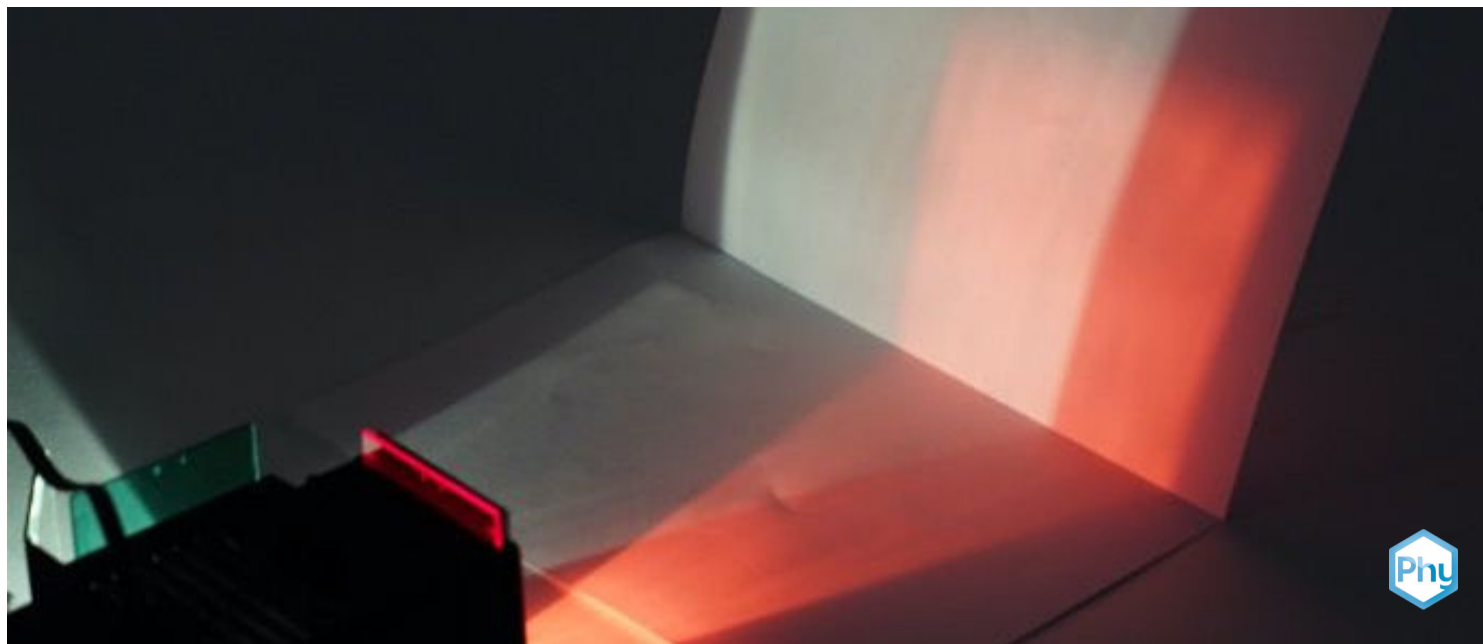


Additive colour mixing



Physics

Light & Optics

Light & Colour



Difficulty level

medium



Group size

2



Preparation time

10 minutes



Execution time

10 minutes

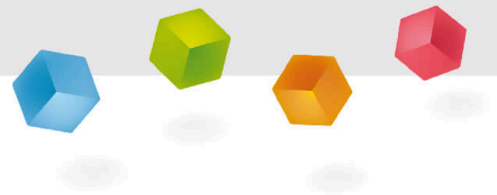
This content can also be found online at:



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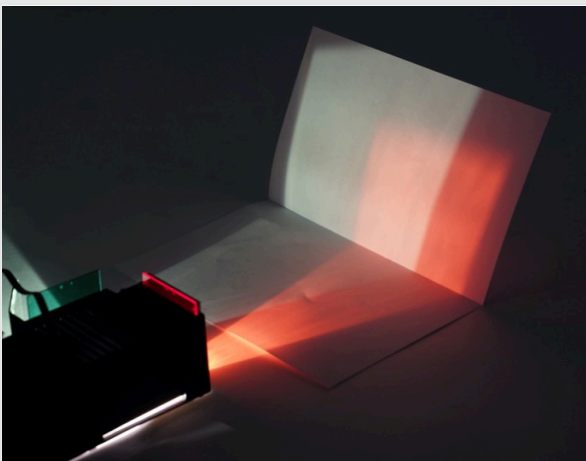
PHYWE

Teacher information



Application

PHYWE



Experiment set-up

With the experiment of additive color mixing, the students learn about one of the most important, technically used methods for creating colored images.

They will first investigate the superimposition of two differently colored light beams each, and then in a further part of the experiment they will observe the possibility of generating white light and mixed colors by combining the three additive primary colors red, green and blue.

Other teacher information (1/3)

PHYWE

Prior knowledge



The observation of colored shadows can be used to repeat the penumbra formation when illuminating an opaque object with two separate light sources, as well as to prove that the mixed color area actually contains both additive primary colors.

The experiment can be carried out with little effort and without any great demands on the students' experimental skills if the accessories for colour mixing are available. In the evaluation, the student is guided to a basic understanding of the creation of coloured television pictures. Here, the teacher's assistance is certainly useful. On the one hand, the experiment leads to an understanding of important phenomena in nature (colour perception of the human eye) or in technology (colour television), on the other hand, the experiment has an emotional effect on the students due to its simple and effective design.

Other teacher information (2/3)

PHYWE

Scientific principle



Notes on construction and implementation

When assembling, make sure that the colour filters are carefully inserted into the mirror holders. The elevations on the edges of the filters should point outwards.

In the first part of the experiment, the unused lateral light well should be closed for the examination of the superposition of two coloured light beams. If the light box is possibly too close to the folding edge in the second part of the experiment, the red and green light beams do not overlap and the mixed colours yellow and white cannot be observed.

The door panel must always be lifted into the front light shaft together with the respective colour filter. This limits the central light beam so that all colour areas can be easily observed.

Other teacher information (3/3)

PHYWE

Learning objective



The students should understand the principle of additive colour mixing and be able to understand its use in technology.

Tasks



Investigate which mixed colours can be achieved by different combinations of coloured light beams.

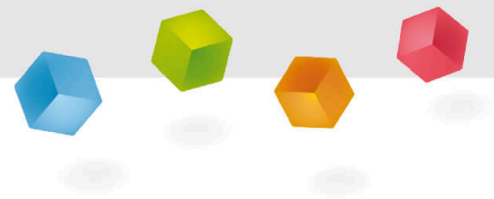
Safety instructions

PHYWE



The general instructions for safe experimentation in science teaching apply to this experiment.

PHYWE



Student Information

Motivation

PHYWE

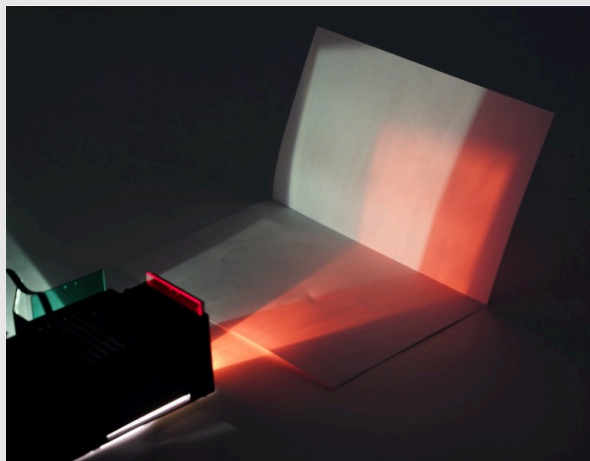


Additive colour mixing

Did you know that coloured light, when you mix it, appears white again? This phenomenon is called additive colour mixing. This phenomenon occurs in nature, but is also used, for example, to make colours on television possible.

Tasks

PHYWE



Experiment set-up

How is the colour television picture created?

Investigate which mixed colours can be achieved by different combinations of coloured light beams.

Additional is required:

- White paper (DIN A4)

Equipment

Position	Material	Item No.	Quantity
1	Light box, halogen 12V/20 W	09801-00	1
2	Light box accessories for colour mixing	09806-00	1
3	Colour filter set, additive (red, blue, green)	09807-00	1
4	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

Assembly - Attention!

PHYWE



Make sure that the trapezoidal model body does not change its position when moving the light box.

Set-up (1/2)

PHYWE



Experiment set-up

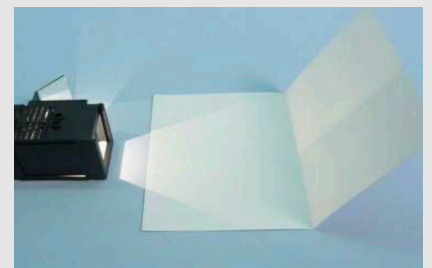
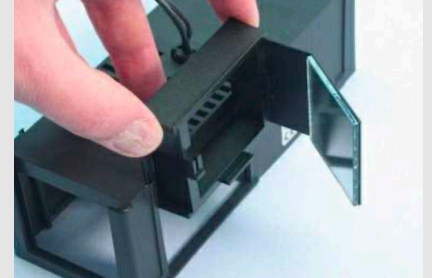
Fold your sheet of paper once crosswise in the middle and fold the right half upwards. This is your screen.

Set-up (2/2)

PHYWE

Fig. 1 and 2: Insert a mirror holder on one side of the light box and place the light box with the lamp side at about 22 cm from the folding edge.

Make sure that the side opposite the mirror holder and the back of the light box (lens side) are closed with the tightly closing panels.



Procedure (1/3)

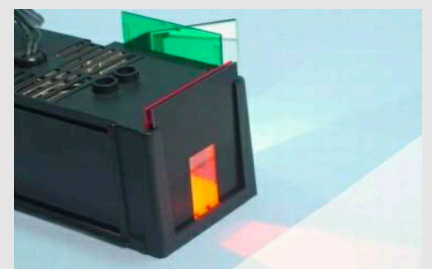
PHYWE

Fig. 3: Connect the light box to the power supply unit (12 V ~)

Fig. 4: Insert the red colour filter and the door panel into the front light well and the green colour filter into the side light well (on the mirror holder).

Observe the superimposition of the colored light beams. Which mixed colour results? Note your observations in the protocol.

Repeat this partial experiment for the filter combination green-blue and blue-red, and note the mixed color in each case.



Procedure (2/3)

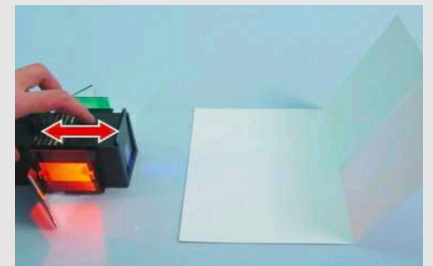
PHYWE

Fig. 5: Change the construction by inserting the second mirror holder into the side light well of the light box, place the blue colour filter and the door trim in the front light well and the green and red colour filter in the two side light wells.



Fig. 6: Increase or decrease the distance between the light box and the folding edge slightly until as many mixed colours as possible can be observed on the screen.

Make a note of all the mixed colours that appear on the screen.



Procedure (3/3)

PHYWE

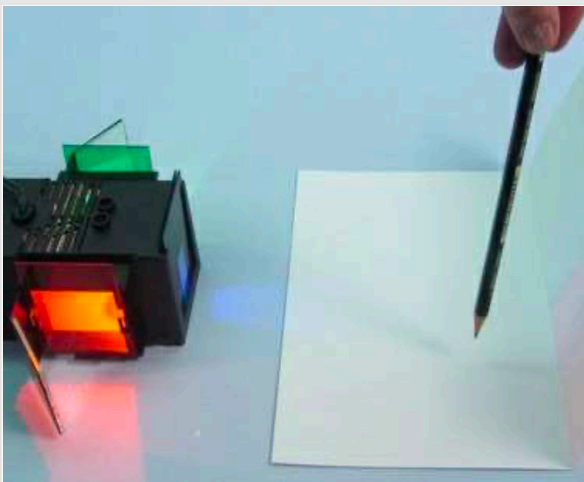
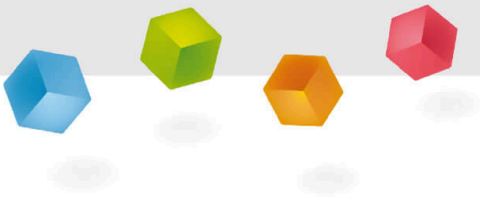


Figure 7

Fig. 7: In this setup, hold a pen about 8 cm from the screen and insert it into the differently colored light beams. Describe the observed shadows in the protocol.

Switch off the power supply unit.

PHYWE



Report

Table

PHYWE

Write down your observations in the table.

Filter colors	Observation of the mixed colour
Red and green	
blue and green	
Red and blue	
Red, Green and Blue	

Observation

PHYWE

Describe the shadow images in the following color ranges:

(a) Purple

(b) Cyan

(c) White

Evaluation - Question 1

PHYWE

The colour yellow can be created by mixing (adding) two coloured light beams. Which colours can be used for this?

Evaluation - Question 2

PHYWE

A color that does not occur in the spectrum (rainbow) can be created by adding colored light bundles. Which colour is it and which coloured light bundles are used for it?

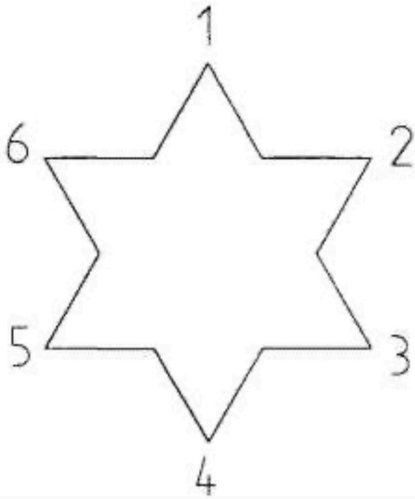
Evaluation - Question 3

PHYWE

What colour impression is created when the red, green and blue light beams overlap? What is the conclusion to be drawn from this?

Evaluation - Question 4

PHYWE



Complete the color hexagon (see illustration on the left) by adding the colors red, green and blue (also called basic colors of color addition) to the corners 1,3 and 5 and between them the mixed color which results from the addition of neighboring colors.

Evaluation - Question 5

PHYWE

The colour television picture is composed of approximately 900 000 red, green and blue rods. You can see them clearly with a magnifying glass. Each of these rods is combined into a colour group (colour triplet) and its brightness is varied 25 times per second from very dark (black) to very bright.

For example, how could the yellow colour impression (coloured image of a desert landscape) come about?

Evaluation - additional task

PHYWE

Try to give an explanation for your observations of shadow formation in coloured light.

Evaluation - additional task

PHYWE

Try to give an explanation for your observations of shadow formation in coloured light.

Task 1

PHYWE

Fill in the missing words.

The basic colours of the additive colour mixture are red, green and .

Additive Farbmischung entsteht durch die verschiedener Farben.

☒ Check

shadow play

Task 2

PHYWE

Which of the following mechanisms is the additive color mixing based on?

☐ Stage lighting☐ Smartphone displays☐ Television☒ Check

Stage light

Task 3

PHYWE

Additive colour mixing is the splitting of white light into different colours.

☐ True☐ Wrong☒ Check

Rainbow