and Circadian Rhythms. (2025, May). https://www.sciencedirect.com/science/article/pii/S2451994425000082

Does color blindness affect how your brain reacts to light? 12/20/2025, 12/21/2025

- Since colour blindness means you have less or more faulty cones then the message that gets sent to the brain is altered.
- Colour blindness results in the brain perceives different or less colours than the average human.
- Humans have three different types of cones. Each process a different kind of wavelength: long, medium, and short wavelengths.

Color: The world your brain creates. BrainFacts.org. (2025, November 10). https://www.brainfacts.org/thinking-sensing-and-behaving/vision/2025/color-the-world-your-brain-creates-111025#:~:text=Colors%20aren’t%20a%20fixed,more%20limited%20range%20of%20color.

Isherwood, Z. J., Joyce, D. S., Parthasarathy, M. K., & Webster, M. A. (2020, November 13). *Plasticity in perception: Insights from color vision deficiencies*. Faculty reviews. https://pmc.ncbi.nlm.nih.gov/articles/PMC7886061/#:~:text=Abstract,underlying%20how%20we%20experience%20color.

A bit about colour blindness. 12/21/2025

- Colour blindness results in the signal sent to the brain being modified and the images your brain processes are in different colours.
- There are many types of colour blindness.
- Colour blindness is the result of some of your cones being missing or damaged.
- Depending on your type of colour blindness different colours are harder to see. Some types of colour blindness allow you to see some colours.

Mulligan, K. (2019, February 6). *What do color blind people see?*. EnChroma. https://enchroma.com/blogs/beyond-color/how-color-blind-see#:~:text=Color%20Blindness%20Definition,than%20they%20are%20supposed%20to.

More about colour blindness. 12/21/2025

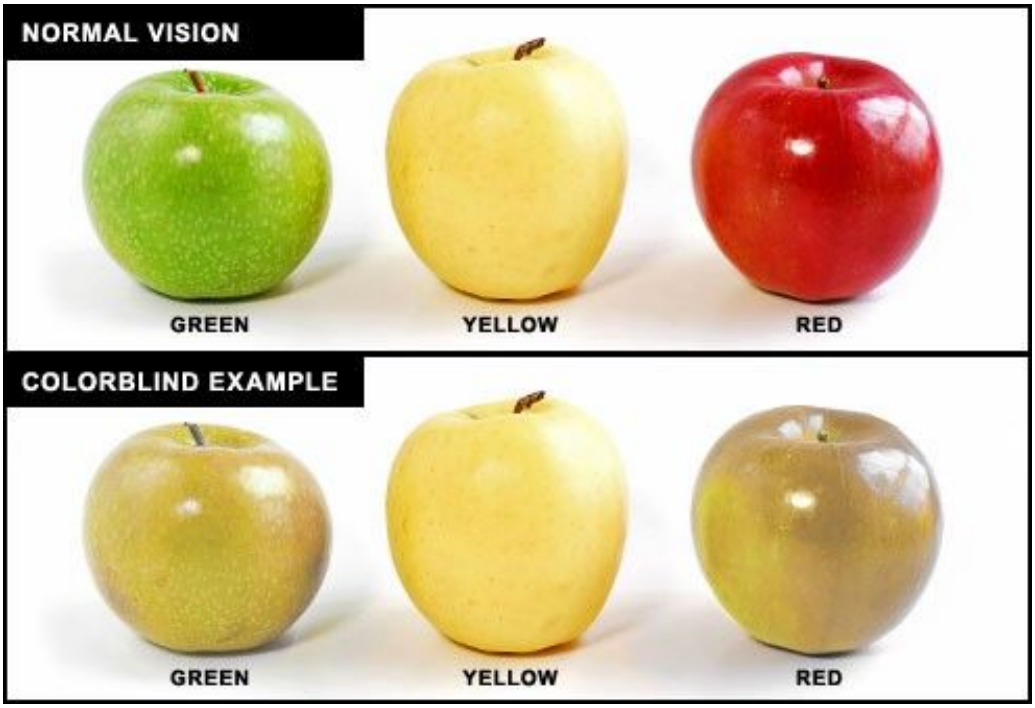
- Your long wavelength sensing cones detect red light.
- Your medium wavelength sensing cones detect green light.
- Your short wavelength sensing cones detect blue light.
- Some types of colour blindness could result in you not having one of your cone types entirely.
- Some rare types of colour blindness could result in you not being able to perceive colour at all. You would see in only white, black, and grey.

Dowd, B. (n.d.). *I See, You See, We All See Differently!*. CYSF. https://platform.cysf.org/project/0e41d5d7-2c6d-4aab-aef5-7d4bcf22732b/

Use of AI. 12/21/2025

I used AI in order to find websites that would answer my questions. I asked Google's "AI Mode" to find me a website that would answer my question. The question I needed to answer was "Does colour blindness affect how your brain reacts to light.

Rare case of colour blindness example. 12/21/2025



What is color blindness? - zoomax low vision AIDS. Zoomax. (n.d.). https://zoomax.com/low-vision-information/what-is-color-blindness-.html

Melatonin regulation in colour blind people. 12/22/2025

- A study was done to figure out if colour blind people produce melatonin differently since they may not be able to process blue light.
- The study exposed people with red-green colour blindness and people without colour blindness to white and green light at night.
- Red-green colour blindness:
  - Most common.
  - Makes it hard to see red, green, and colour containing red and green.
  - More common among men.
- The study showed that both groups produced little to no melatonin which proves that if you are colour blind it does not impact your ability to produce melatonin.

Ruberg, F. L., Skene, D. J., Hanifin, J. P., Rollag, M. D., English, J., Arendt, J., & Brainard, G. C. (n.d.). *Melatonin regulation in humans with color vision deficiencies*. The Journal of clinical endocrinology and metabolism. https://pubmed.ncbi.nlm.nih.gov/8768862/#:~:text=In%201%20study%2C%2014%20red,for%20light%2Dmediated%20neuroendocrine%20regulation.

Dowd, B. (n.d.-a). *I See, You See, We All See Differently!*. CYSF. https://platform.cysf.org/project/0e41d5d7-2c6d-4aab-aef5-7d4bcf22732b/

Melatonin regulation in colour blind people. 12/22/2025

- There were no significant differences between the two groups.
- The reason there was no difference in melatonin levels is because your body has a hidden light detector.
- The main factor in the production and suppression of melatonin is another cell in the eye. These cells are proteins called melanopsin.
- Colour blindness does not protect you from the late night light circadian rhythm disruption.

Ruberg, F. L., Skene, D. J., Hanifin, J. P., Rollag, M. D., English, J., Arendt, J., & Brainard, G. C. (n.d.). *Melatonin regulation in humans with color vision deficiencies*. The Journal of clinical endocrinology and metabolism. https://pubmed.ncbi.nlm.nih.gov/8768862/#:~:text=In%201%20study%2C%2014%20red,for%20light%2Dmediated%20neuroendocrine%20regulation.

Use of AI. 12/22/2025

I pasted a paragraph I did not understand from a website and asked Google's AI mode to make it easier to understand. The information that was simplified is in pages 36 and 37.

Melanopsin. 12/22/2025

- Melanopsin are photopigments (light sensitive molecules that change shape when they are exposed to light.)
- Most sensitive to blue light.
- Present in blind and colour blind people which allows their circadian rhythms to work normally.
- They can function as brightness detectors.
- Third type of light sensor in our eyes.
- Melanopsin are also known as mRGCs (Melanopsin retinal ganglion cells.)
- Responsible for non-visual tasks.
- These cell stell the suprachiasmatic nucleus if it is day or night. The suprachiasmatic nucleus is in charge of signaling the circadian rhythm.
- They also help with reducing pupil size in bright light, influencing our alertness and mood, and maybe even seeing basic movement and brightness.

Melanopsin - an overview | sciencedirect topics. ScienceDirect. (n.d.). https://www.sciencedirect.com/topics/nursing-and-health-professions/melanopsin

Use of AI. 12/22/2025

I used Google's AI Mode to simplify a paragraph. The information from that paragraph is on page 39.

Colour temperature. 12/23/2025

- Colour temperature is whether or not light appears warm or cool to the human eye.
- Colour temperature is measured in kelvin (K).
- Ranges from 100K to 10000K
- Warm light colours are reds, oranges and yellows. They have a lower level of kelvin.
- Cool light colours have a more bluish tint and have a higher level of kelvin.

Espejo, G. (2025, June 1). *Guide to light color temperature*. Casa Di Luce. https://www.casadiluce.ca/blogs/how-to/guide-to-light-color-temperature?srsltid=AfmBOooP8e0Pc9spe5vF4Epzz1OMqtr-7YnP9wRGcesWUZMxTJMphkTI

Colour temperature explained. Lights Canada. (n.d.). https://lightscanada.ca/blogs/news/colour-temperature-explained#:~:text=Color%20temperature%20refers%20to%20the,cool%20(more%20blue%20tones).

Colour temperature. 12/24/2025

- All light has been emitted from something
- Sometimes you can tell the temperature of an object by observing the light it emits.
- Measuring colour temperature is another way of measuring the “whiteness” of light.
- Colour temperature can be used to figure out how LEDs can work in different situations to make a room feel a specific way.
- Depending on the colour temperature of a light it can make a room feel calm and welcoming or more intense and alert.
- Light colour temperature is not always about heat.
- Colour temperature can be referring to whether or not something reminds you of warmth or coldness.

Energy=light=radiation=temperature?. ESA. (n.d.). https://www.esa.int/Science_Exploration/Space_Science/Energy_light_radiation_temperature#:~:text=Light%20and%20temperature&text=The%20wavelength%20of%20the%20light,of%20about%206000%C2%B0C.

What is lighting color temperature?. TCP Lighting. (2024, August 20). https://www.tcpi.com/what-is-lighting-color-temperature/

Warm and Cool light. 12/24/2025

What is lighting color temperature?.
TCP Lighting. (2024, August 20).
https://www.tcpi.com/what-is-lighting-color-temperature/

Photophobia. 12/28/2025

- If lights seem too bright or make your headache pain worse you could have photophobia.
- Can be a symptom of migraines.
- If you have photophobia brighter lights can cause more pain.
- It can cause pain in your eyes when you're exposed to bright light.
- Light with shorter wavelengths can have more effect on you when you have photophobia.
- Photophobia is a neurological issue.
- Headaches associated with photophobia:
    - Migraine: Most people with migraines experience photophobia.
    - Tension-type headache: These headaches can cause photophobia during or between headaches.

Light and headache disorders: Understanding light triggers and Photophobia. National Headache Foundation. (n.d.). https://headaches.org/blog/light-and-headache-disorders-understanding-light-triggers-and-photophobia/

Photophobia. 12/28/2025

- More headaches associated with photophobia:
  - Cluster headache: These can cause photophobia during or between headaches.
  - NDPH (New Daily Persistent Headache): Some people with NDPH and photophobia have experienced pain relief in a dark room.
  - Traumatic brain injuries (concussions): Photophobia is a common visual problem for people with traumatic brain injuries.
- Any type of light can cause photophobia.
- There are glasses, like migraine glasses that have a tint that can reduce migraines and photophobia.
- Wearing sunglasses indoors to try to relieve photophobia is not good because seeing darkness all the time can make light seem brighter.

Light and headache disorders: Understanding light triggers and Photophobia. National Headache Foundation. (n.d.). https://headaches.org/blog/light-and-headache-disorders-understanding-light-triggers-and-photophobia/

Incandescent lights vs LEDs? 12/29/2025

- The biggest difference between LEDs and incandescent lights is how they emit light.
- Incandescent lights produce light and heat.
- LEDs emit visible light.
- LEDs are becoming more popular.
- LEDs are more energy efficient than incandescent lights and they last longer.
- Incandescent lights are cheaper.

What is the difference between LED and incandescent lighting?. Light Bulbs Unlimited. (2020, February 13). https://www.light-bulbs-unlimited.net/2020/02/01/what-is-the-difference-between-led-and-incandescent-lighting/

Incandescent lights. 12/29/2025, 12/30/2025

- Convert electricity into light using heat.
- Emit electromagnetic radiation.
- As electrical currents flow through an incandescent light the temperature rises which is what causes the light to light up. That is known as incandescence.
- Lots of energy goes into heat.

Incandescent light bulb. Incandescent light bulb - Energy Education. (n.d.). https://energyeducation.ca/encyclopedia/Incandescent_light_bulb

Screen time effects on the development of a child's brain.. 12/30/2025

- Screen time can disrupt connections in the brain and brain development.
- If people are on screens it can reduce the amount of time spent on things that are good for your brain and brain development.
- Screen use can cause changes in the brain's cognitive control center.
- Screen time can cause disconnections between parts of the brain that control decision making and critical thinking.
- Screen time in young people can cause delays in development and language development.
- Some teens spend 13-25 hours on screens.
- Screen time can have negative effects on social-emotional development.

Screen Time and the developing brain: Research, benefits, risks, and policy. Brain Canada Foundation. (2025a, May 30). https://braincanada.ca/announcements/screen-time-and-the-developing-brain-research-benefits-risks-and-policy/#:~:text=he%20key%20message%20from%20Dr,the%20teens%20coming%20into%20Dr.

Circadian rhythm. 12/31/2025

- A rhythm that repeats once daily is circadian.
- Nearly every organism has these rhythms.
- These circadian rhythms occur even without an external cue.
- Circadian rhythms are generated within an organism and not primarily by the light/dark cycle.
- Circadian rhythms are used to anticipate the time in correspondence to the daylight cycle.
- Circadian rhythms are what determine whether you should be resting or active.
- Circadian rhythms are written into our DNA.
- Just like you get your features from your ancestors like your moms hair colour, your circadian rhythm comes from your ancestors too.
- With electric lighting and the ability to create dark spaces in the day can greatly disrupt the circadian clock because you can have bright light son in the night or be in a dark room during the day.
- Disruptions to the circadian rhythm can lead to diseases.

Panda, S. (2024, January 25). *What are circadian rhythms?*. myCircadianClock Blog. https://blog.mycircadianclock.org/what-are-circadian-rhythms/

Suprachiasmatic nuclei. 12/31/2025

- You have two suprachiasmatic nuclei.
- Your suprachiasmatic nuclei are in charge of your life. They control when you feel hungry or when you can concentrate better.
- The suprachiasmatic nuclei are composed of approximately 10000 closely interconnected neurons.
- Your suprachiasmatic nuclei are part of your circadian rhythm.
- They coordinate the daily behavioral and physiological cycles to adapt to the 24 hour day cycle.

Patton, A. P., & Hastings, M. H. (2018, August 6). *The suprachiasmatic nucleus*. ScienceDirect. https://www.sciencedirect.com/science/article/pii/S0960982218308431#:~:text=Summary,health%20of%20far%20greater%20scale.

Suprachiasmatic nucleus. 1/1/2026

- Master clock for the body.
- Inside of the hypothalamus (part of the brain).
- Each cell of the SCN acts as a 24 hour clock.
- If one of the cells in the SCN were isolated from the SCN and brain it would still work in its 24 hour cycle.
- The SCN controls behavior.
- If an animal is in a perfect 24 hour day-night cycle the SCN stays in tune with the sun.
- If an animal is in constant darkness the SCN will keep running its 24 hour cycle based on it's "memory" of a day/night cycle.
- The SCN coordinates the rhythms within the body.

Patton, A. P., & Hastings, M. H. (2018, August 6). *The suprachiasmatic nucleus*. ScienceDirect. https://www.sciencedirect.com/science/article/pii/S0960982218308431#:~:text=Summary,health%20of%20far%20greater%20scale.

Use of AI. 1/1/2026

I used Google's "AI Mode" for the purpose of simplifying a paragraph to make it easier to understand. The information taken from that paragraph is on page 51. I did the same thing with a three other paragraphs from the same website and put the information on page 53. I did that again with another paragraph and put that information onto page 54.

Suprachiasmatic Nucleus. 1/1/2026

- The SCN also tracks the seasons.
- The retinohypothalamic tract is a nerve pathway that allows travel from the eye to the SCN. It is also known as the RHT.
- The RHT is the only way for light to travel to the SCN and have impact on the clock.
- The amount of melatonin released in a mammal tells the SCN what season it based on how much melatonin is released each night. Long pulses of melatonin = winter. Short pulses of melatonin = summer.
- The SCN acts like an internal calendar.Your daily rhythm is the building up and breaking down of proteins in your body over the span of 24 hours.

Patton, A. P., & Hastings, M. H. (2018, August 6). *The suprachiasmatic nucleus*. ScienceDirect. https://www.sciencedirect.com/science/article/pii/S0960982218308431#:~:text=Summary,health%20of%20far%20greater%20scale.

Suprachiasmatic Nucleus. 1/1/2026

- The SCN keeps it's 24 hour rhythm going indefinitely, even if it is taken out of a mammal. This is different from other "body clocks" in a mammal that usually weaken over the span of a few days.
- Each cell in the SCN is in sync.
- The cells in the SCN communicate through rapid electrical signals (kind of like nerve impulses). If these electrical signals are blocked the SCN begins to lose it's sync.
- The cells within the SCN are very active and communicative during the day but quiet at night. This occurs even if an animal is a nocturnal creature.

Patton, A. P., & Hastings, M. H. (2018, August 6). *The suprachiasmatic nucleus*. ScienceDirect. https://www.sciencedirect.com/science/article/pii/S0960982218308431#:~:text=Summary,health%20of%20far%20greater%20scale.

What screen time does to your brain. 1/2/2026

- Being on screens disrupts sleep by suppressing the production of melatonin.
- Screens mimic midday daylight.
- Even a little bit of screen time can reduce hours of melatonin production.
- It desynchronizes your circadian rhythm.
- Gaming triggers a large release of dopamine. If your brain has lots of dopamine released your brain will make itself less sensitive to dopamine to protect it. This will make people need to play more video games to experience the same amount of pleasure. If the brain is less sensitive to dopamine then it will be harder to stay motivated and focus. Everyday tasks can start feeling boring or hard since dopamine is a chemical that helps you focus and stay motivated.

Dunckley, V. L. (n.d.). *What does screen time do to my brain?*. Potsdam. https://www.potsdam.edu/studentlife/wellness/counseling-center/what-does-screen-time-do-my-brain

Use of AI. 1/2/2026

I used Google's "AI Mode" for the purpose of making a paragraph easier to understand. The information taken from that paragraph is on page 55.

What screen time does to your brain. 1/3/2026

- Screen time can expose people to light at night which has been linked to increased risk of suicide and depression even if you are not directly staring at the screen.
- Removing screens at night is very protective of your body.
- Screen time can induce stress reactions. Cortisol, which is a stress hormone can be both a cause and an effect of depression.
- Screen time can overload the sensory system.
- Screen time can decrease your attention span.
- Screen time can deplete your mental reserves. Unfortunately this can lead to meltdowns becoming a coping mechanism since meltdown can temporarily boost mental reserves.
- Screen time leads to poor focus which can lead to aggressive behavior.
- Screen time can lead to people making big deals out of little things.

What does screen time do to my brain?. Potsdam. (n.d.). https://www.potsdam.edu/studentlife/wellness/counseling-center/what-does-screen-time-do-my-brain

What screen time does to your brain. 1/3/2026

- Screen time reduces the amount of physical activity people are participating in.
- Lessened physical activity is bad for your overall health.
- People who are constantly on screens are also not getting outside much which is also good for your overall health and restore attention as well as lower levels of stress and decrease aggressiveness.

What does screen time do to my brain?. Potsdam. (n.d.). https://www.potsdam.edu/studentlife/wellness/counseling-center/what-does-screen-time-do-my-brain

Melatonin. 1/3/2026

- Produced mainly by your pineal gland in your brain.
- Helps regulate your circadian rhythm.
- Makes you feel sleepy.
- Melatonin gets released most when it's dark and less when there is light present.
- When it's winter there is more darkness each day so your body makes more melatonin.
- Melatonin affects the cells in your hypothalamus which tells it it's time to wind down for the day.

How does melatonin work?. Cleveland Clinic. (2025, December 22). https://my.clevelandclinic.org/health/articles/23411-melatonin

Melatonin. 1/4/2026

- Your pineal gland releases melatonin around the same time each day.
- Melatonin helps your retinas become less sensitive to light which can make less alert and ready for bedtime.
- Melatonin helps you get enough sleep which is good for the following:
  - Skin.
  - Hair.
  - Internal organs.
  - Mental health.
  - Emotional health.
- Melatonin helps regulate menstrual cycles.
- Melatonin protects your brain health and prevents brain cells from breaking down. If the cells in your brain break down it can lead to dementia and alzheimer's disease as well as parkinson's disease.
- There was a study done where the pineal gland was removed from a human which lead to faster aging. This supports the belief of melatonin having the ability to slow aging.

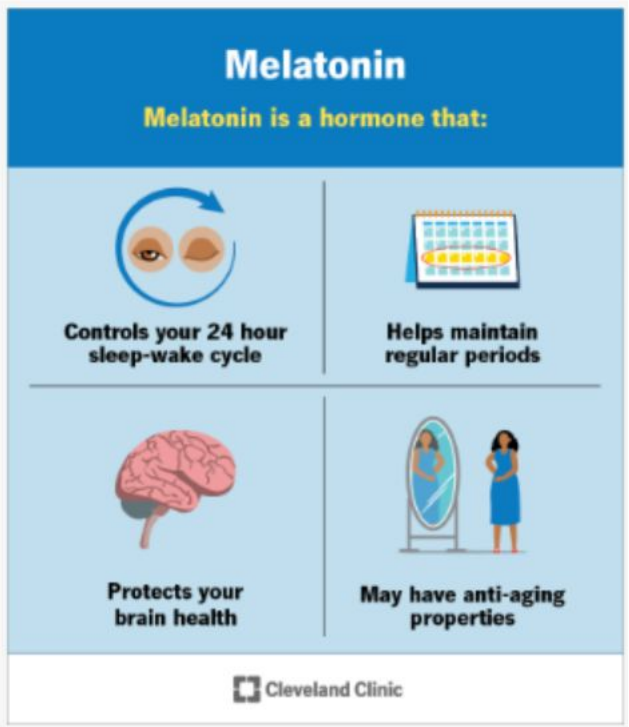
How does melatonin work?. Cleveland Clinic. (2025, December 22). https://my.clevelandclinic.org/health/articles/23411-melatonin

Melatonin. 1/4/2026

- Females usually have more melatonin than males.
- Kids and teens have the most melatonin before they begin puberty.
- Melatonin levels in people are pretty consistent from late teens until roughly the age of 40. After the age of 40 melatonin levels decrease for the rest of your life.

How does melatonin work?. Cleveland Clinic. (2025, December 22). https://my.clevelandclinic.org/health/articles/23411-melatonin

Melatonin benefits. 1/4/2026



How does melatonin work?. Cleveland Clinic. (2025, December 22). https://my.clevelandclinic.org/health/articles/23411-melatonin

Too much or too little melatonin. 1/4/2026

Hypomelatoninemia:

- Lower than average melatonin levels at night or lower melatonin levels than is usual for your age.
- Can change when you fall asleep and wake up.
- Can worsen quality of sleep.
- Can have impact on how you function and feel during your waking hours.

Hypermelatoninemia:

- Too much melatonin in your blood.
- Mostly occurs when you take too many melatonin supplements. It can also be caused by your pineal gland releasing too much melatonin but that is rare.
- Can increase your risk of getting eating disorders.
- Can cause irregular periods or potential infertility.
- Can cause high blood sugar.
- Can cause hypothermia or excess sweating.

How does melatonin work?. Cleveland Clinic. (2025, December 22). https://my.clevelandclinic.org/health/articles/23411-melatonin

Green light and migraines. 1/11/2026

- Research has shown that exposing people with migraines to a narrow band of green light can reduce photophobia and the sensitivity of the headache. The narrow band of green light reduces headache severity more than other colours of light that were tested.
- Many people with migraines seek darkness and can isolate themselves from others.
- Blue light hurts blind migraine patients.

Kritz, J. (2016, May 17). *Green Light for Migraine Relief*. Harvard Medical School. https://hms.harvard.edu/news/green-light-migraine-relief

Use of AI. 1/11/2026, 1/12/2026, 1/13/2026

I have used Google's AI mode to find a website that would tell me about green light and its impact on the brain. The information from the first site I found is on page 65. The information from the second site I used is on page 67 and the information from the third cite is on page 68.

Green light and the brain. 1/12/2026, 1/13/2026

- Green light therapy can have positive impact on multiple conditions such as:
  - Seasonal affective disorders (a type of depression linked to the change in seasons. It begins and end at roughly the same time each year).
  - Dysregulations in the circadian rhythm.
  - Neurodegenerative disease.
- Green light can reduce pain and be a way to reduce medical drug use.

Martin, L. F., Cheng, K., Washington, S. M., Denton, M., Goel, V., Khandekar, M., Largent-Milnes, T. M., Patwardhan, A., & Ibrahim, M. M. (2023, March). *Green Light Exposure Elicits Anti-inflammation, Endogenous Opioid Release and Dampens Synaptic Potentiation to Relieve Post-surgical Pain*. ScienceDirect. https://www.sciencedirect.com/science/article/pii/S1526590022004370

Mayo Foundation for Medical Education and Research. (n.d.). *Seasonal affective disorder (SAD)*. Mayo Clinic. https://www.mayoclinic.org/diseases-conditions/seasonal-affective-disorder/symptoms-causes/syc-20364651

Martin, L. F., Cheng, K., Washington, S. M., Denton, M., Goel, V., Khandekar, M., Largent-Milnes, T. M., Patwardhan, A., & Ibrahim, M. M. (2023, March). *Green Light Exposure Elicits Anti-inflammation, Endogenous Opioid Release and Dampens Synaptic Potentiation to Relieve Post-surgical Pain*. ScienceDirect. https://www.sciencedirect.com/science/article/pii/S1526590022004370

Green light and the brain. 1/13/2026, 1/14/2026

- When you are exposed to different colours of light it can change the way different parts of the brain communicate with each other which can improve mental health and focus.
- Light therapy can treat sleep issues, seasonal disorders, amd alzheimer's disease.
- Although the exact areas light changes is unknown, but scientists are currently trying to figure it out.
- A study was done using brain scans in order to figure out how a minute of a specific colour of light affects the way brain regions work together:
    - Blue light had a decrease in the connectivity between most areas of the brain but not the salience network. The salience network is what helps you notice information.
    - Green light had an increase in brain connectivity, more so in the left side of the brain. Green light also appears to increase visual attention.

Argilés, M., Sunyer-Grau, B., Arteche-Fernandez, S., & Peña-Gómez, C. (2022, September 28). *Functional connectivity of brain networks with three monochromatic wavelengths: A pilot study using resting-state functional magnetic resonance imaging*. PubMed Central. https://pmc.ncbi.nlm.nih.gov/articles/PMC9519584/

Use of AI. 1/13/2026, 1/14/2026

I used Google's AI Mode to simplify a few paragraphs that were hard to understand. The information from those paragraphs is on page 68.

What is light? 1/15/2026, 1/19/2026

- Light is electromagnetic radiation.
- To a scientist light is a physical property.
- Light is important because:
  - It comes from the sun to warm the earth and let plant conduct photosynthesis.
  - Light is what allows our eyes to see by bouncing off of objects and entering our eyes.
- Optics is the study of how light moves and behaves.
- At a low intensity light acts as a bunch of energy known as photons.
- Light is neither a wave nor particle. It is a little bit of both.

Light | *definition, properties, physics, characteristics, types, & facts* | *britannica*. Britannica. (n.d.). https://www.britannica.com/science/light

Use of AI. 1/15/2026, 1/29/2025

I used Google's AI Mode to simplify a few paragraphs so that it would be easier to understand the information taken from those paragraphs is on page 70.

How ultraviolet light gets to the brain through skin. 1/20/2026

- Skin is an intelligent organ
  - It is a barrier that self regulates.
  - It senses environmental information.
  - It computes that environmental information.
  - It works with your immune system and endocrine, which is a hormone, to maintain the steady state in which your body is best able to function known os homeostasis.
- UV light is bad in the sense that it can cause damage to the skin which may lead to aging, autoimmune issues, and cancer.
- UV light is good because it gets converted into neural and chemical signals which travel from your skin and eyes directly into the brain. UVB light is better at doing this.
- UV light exposure releases stress regulating hormones into your bloodstream.
- UV light effects your hypothalamus which is essentially your brains control center. The hypothalamus can help "reset" the way your body will handle energy and stress levels.

Slominski, A. T., Zmijewski, M. A., Plonka, P. M., Szaflarski, J. P., & Paus, R. (n.d.). *How UV light touches the brain and endocrine system through skin, and why*. Endocrinology. https://pmc.ncbi.nlm.nih.gov/articles/PMC5905393/

How ultraviolet light gets to the brain through skin. 1/20/2026

- UV light has influence on the brain and on hormones.
- UV light has therapeutic potential to treat mood disorders, depression, autoimmune diseases (even though it can also cause them), addiction, and obesity.
- UV light can cause a reaction in your skin that can protect it from damage. It's almost like a built in anti-skin-damage-from-sunlight alarm system.
    - That protection system is managed by a communication network operating within the skin that uses nerves and hormones.
    - That communication network reaches and communicates with the control centers of the brain as well as many hormone systems.
    - The whole process keeps your body healthy and balanced.

Slominski, A. T., Zmijewski, M. A., Plonka, P. M., Szaflarski, J. P., & Paus, R. (n.d.). *How UV light touches the brain and endocrine system through skin, and why*. Endocrinology. https://pmc.ncbi.nlm.nih.gov/articles/PMC5905393/

How ultraviolet light gets to the brain through skin. 1/20/2026

- Skin is coordinated partly by the brain and partly by systems within the skin itself.
- UV light enters mammals via the eyes and integument (the integument is a scientific term that refer to the skin, hair, and nails.) Those are the only two ways for light to enter our bodies and have affect on our biology.
- UVB light creates vitamin D.
- UV light and light on the visible spectrum regulate the central nervous system which consists of the spinal cord and brain.

Slominski, A. T., Zmijewski, M. A., Plonka, P. M., Szaflarski, J. P., & Paus, R. (n.d.). *How UV light touches the brain and endocrine system through skin, and why*. Endocrinology. https://pmc.ncbi.nlm.nih.gov/articles/PMC5905393/

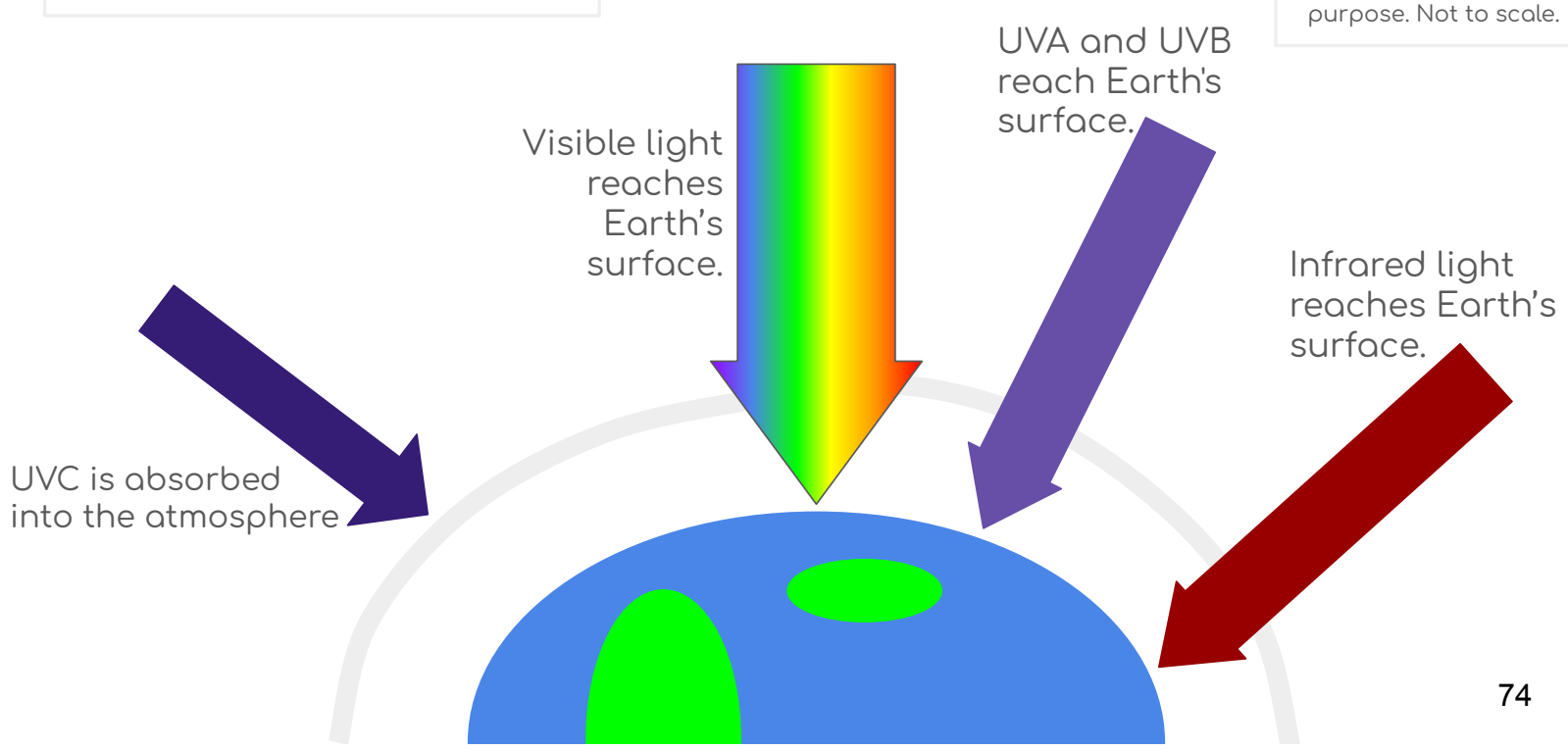
Sunlight. 1/20/2026

- The light that reaches the ground when the sun is directly above you is broken down into three parts:
  - 53% Infrared, felt as heat.
  - 44% Visible light, light that bounces off of things so we can see.
  - 3% Ultraviolet, biological impacts.
- UVC rays are the sun's most dangerous rays, but the Earth's atmosphere filters them out.
- When the sun is angled more light gets filtered out. This is why it is darker and cooler just after the sun has rose.
- When the sun is directly above you then the sun is in zenith.

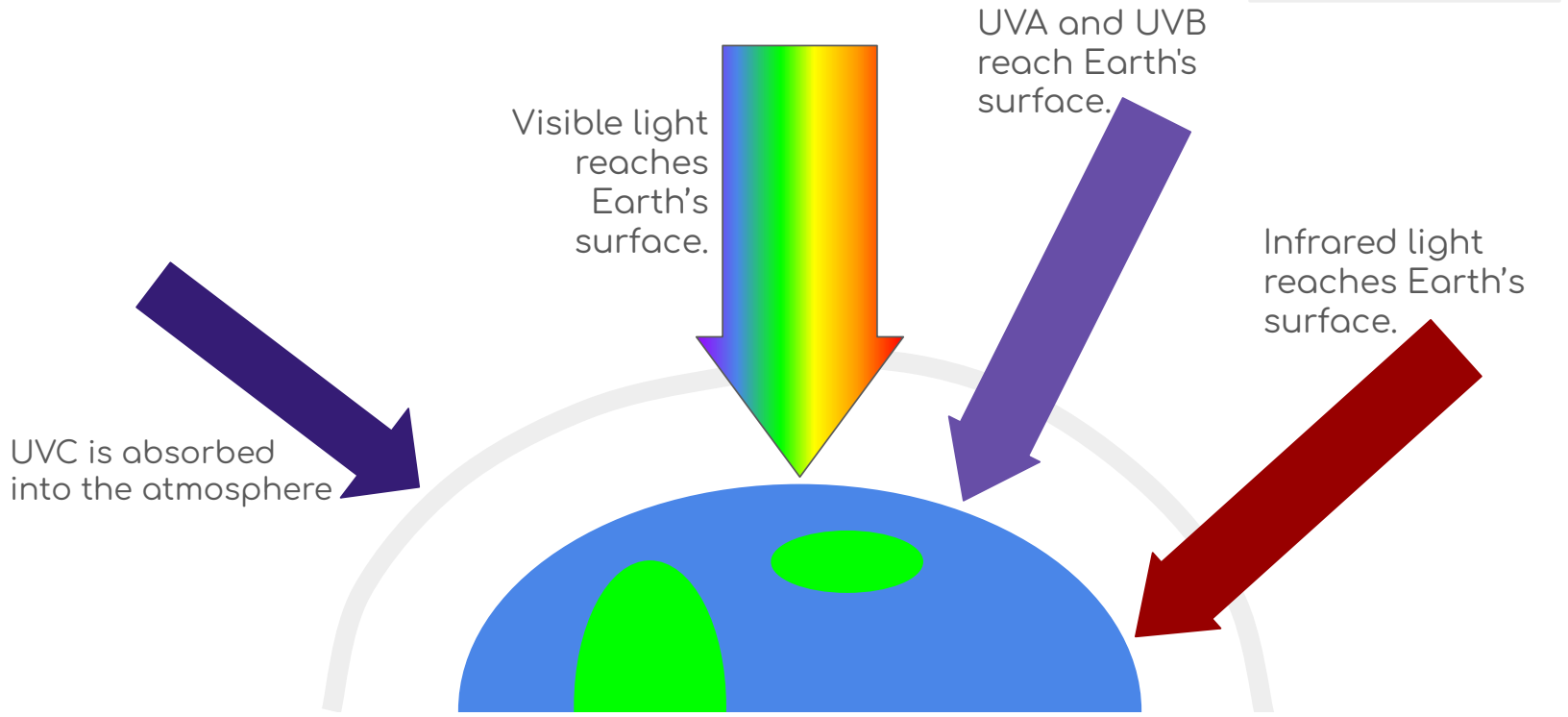
Slominski, A. T., Zmijewski, M. A., Plonka, P. M., Szaflarski, J. P., & Paus, R. (n.d.). *How UV light touches the brain and endocrine system through skin, and why*. Endocrinology. https://pmc.ncbi.nlm.nih.gov/articles/PMC5905393/

Light that reaches earth diagram. 1/20/2026

This diagram is meant only to show what types of light do and don't reach the Earth's surface. That it the only purpose. Not to scale.



This diagram is meant only to show what types of light do and don't reach the Earth's surface. Not to scale.



UV light and memory. 1/20/2026

- Sunlight makes you smarter.
- When you get enough sunlight your body produces a chemical known as urocanic acid, in your blood.
- The urocanic acid then travels to your brain where it becomes glutamate.
- Glutamate is a very important signal in your nervous system.
- Having extra glutamate in your brain strengthens the circuits in your brain responsible for learning and memory.
- This leads to you learning new things and skills easilier and recognizing things faster and easilier.
- The urocanic acids in your blood are special chemicals because they are able to pass through the blood brain barrier when it would otherwise keep chemicals in the blood out.

Zhu, H., Wang, N., Yao, L., Chen, Q., Zhang, R., Qian, J., Hou, Y., Guo, W., Fan, S., Liu, S., Zhao, Q., Du, F., Zuo, X., Guo, Y., Xu, Y., Li, J., Xue, T., Zhong, K., Song, X., … Xiong, W. (2018, June 14). ScienceDirect. https://www.sciencedirect.com/science/article/pii/S0092867418305075

UV light and memory. 1/20/2026

- In order for urocanic acids to turn into glutamate it needs to be converted by urocanase.
- Glutamate is used by neurons in your brain to make new memories.
- Tests were done on mice by exposing some to darkness and some to UV light and the mice exposed to UV light learned new skills much faster than the mice kept in the dark. Those mice were also better able to remember and recognize new objects.
- Then another test was done where urocanic acids were injected into mice. Those mice had the same results as the ones exposed to UV light.
- A test was also done where urocanase was blocked in mice and they no longer had the benefits of UV light exposure.

Zhu, H., Wang, N., Yao, L., Chen, Q., Zhang, R., Qian, J., Hou, Y., Guo, W., Fan, S., Liu, S., Zhao, Q., Du, F., Zuo, X., Guo, Y., Xu, Y., Li, J., Xue, T., Zhong, K., Song, X., … Xiong, W. (2018, June 14). ScienceDirect. https://www.sciencedirect.com/science/article/pii/S0092867418305075

Use of AI. 1/20/2026

I used Google's AI Mode to break down a few paragraphs. The information that was taken from those simplified paragraphs is on pages 72, 73, 74, and 75. I did the same thing with other paragraphs from another site. The broken down information from those paragraphs is on pages 77 and 78.

Sunlight improving memory. 1/20/2026

- Sunlight (UVB) exposure increases levels of glutamate which causes better memory and ability to learn in mice.
- High exposure to UV light can be damaging to skin but lower amounts are good for health.
- Glutamate is a neurotransmitter.

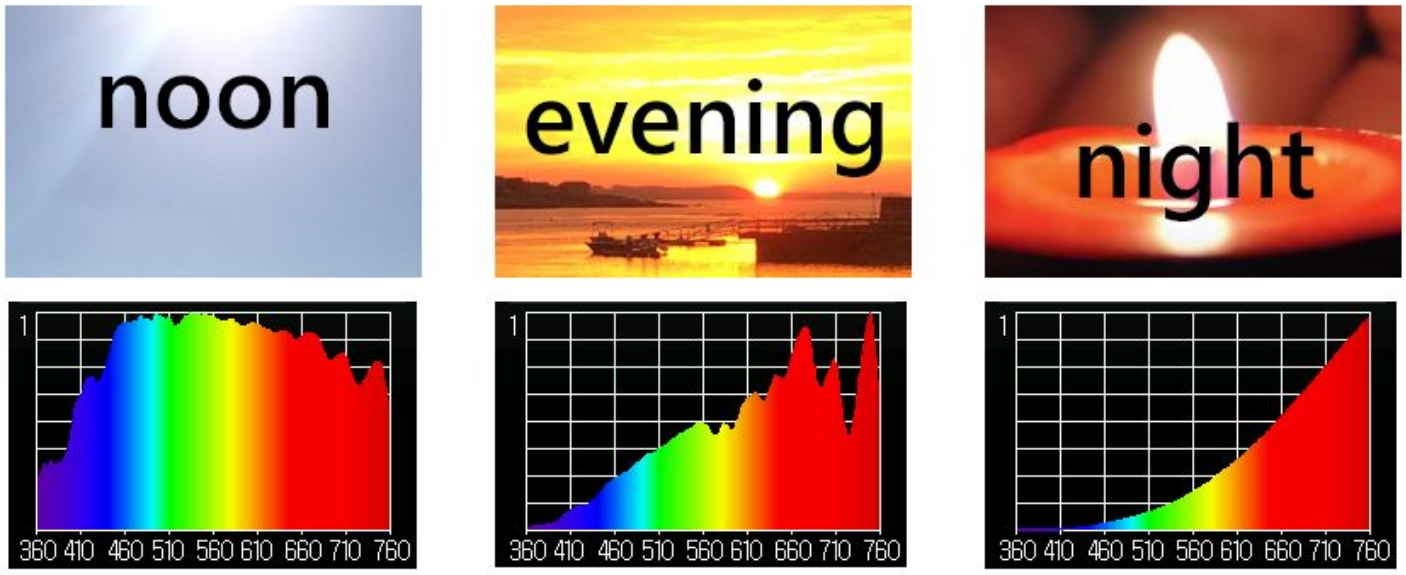
Parvatam, S. (2018, June 26). *How getting some sun can improve learning and memory*. BioTechniques. https://www.biotechniques.com/drug-discovery-development/how-getting-some-sun-can-improve-learning-and-memory/#:~:text=A%20new%20study%20published%20in,require%20four%20rounds%20of%20training.%E2%80%9D

Natural vs artificial light at different times. 1/22/2026

- Candlelight has no blue light.
- Sunlight changes its intensity and colour as the time of day changes.
- Natural light is healthy.
- Artificial light does not change colour or intensity throughout the day.
- Artificial light is unhealthy.
- For LEDs you have to choose between warm and cool white which means that you are not getting the difference throughout the day.
- At night most forms of artificial light have too much blue light which is bad for nighttime.
- Incandescent light does not have very much blue light.

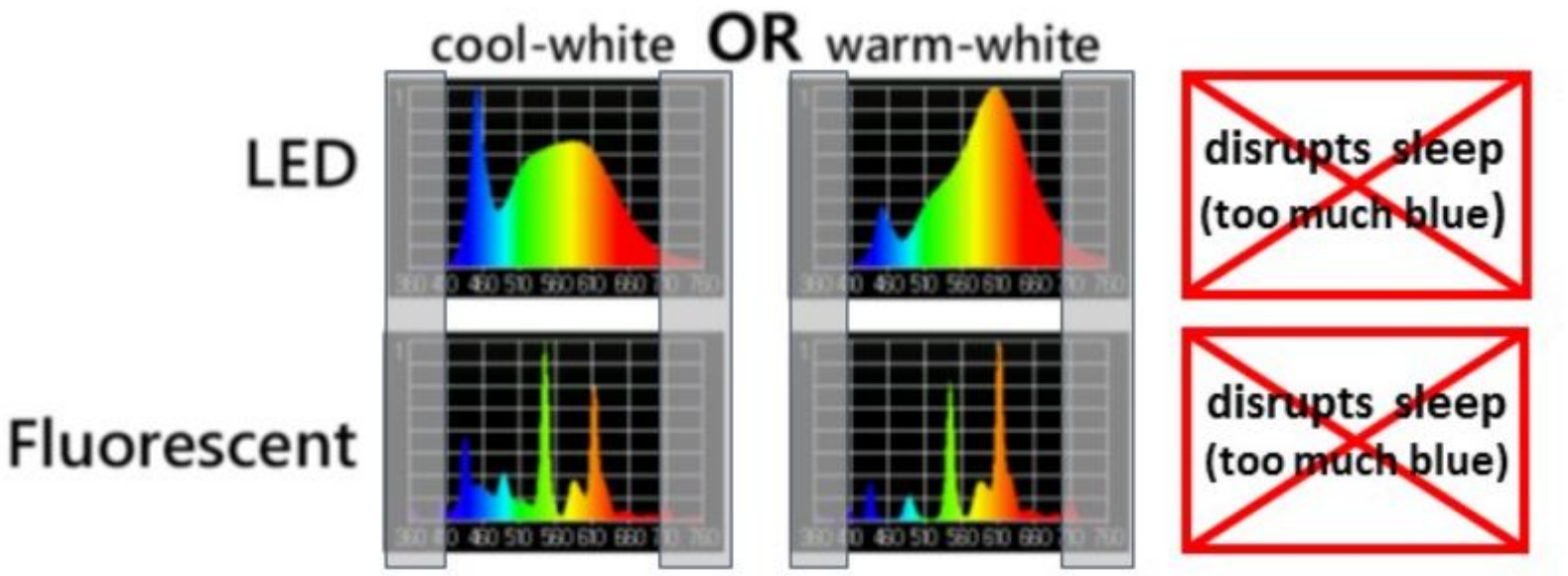
Comparing natural light and artificial light. Sunlight Inside. (n.d.). https://www.sunlightinside.com/light-and-health/natural-light-vs-artificial-light/#

Natural vs artificial light at different times. 1/22/2026



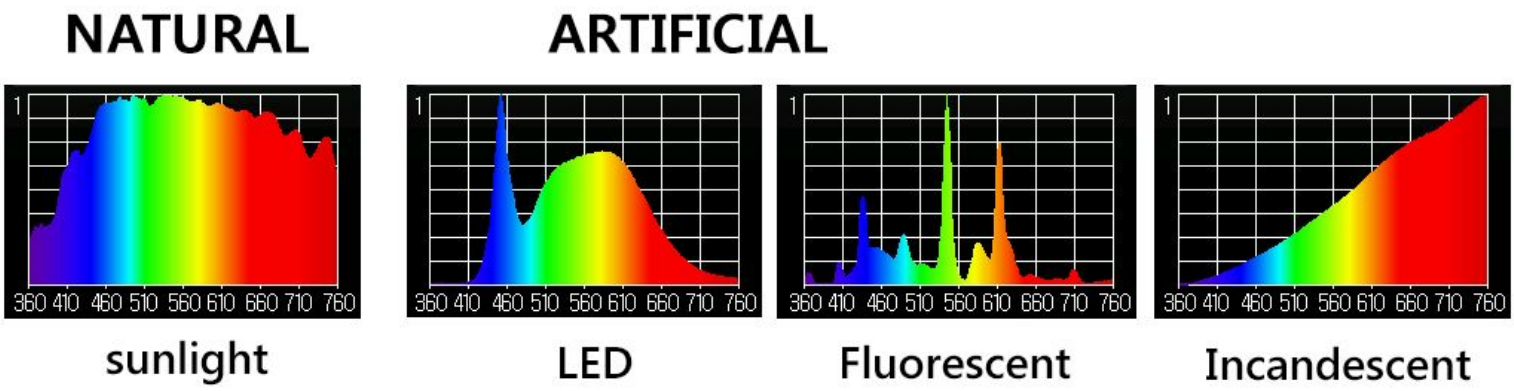
Comparing natural light and artificial light. Sunlight Inside. (n.d.). https://www.sunlightinside.com/light-and-health/natural-light-vs-artificial-light/#

Natural vs artificial light at different times. 1/22/2026



Comparing natural light and artificial light. Sunlight Inside. (n.d.). https://www.sunlightinside.com/light-and-health/natural-light-vs-artificial-light/#

Natural vs artificial light at different times. 1/22/2026



Comparing natural light and artificial light. Sunlight Inside. (n.d.). https://www.sunlightinside.com/light-and-health/natural-light-vs-artificial-light/#

What artificial light should be like to match sunlight. 1/22/2026

Comparing natural light and artificial light. Sunlight Inside. (n.d.). https://www.sunlightinside.com/light-and-health/natural-light-vs-artificial-light/#

Orange light impact on the brain. 1/24/2026

- Orange light improves alertness.
- Orange light improves cognitive brain function.
- Melanopsin can either be photoinsensitive (passive) or photosensitive (active).
- Orange light triggers a change in passive melanopsin turning it into active melanopsin.
- Blue light triggers a change in active melanopsin turning it into passive melanopsin.
- A study was conducted:
    - 16 participants were exposed to 10 minutes of either orange or blue light.
    - Then they were blindfolded for 70 minutes and put in an MRI scanner.
    - While in the MRI scanner the participants performed memory tasks.
    - The MRI scanner allowed the scientists to see which parts of the brain were active.
    - Orange light had a much higher impact on parts of the brain necessary for cognition than blue light.
    - This shows that melanopsin may be involved in making it easier for cognitive processes to occur.

Orange light helps thinking. Science Learning Hub. (n.d.). https://www.sciencelearn.org.nz/resources/2290-orange-light-helps-thinking

Cadena, V. (2014, June 1). *Shedding (orange) light on to Cognitive Brain Function*. The Company of Biologists . https://journals.biologists.com/jeb/article/217/11/1836/12130/Shedding-orange-light-on-to-cognitive-brain

Yellow and white light impact on the brain. 1/30/2026

- White light increases alertness and concentration.
- Yellow light can reduce eye fatigue by 20%.
- Yellow light increases relaxation by 30%.
- White light can reduce melatonin levels by 23%.
- Lots of exposure to blue light increases eye strain by 18%.
- Yellow light can reduce stress by 20%.
- White light boosts productivity by 15%

Yellow vs white lighting: Mood, health, productivity. BenQ. (2024, May 27). https://www.benq.com/en-us/knowledge-center/knowledge/yellow-lighting-vs-white-lighting.html

Use of AI. 1/30/2026, 1/31/2026

I used AI to find websites that would answer a question. The information taken from that website is on page 88. The information taken from another website is on pages 89 and 90. The information taken from a third website is on page 91. The information from a fourth site is on page 92.

Yellow light impact on the brain. 1/30/2026, 1/31/2026

- Yellow light has impact on the ventromedial prefrontal cortex also known as the vmPFC, which is a region of the brain that plays a role in decision making and emotional regulation.
- Yellow light can stimulate cognitive abilities and increase alertness.
- Yellow light can also be useful for conditions that involve indecision, mental sluggishness, or lack of motivation because yellow light can cause a sense of clarity.
- Yellow light can increase energy and mood levels.
- Yellow light can bring up unresolved emotions related to stress. Anxiety, or fear.
- Yellow light can increase mental flexibility.

Blackstock, J. (2025, February 20). *The Psychology of Yellow: Illuminating the Mind, Empowering the Self*. Taproot Therapy Collective. https://gettherapybirmingham.com/the-psychology-of-yellow-illuminating-the-mind-empowering-the-self/

Yellow light impact on the brain. 1/30/2026, 1/31/2026

- The cognitive functions yellow light can improve are problem solving, attention, and memory.
- Yellow light increases creativity and the ability to think of new ideas.
- Yellow light can increase feelings of joy and optimism and decrease feelings of depression and anxiety.
- Yellow light can increase self empowerment and self awareness.

Blackstock, J. (2025, February 20). *The Psychology of Yellow: Illuminating the Mind, Empowering the Self*. Taproot Therapy Collective. https://gettherapybirmingham.com/the-psychology-of-yellow-illuminating-the-mind-empowering-the-self/

Colour of light impact on circadian rhythms. 1/31/2026

- Blue light has the highest impact on your circadian rhythm compared to other colours of light. It causes difficulties in falling asleep and staying asleep.
- Red light does not have any affect on your circadian rhythm making it an ideal choice for nighttime.
- Yellow and orange light have minimal impact on the circadian rhythm.

Centers for Disease Control and Prevention. (n.d.). *The color of the light affects the circadian rhythms*. Centers for Disease Control and Prevention. https://archive.cdc.gov/www_cdc_gov/niosh/emres/longhourstraining/color.html

Colour of light impact on circadian rhythms. 1/31/2026

- Red light before bed can improve sleep.
- If you expose yourself to red light before bed and in the morning it can make you feel less tired.
- If red light is too bright it can lower melatonin productions.
- Green and blue light both decrease drowsiness.

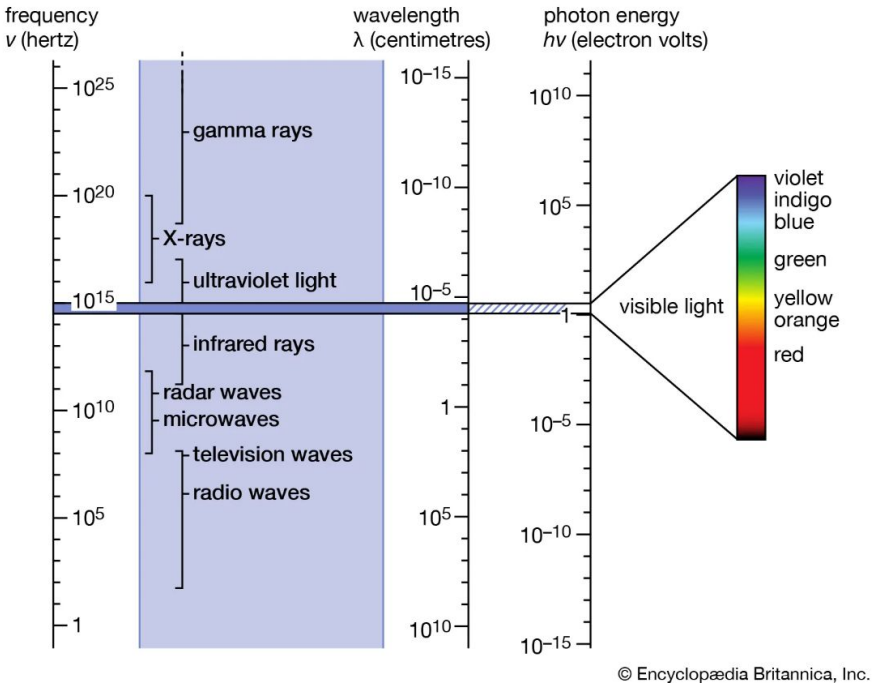
Summer, J. V., & Adavadkar, P. (2025, July 11). *What color light helps you sleep?*. by Sleep Doctor. https://www.sleepfoundation.org/bedroom-environment/what-color-light-helps-you-sleep

The electromagnetic spectrum. 2/6/2026

- Visible light is only a small fraction of the spectrum.
- The whole spectrum is known as the electromagnetic spectrum.
- Visible light is in the middle of the spectrum.
- Wavelengths longer than red light (in order from shortest to longest) are:
  - Infrared.
  - Radar waves.
  - Microwaves.
  - Television waves.
  - Radio waves.
- Wavelengths shorter than violet light (in order from longest to shortest) are:
  - Ultraviolet.
  - X-rays.
  - Gamma rays.

Electromagnetic spectrum | *definition, diagram, & uses* | *britannica*. Britannica. (n.d.). https://www.britannica.com/science/electromagnetic-spectrum

Electromagnetic spectrum. 2/8/2026



Electromagnetic spectrum | definition, diagram, & uses | britannica. Britannica. (n.d.). https://www.britannica.com/science/electromagnetic-spectrum

Wavelengths. 2/8/2026, 2/9/2026

- Infrared: 700 nm - 1μm
- Red: 600 nm - 750 nm
- Orange: 585 nm - 620 nm

Infrared radiation. ICNIRP. (n.d.). https://www.icnirp.org/en/frequencies/infrared/index.html

Klein, C. (2019, December 12). *Infrared radiation and infrared spectroscopy*. Thermo Fisher Scientific . https://www.thermofisher.com/blog/materials/all-about-infrared-radiation-and-spectroscopy/#:~:text=The%20infrared%20range%20covers%20700%2D1000,100%20to%20400%20nm%20(wavelength).

Tsai, S.-R., & Hamblin, M. R. (2018, May 1). *Biological effects and medical applications of infrared radiation*. Journal of photochemistry and photobiology. B, Biology. https://pmc.ncbi.nlm.nih.gov/articles/PMC5505738/

Project E Beauty. (2025, May 9). *Understanding red light therapy wavelengths*. Project E Beauty. https://www.projectebeauty.com/blogs/news/understanding-red-light-therapy-wavelengths-3?srsltid=AfmBOoqCSHFru1MVvQKT_KN33uggD-KUxzWDQ8YB1wHFq_qapUzzJb_V

Red Light Wavelength explained. Joovv. (2025, October 6). https://joovv.com/blogs/joovv-blog/red-light-wavelength?srsltid=AfmBOoorG2tG3LPSp_uNIcege2-K30O0zm06jbPmctae0Dv9D1PUsRT5

Center for Science Education. Wavelength of Blue and Red Light | Center for Science Education. (n.d.). https://scied.ucar.edu/image/wavelength-blue-and-red-light-image

Kelley, T. (n.d.). *Orange | description, etymology, & facts | britannica*. Britannica. https://www.britannica.com/science/orange-color

Lumitex, LLC. All Rights Reserved. (2018, April 19). *Visible light spectrum: From a lighting manufacturer's perspective*. Lumitex. https://www.lumitex.com/blog/visible-light-spectrum

Wavelengths. 2/10/2026, 2/11/2026, 2/14/2026

- Yellow: 570 nm - 600 nm
- Green: 495 nm - 570 nm
- Blue: 380 nm- 510 nm

Red Light Wavelength explained. Joovv. (n.d.). https://joovv.com/blogs/joovv-blog/red-light-wavelength?srsltid=AfmBOoorG2tG3LPSp_uNlcege2-K30O0zm06jbPmctae0Dv9D1PUsRT5

Yellow | description, etymology, & facts | britannica. Britannica. (n.d.-b). https://www.britannica.com/science/yellow-color

Klein, E. M. (n.d.). *Effects of green light on Biological Systems*. U.S. National Library of Medicine. https://pubmed.ncbi.nlm.nih.gov/1498206/

Visual spectrum, color. Jack Westin. (n.d.). https://jackwestin.com/resources/mcat-content/light-and-electromagnetic-radiation/visual-spectrum-color

Wavelength of Blue and Red Light. Center for Science Education. (n.d.). https://scied.ucar.edu/image/wavelength-blue-and-red-light-image

What is blue light?. Block Blue Light. (n.d.). https://www.blockbluelight.com/pages/what-is-blue-light?srsltid=AfmBOoq4a6DNhGgrR9KuLmLyF2nDz5t6vypjU44oanBUf-1-a8Ia9Kkv

A guide to the spectrums of light. Healthlighting. (n.d.). https://healthlighting.com/blogs/lighting-guide/guide-to-the-spectrum-of-light?srsltid=AfmBOopBfQw_zOOuk3Y72fo7Q1GiIDN4JQvM1dk5H8Pkcaar99CKhi5-

Wavelengths. 2/11/2026, 2/12/2026

- Violet: 380 nm - 450 nm
- Ultraviolet 10 nm - 400 nm

Red Light Wavelength explained. Joovv. (n.d.). https://joovv.com/blogs/joovv-blog/red-light-wavelength?srsltid=AfmBOoorG2tG3LPSp_uNIcege2-K30O0zm06jbPmctae0Dv9D1PUsRT5

Kelley, T. (n.d.-b). *Violet | description, etymology, & facts | britannica*. Britannica. https://www.britannica.com/science/violet

Helmenstine, A. M. (2025, June 10). *The Visible Spectrum: Wavelengths and Colors*. ThoughtCo. https://www.thoughtco.com/understand-the-visible-spectrum-608329

Ultraviolet (UV) Radiation. UCAR Center for Science Education. (n.d.). https://scied.ucar.edu/learning-zone/atmosphere/ultraviolet-uv-radiation

World Health Organization. (2016, March 9). *Radiation: Ultraviolet (UV) radiation*. World Health Organization. https://www.who.int/news-room/questions-and-answers/item/radiation-ultraviolet-(uv)

Does the visible spectrum have indigo light? 2/13/2026

Yes, Indigo light is the second last colour of the visible spectrum between blue and violet.

Visible light. Physics and Radio Electronics. (n.d.). https://www.physics-and-radio-electronics.com/physics/electromagnetic-spectrum/visible-light.html#google_vignette

Impact of indigo light on the brain. 2/14/2026

- Indigo light “turns on” the hippocampus. The hippocampus is a region of your brain makes your brain better at finding and storing information.
- Using indigo light while studying can make you remember things better.
- Exposure to indigo light switches your brain waves to alpha and theta states.
    - Alpha states are associated with restful and meditative states.
    - Theta states play a role in processing information and making memories.
- Indigo light helps work feel more effortless.

Blackstock, J. (2025, February 20). *Indigo: The Color of Insight, Intuition and Inner Vision*. Taproot Therapy. https://gettherapybirmingham.com/indigo-the-color-of-insight-intuition-and-inner-vision/

Cherry, K. (2025, October 29). *What Are Alpha Brain Waves?*. Verywell Mind. https://www.verywellmind.com/what-are-alpha-brain-waves-5113721

Larson, J. (2020, July 1). *Theta brain waves: Frequency, sleep, binaural beats, and more*. Healthline. https://www.healthline.com/health/theta-waves

Impact of indigo light on the brain. 2/14/2026

- Indigo light may help you become more aware.
- Many people think that indigo light can connect your conscious and unconscious mind.
- The areas of the brain indigo light impacts are the hippocampus, prefrontal cortex, and pineal gland.

Blackstock, J. (2025, February 20). *Indigo: The Color of Insight, Intuition and Inner Vision*. Taproot Therapy. https://gettherapybirmingham.com/indigo-the-color-of-insight-intuition-and-inner-vision/

Use of AI. 2/14/2026, 2/15/2026, 2/16/2026, 1/19/2026

I used Google's AI Mode to break down a few paragraphs all from the same website so they would be easier to understand. The information taken from those simplified paragraphs is on pages 99 and 100. I also used AI Mode to find a few websites for pages 102, 103, 104, 105, 106, 107, AI Mode was also used to simplify some paragraphs from those websites.

Impact of violet light on the brain. 2/15/2026

- Exposure to violet light can regulate the following:
  - Your circadian rhythm.
  - The way your body creates and manages heat.
  - Eye growth.
- A study was done that showed that exposing old mice to violet light:
  - Improved memory.
  - Reduced depression-like feelings if OPN5s were present.
- Violet light is a regulator of mood and cognition.
- OPN5s keep the brain healthy as it ages.
- Violet light use could lead to treatment for neurodegeneration and psychiatric disorders.

Hayano, M., Gusain, P., Robertson, S., Mitsukura, Y., & Tsubota, K. (2023, June). *Violet light modulates the central nervous system to regulate memory and mood*. Arvo Journals. https://iovs.arvojournals.org/article.aspx?articleid=2790376

Impact of violet light on the brain. 2/15/2026 2/16/2026

- Violet light can prevent myopia (nearsightedness).
- It has not been thoroughly studied how violet light affects humans.
- A study was done to see how violet light impacted health.
  - 25 participants aged 23-65 were exposed to 2 hours of violet light via violet light glasses each morning.
  - The study was done to figure out if violet light improved sleep and if it managed glucose levels.
  - Heart rate and sleep stages were monitored for ten weeks. Throughout those ten weeks glucose levels were monitored during weeks 1-2, 4-6, and 8-10.
  - Four things were measured to evaluate sleep quality:
    - How much time is spent sleeping when in bed.
    - How long it takes to fall asleep.
    - How long sleeping lasts.
    - How much time the participant was awake after first falling asleep.

Kato, T., & Mitsukura, Y. (2025, August 1). *Violet light could improve sleep quality and blood glucose levels in healthy individuals: A pilot study*. PLOS ONE. https://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0314346

Impact of violet light on the brain. 2/16/2026

- There were five phases to the study:
  - A: For two weeks the participants were observed in their normal routines.
  - B, C: One month of violet light every morning.
  - D, E: checking one month after stages B and C to see if effects lasted.
- Results:
  - Over 50% of participants began the study with sleep issues.
  - 67% of participants experienced improvement with difficulties falling asleep.. One they stopped the violet light in the morning the benefits disappeared and by the time four weeks had passed nobody had the benefits anymore.
  - Everyone improved in the amount of times they woke up at night and 60% of that improvement was still there a month after using the violet glasses.
  - 54% of participants showed improvement on waking up early and 30% still had the benefits after they stopped using the violet light glasses.
  - There were a few people that had the amount of time it takes to fall asleep drop by a lot however after they stopped using the violet light glasses the amount of time it took them to fall asleep increased to be more than it originally was.

Kato, T., & Mitsukura, Y. (2025, August 1). *Violet light could improve sleep quality and blood glucose levels in healthy individuals: A pilot study*. PLOS ONE. https://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0314346

Impact of violet light on the brain. 2/16/2026

- In the study everyone reacted differently.
- Some people saw great improvement while others didn't.
- 30% of people fell asleep faster with the violet light.
- Better sleep lasted for a whole month in some cases.
- 10% of people had more trouble falling asleep
- People who struggled with waking up earlier than they should have did not see much improvement.
- Scientist believe that violet light has impact on the hypothalamus which is in control of hunger and sleep.
- 40% of the participants felt hungrier after a month of using the violet light glasses.
- 90% of the participants had their digestion improve while they were wearing their glasses, however it stopped once they stopped using the glasses.
- People who had improved sleep also had their blood sugar levels drop after using the glasses.

Kato, T., & Mitsukura, Y. (2025, August 1). *Violet light could improve sleep quality and blood glucose levels in healthy individuals: A pilot study*. PLOS ONE. https://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0314346

Impact of violet light on the brain. 2/16/2026

- ~30% of participants didn't have their blood sugar levels drop until they stopped using the violet light glasses.
- 12% of participants had their blood sugar levels go up post treatment.
- Violet light is helpful for some peoples health.
- Violet light helps the body regulate blood sugar levels.
- Violet light helps people with high blood sugar or those who take awhile to fall asleep.
- Researches suggest adding violet light it to your daily routine.

Kato, T., & Mitsukura, Y. (2025, August 1). *Violet light could improve sleep quality and blood glucose levels in healthy individuals: A pilot study*. PLOS ONE. https://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0314346

Impact of violet light on the brain. 2/19/2026

- Violet light boosts your mood and your memory.
- Violet light could potentially treat depression and dementia in the future.
- Violet light light send signals to the habuenala.
- Violet light speeds up electrical signals in the brain and matures brain cells.
- In a study, mice that were considered “depressed" became more social after exposure to violet light compared to mice exposed to white light.
- Violet light increases the wanting for rewards/pleasure, which is lost if you have depression, however neuropsin must be present.
- Violet light does not impact the SCN.
- Most light doesn’t have violet light in it.

Sasaki, N., Gusain, P., Hayano, M., Sugaya, T., Tonegawa, N., Hatanaka, Y., Tamura, R., Okuyama, K., Osada, H., Ban, N., Mitsukura, Y., Lang, R. A., Mimura, M., & Tsubota, K. (2021, November 4). *Violet light modulates the central nervous system to regulate memory and mood*. bioRxiv. https://www.biorxiv.org/content/10.1101/2021.11.02.466604v1.full

Indigo Wavelength. 2/21/2026

420 nm - 450 nm

Visible light spectrum: From a lighting manufacturer's perspective. Lumitex. (2018b, April 19). https://www.lumitex.com/blog/visible-light-spectrum

Westland, S. (2012, February 25). *What colour is Indigo?*. Colourchat. https://colourware.org/2012/02/25/what-colour-is-indigo/

Conclusion. 2/19/2026, 2/28/2026, 3/1/2026

In conclusion there are a variety of different colours of light, and they're only part of the whole electromagnetic spectrum. Infrared light, at 700 nm - 1μm is invisible to the human eye and does not have many benefits for the brain however it is good for the body. Red light, at 600 nm - 750 nm can improve mental health and sleep because it doesn't impact the circadian rhythm. Orange light, at 585 nm - 620 nm improves alertness and cognitive brain function. Yellow light, at 570 nm - 600 nm has lots of benefits including reduced eye fatigue, relaxation, increased mood, and increased cognitive ability. Green light, at 495 nm - 570 nm is good for when you have migraines because it can reduce migraine severity. Green light also helps with SAD and increases brain connectivity. Blue light, at 380 nm - 510 nm is the primary influence for the circadian rhythm however blue light can harm you by increasing eye strain, potentially shortening lifespan, but also increase alertness and memory. Indigo light, at 420 nm - 450 nm allows you to remember and store information better as well as allow you to be a little bit more relaxed. Violet light, at 380 nm - 450 nm can help regulate your circadian rhythm, mood, and cognition. Violet light also helps with sleep and glucose levels. UV light, at 10 nm - 400 nm is also invisible to the human eye is good for mood regulation, depression reduction, healthy body function, and making you smarter. It can also harm your skin though. White light contains mostly blue light and has most of the same impacts of blue light. Same goes for LED light which is a form of white light. Incandescent light has less blue light than LED light but is also a form of white light. Sunlight has every colour of the light spectrum and is the most healthy light you can expose yourself to. Light can also impact the brain by causing pain if you have photophobia. Overall there are ways that light is good for the brain and also bad for the brain, but one thing is for sure, the good things light does for you exceed the bad and keep you healthy and happy. The best thing you can do for yourself is expose yourself to sunlight and the spectrum.

Wavelength clarification. 2/28/2026

The wavelengths of different colour overlaps very much because no website gave the same answer as another. There is overlap between the varying colours of light and you will notice that there are lots of citations on the slides with wavelengths. That is because I tried to create a very broad area of what the wavelengths are based on all of the different websites.