Universität Basel
Swiss Nanoscience Institute

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EINE INITIATIVE DER UNIVERSITÄT BASEL UND DES KANTONS AARGAU

Which color to wear on a hot summer's day?

Simply being outside on a hot summer's day can be enough to work up a sweat. But does it make any difference whether you wear a white, black or red t-shirt? Let's find out in this experiment.

What you'll need?

- Sheets of white, black and colored paper, each measuring around 15 x 15 cm
- Ice cubes of the same size
- Kitchen scales
- A washable tray or board to work on
- Paper towels
- A sunny day with no wind

Instructions

- Fold each sheet of paper into a small box (instructions on the last page).
- Prepare some ice cubes that are as close in size as possible.
- Cover a washable tray or board with paper towels, arrange the boxes on it and place it in a sunny spot. Make sure that all of the boxes are facing the same direction, and that it's not too windy. There's a chance that the dye in the paper might run, so choose your work surface accordingly.
- Use the kitchen scales to select ice cubes that all weigh the same amount. Work quickly, as they will soon start to melt.
- Place one ice cube in each box, making sure they are all in roughly the same position and facing the same way in the box.
- Now watch how the ice cubes melt.

What happens?

- The ice cubes will soon start to melt under the hot sun.
- In the boxes with darker colors, they will melt a little faster than in the white or yellow ones.
- Sometimes the dye in the boxes will run, as it is water-soluble. That's why it is a good idea to cover your work surface with paper towels.
- After a few minutes, the ice cube in the black box

will have melted completely, while there is still a small piece of ice in the white box.

- The dark paper absorbs much more of the sun's radiation than lighter surfaces. As a result, it absorbs more energy, so it gets hotter in the dark boxes than in the light ones. That's why the ice in these boxes melts faster.

If you'd like to know more

Sunlight behaves like a wave. The wavelength of visible light is between around 400 and 780 nanometers (nm). Light waves with a wavelength between 780 nm and 1,000,000 nm (1 mm, for far infrared) are known as infrared or thermal radiation, and are invisible to the human eye.

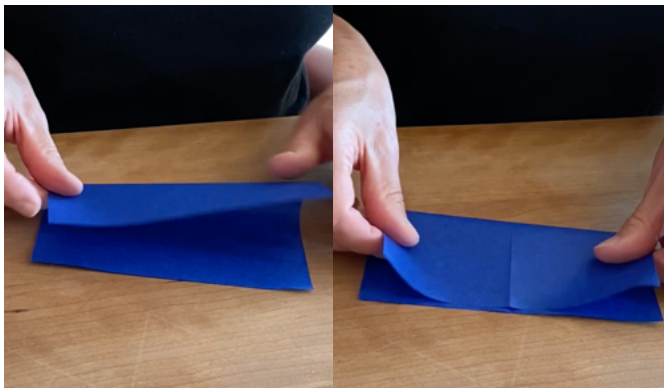
In the visible spectrum, we only see the portion of light that is reflected by an object. For example, if we perceive an object as red, this means that it reflects light with a wavelength of around 700 nanometers.

The remainder of the light is either absorbed by the object (absorption), or passes through it (transmission). A perfectly black object absorbs all of the wavelengths in the visible spectrum, whereas a white one reflects them.

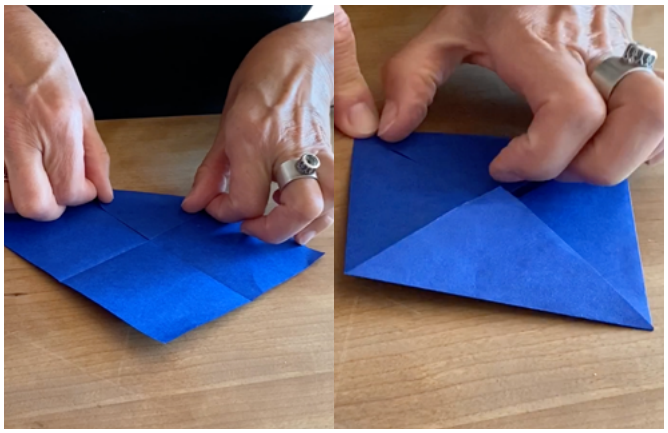
When an object absorbs light, it also absorbs energy. As the black box absorbs almost all of the visible spectrum, it gains a large amount of energy, some of which is transformed into heat. By contrast, the white box reflects most of the light, so it absorbs much less energy and doesn't heat up as much.

Folding instructions for the boxes

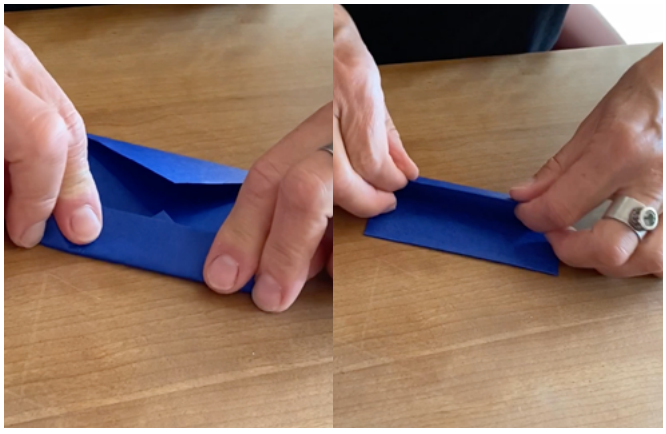
First of all, fold the square in half along the middle. Unfold, then turn the square 90° and fold it along the middle again.



Unfold the square again, then fold all four corners to the center.

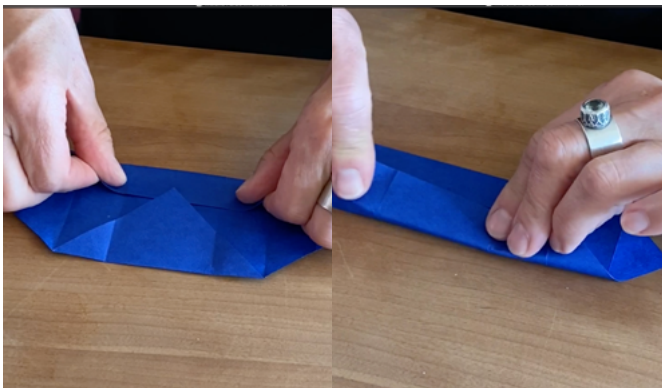


Now fold two long sides to the middle.

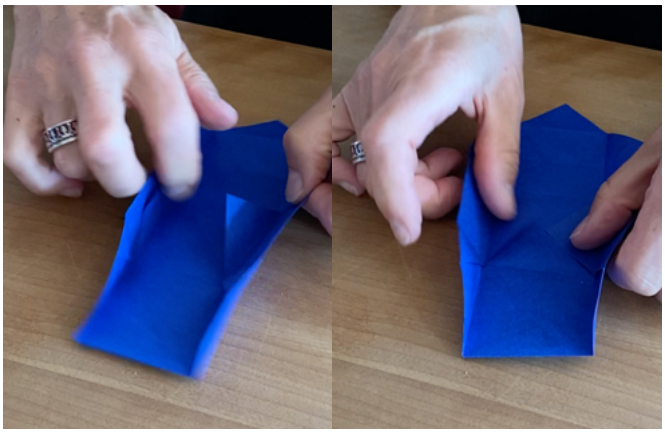


Open these folds again so that only two opposite corners are folded to the center.

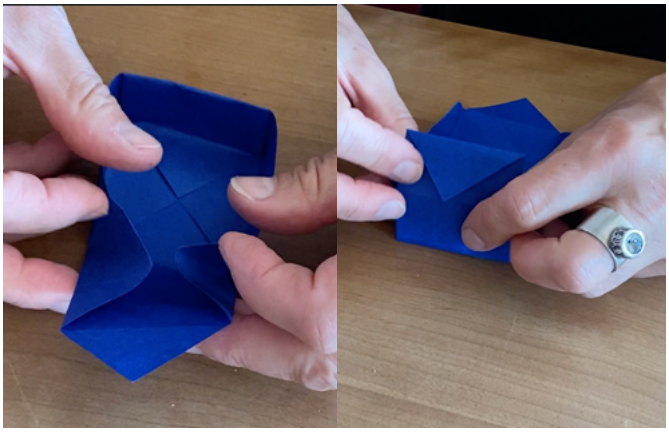
Now fold the long sides to the middle once again.



Open these folds to leave two sides of the box upright.



Fold the remaining sides up, making sure that the paper is tucked inwards along the creases.



When you have folded up the two remaining sides, the box is finished.