

Intensity of Light and Heat

When talking about a light source, most people are more comfortable with the word “brightness” than they are with the word “intensity.” Scientists generally prefer the word “intensity” and there are a couple of reasons for that.

The first reason is that although brightness is a property of only light, the concept of intensity can be applied to light, heat, and other forms of radiation. We feel heat from the Sun. We see light from the Sun. Generally speaking, the heat is most intense when the light is most intense.

Important concept: it is the heat from the Sun, and not the light from the Sun, that is primarily responsible for our weather and climate. However, since we can see and measure light more easily, we will use what we learn about the intensity of light from the Sun to better understand the heat. The factors that influence the intensity of light will also influence the intensity of heat in the same way.

The second reason that scientists prefer the word “intensity” is... Well, see for yourself.

➤ **Imagine that you saw two green circles. How would you decide which was the “brighter” shade of green?**

➤ **On the following web page you will find two green circles. Open the web page (which may take a moment), look at the two pictures, and BEFORE YOU DO ANYTHING ELSE write down which *CIRCLE* is brighter: the upper one or the lower one?**

Go to <http://www.instruction.greenriver.edu/physics/intensity> and click on “Introduction to Intensity”

➤ **Now follow the instructions on the web page. After you have done everything on this page, look back at your answers above. How reliable are your eyes for determining brightness? How were they fooled?**

Scroll down and go on to the next page. You should now be at

<http://www.instruction.greenriver.edu/physics/intensity/intensity.html>

In this example and in those that follow, by “amount of light” we mean the amount of light energy that strikes the screen every second. That may sound complicated, but this is what is meant by “watts”. A high wattage light bulb produces more light energy per second than a low wattage light bulb.

On IntensityQ1.html , the second question has been answered for you. See if you can answer the first and third. Check your results by clicking on “show answers.” Talk to your classmates or your teacher if you are having trouble.

Go on to the next page: IntensityQ2.html. Again, try to answer the questions and check your results. Again, check with classmates or your teacher.

Go on to the next page: IntensityQ3.html. Try to answer the questions and check with classmates or your teacher.

➤ **Thinking back to your analogy about the book on the table, can you come up with a definition of the word “intensity” that we could use for the intensity of light or heat?**

➤ **Imagine that light flies out from the sun or from a light bulb in straight little rays (which we call “light rays”). If each ray carries the same amount of energy per second, what arrangement of rays will produce the most intense light? What arrangement would produce less intense light?**

By using a definition like the one you came up with, scientists can define the concept of intensity in a way that can be measured. Check your definition and your idea about the light rays with a teacher.

- ***Based on what you see in this animation, does the intensity of light on our flat Earth change with the distance from the Sun? How do you know?***

Now try to “move the Sun.” This will allow the Earth to move back and forth in the same spot, but with the Sun positioned farther away. Click on “Not so near” and then repeat the “move the flat Earth” experiment.

- **Does the change in the position of the Earth still change the intensity of light from the Sun? How do you know?**

- **Do you think that a change in the position of the Earth changes the intensity of light from the Sun by as much as it did when the Sun was closer? Explain your reasoning.**

Second, notice the graph on the right. This will actually tell us the distance between the Earth and the Sun at different times of year.

Go ahead and run the animation. For this animation, one year is 366 days.

- **Look carefully at the difference between the path that the green dot (Earth) follows and the blue circle. Does the difference between the two paths appear to be great enough to cause the seasons here on Earth? Explain.**

- **Now look carefully at the graph of the actual distance between the Earth and the Sun. Do the changes in the distance appear to be great enough to cause the seasons here on Earth? Explain.**

- **Oh we almost forgot. It turns out that January starts at about the “day zero” in this animation. July comes around about “day 183.” When is the Earth closer to the Sun? When should the intensity of Solar radiation (both heat and light) on Earth be the greatest?**

- **Can this explain the seasons in Seattle? Explain.**

Scroll to the bottom and go on to the next animation.

This animation is the same as the last except that there is an additional graph which shows the intensity of solar radiation on Earth. Run the animation.

- **Where on this real planet do you expect the solar radiation to be most intense and why? (Draw a sketch if that will help.)**

- **Another student says he knows that the sunlight will be most intense on the farthest left spot on this planet *because that is the part of this planet that is closest to the sun*. Do you agree? Have we seen any other shapes that suggest that this is an oversimplification?**

- **Think about (roughly) where the Equator is on the Earth. Think about (roughly) where the poles are. Can you explain the difference in the climates of these locations based on our current understanding of intensity and angles? If so, how?**

- **Harder question: Think about (roughly) where Seattle winds up in July and (roughly) where Seattle winds up in January. Can you explain the difference in temperatures during these two times of year based on our current understanding of intensity and angles? If so, how?**

- **Which explanation works better for you:**
 1. **“The seasons are caused by annual changes in the distance between the Earth the Sun.”**
 2. **“The seasons are caused by changes in angle of incidence of radiation (heat and light) from the Sun.”****Explain your reasoning.**