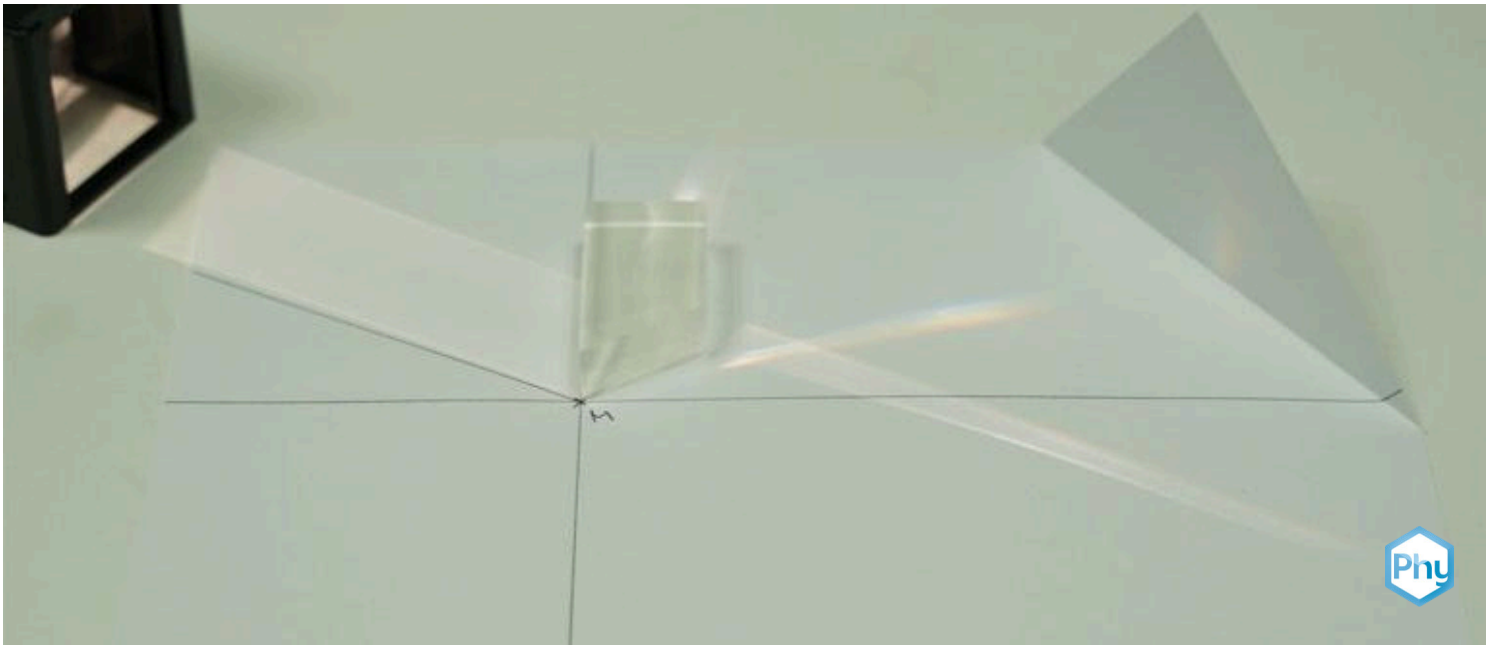
Colour dispersion with a prism



Physics > Light & Optics > Light & Colour

Difficulty level	Group size	Preparation time	Execution time
easy	1	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/5f4e66ee38db8d00032659e0

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Teacher information

Application

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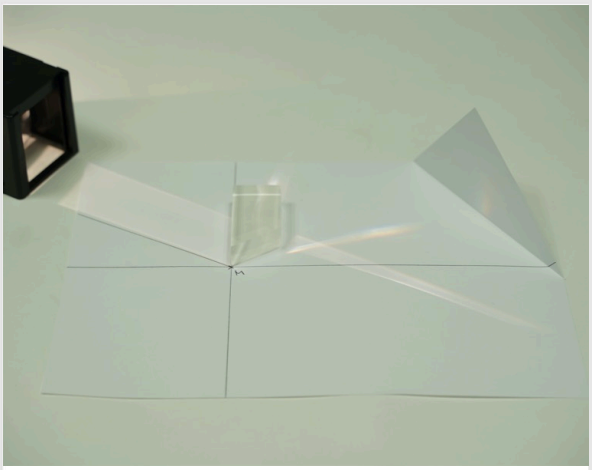

Experiment set-up

The aim of this experiment is to study the dispersion of light. The knowledge about the refraction of light at the transition from air to glass or glass to air is repeated and extended with regard to the dependence of the refraction on the colour (wavelength) of the light.

In a further part of the experiment it will be investigated whether the spectral colours can be further decomposed with a prism. This touches on the physico-historically interesting aspect of the reasoning behind the decomposition of colours.

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Other teacher information (1/4)

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Prior knowledge

Background of both experiments:

J.W.v Goethe (1749-1832): "The colours are created by the influence added to the vitreous body, in a sense by contamination through the glass".

Isaac Newton (1663-1729): "Light, which creates the impression of "white" in the eye, is composed of many types of light, which - when viewed individually - produce the sensation of different colours".

This provides the opportunity to combine the evaluation of the experiment with a consideration of the role of the experiment in scientific knowledge and to derive conclusions about the possibility of the reunification of the spectral colours.

Other teacher information (2/4)

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Scientific principle

The crosshairs and the auxiliary line for fixing the light box are necessary to achieve reproducible test setups that are as error-free as possible. When adjusting the light beam by turning the light box slightly, the teacher may need to be assisted.

In this experiment the use of the single slit diaphragm was deliberately avoided in order to let the colour-intensive spectrum have an effect on the student. However, the continuous, unrefracted part of the light is then disturbing due to the large opening of the light box. The light box opening is therefore covered at the side, e.g. with half a single slit diaphragm or with a piece of paper. If the supplementary accessory for colour mixing (order no. 09806-00) is available, the door panel contained in it can be used to appropriately limit the light box opening.

With the aid of the single slit diaphragm, which is held in the light path of the color-fanned light beam, further individual spectral colors can be faded out and examined for further decomposition.

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Other teacher information (3/4)

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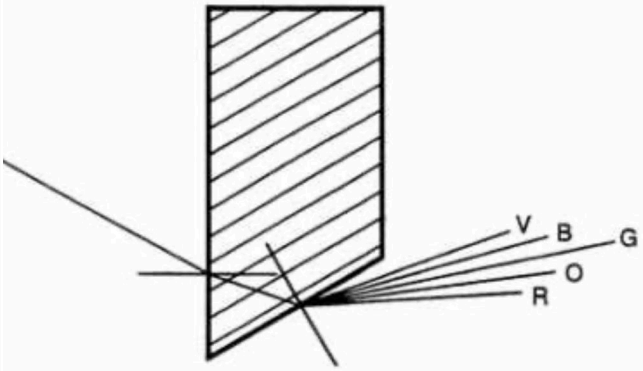
Note on evaluation

The students' records should be similar to those shown in the figure to the right. The markings have been omitted for clarity.

Note

The reflection of the decomposed white light at the "back wall" of the raindrop, which is important for the observation of a rainbow, can be discussed with the students, but for the colour decomposition of sunlight the refraction at the interface air to water is decisive. The diffraction phenomena that occur can be neglected in classroom treatment.

R - Rot; O - Orange; G - Gelb/Grün; B - Blau; V - Violett.



Sketch of the experimental setup

Other teacher information (4/4)

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Learning objective

The students should acquire knowledge about the refraction of light at the transition to glass or glass to air and understand the principle of colour decomposition using a prism.

Tasks

Investigate the color decomposition (dispersion) of white light during refraction on a prism.

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Safety instructions

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

Student Information

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Motivation

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Rainbow

The white light that you encounter in everyday life is actually not only white, but consists of several different colours.

When light is refracted, the different colours become visible. This effect can be seen, for example, in a rainbow. A similar result can be achieved by letting white light shine through a prism, as we do in this experiment.

Tasks

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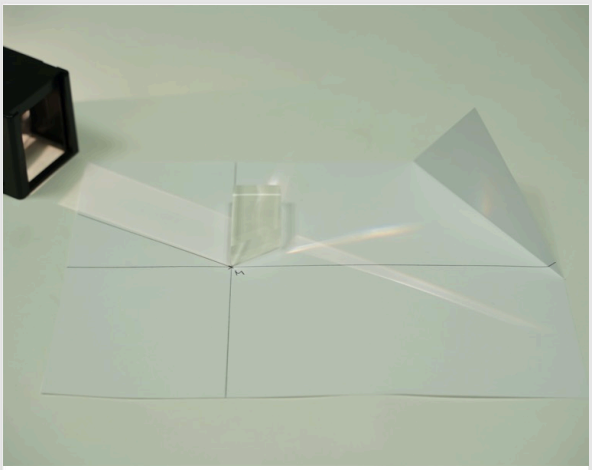

Experiment set-up

Investigate the color decomposition (dispersion) of white light during refraction on a prism.

Additional is required:

- White paper
- Protractor
- Ruler (approx. 30 cm)

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Equipment

Position	Material	Item No.	Quantity
1	Light box, halogen 12V/20 W	09801-00	1
2	Block, trapezoidal	09810-02	1
3	Block, rectangular triangle	09810-03	1
4	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

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Set-up

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Fig. 1: Draw a right-angled line cross in the left third of your sheet and mark the intersection with M.

Mark the vertical line 6 cm above M At the intersection M of the lines, apply an angle of 28° and draw an auxiliary line.

Fold the upper right corner of your sheet upwards as a screen.

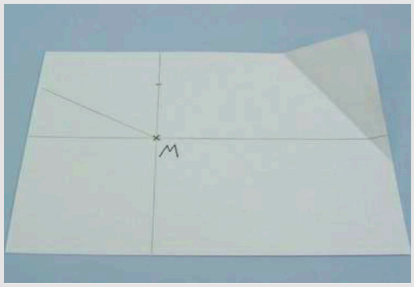
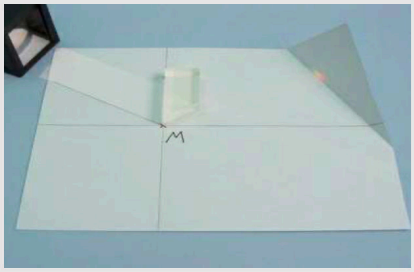


Fig. 2: Place the trapezoidal model body (with the roughened surface down) on the vertical line between M and the mark.

Draw the outline of the prism. Place the light box with the lens side, but without the aperture, diagonally above the model body.



Procedure (1/3)

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

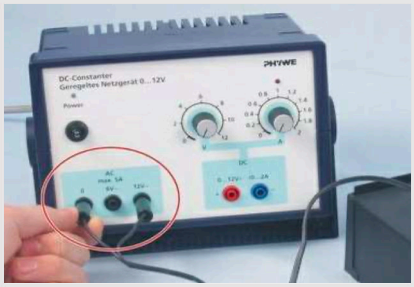
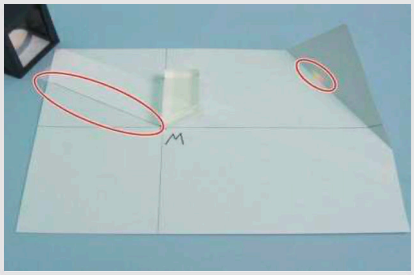


Fig. 4: Now move the light box until the lower shadow limit of the light beam is identical to the guide line. Observe the refracted light beam leaving the prism and correct the position of the light box if necessary by carefully turning it. It is correct if the refracted light beam appears completely coloured on the screen and the violet part is also visible.



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Procedure (2/3)

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Fig. 5: Cover about half of the opening of the light box so that the light only emerges from the sloping surface of the prism. Note which colours are visible on the screen.

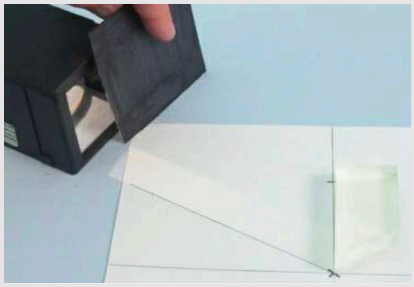
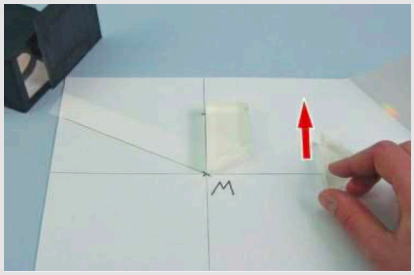


Fig. 6: Now carefully push the tip of the right-angled prism from below into the colourfully fanned out refracted light beam. What do you see behind the tip of the second prism? Write down your observations.



Procedure (3/3)

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Fig. 7: Repeat this procedure, but now push the tip of the rectangular prism into the light beam from above. Note down your observations again.

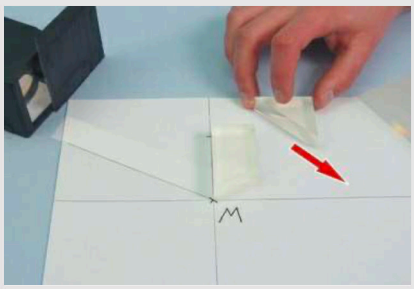
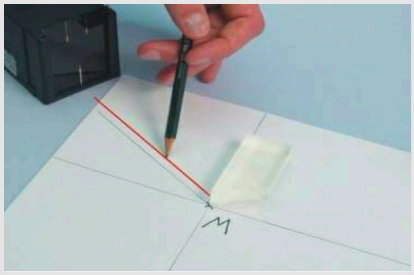


Fig. 8: Take the rectangular prism off the paper.

Insert the slit diaphragm on the lens side into the light box. Move the light box until the light beam falls on the prism parallel to the auxiliary line at a distance of about 1 cm. Mark the incident light beam and the centre and edges of the refracted light beam and note the position of the colours on your sheet of paper.



Switch off the power supply and remove the model bodies from the paper.

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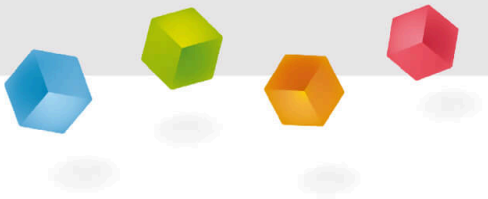

Report

Observation

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Write down the colors you see on the screen.

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Table

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Write down your observations in the table.

Position of the tip of the right-angled prism	Observations
in the red zone	
in the entire beam	
in the blue range	
in the entire beam	

Evaluation - Question 1

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What happens to white light that passes through a prism?

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Evaluation - Question 2

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The light of which colour is refracted the most, which the least?

Evaluation - Question 3

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Can the spectral colours be further broken down with a second prism?

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Evaluation - Question 4

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Where can you observe comparable colour phenomena in nature?

Evaluation - additional task

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Supplement on your sheet of paper the incidence soundings and try to explain the course of the appearance of a prism on the basis of your observations of the narrow beam of light and with the help of the law of refraction.

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Task 1

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Drag the terms to the correct position in the text.

When light falls on a prism, the light beam is refracted due to the different _____ of light. The _____ depends on the _____ of the light. Each wavelength is then given a different _____, causing the light to exit the prism as a _____ beam.

- speed of propagation
- wavelength
- deflection
- index of refraction
- multicolored

Check

Task 2

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What phenomena are underlying the mechanism we are investigating?

- ○ Rainbows
- ○ Colour television

Check

Prism

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Task 3

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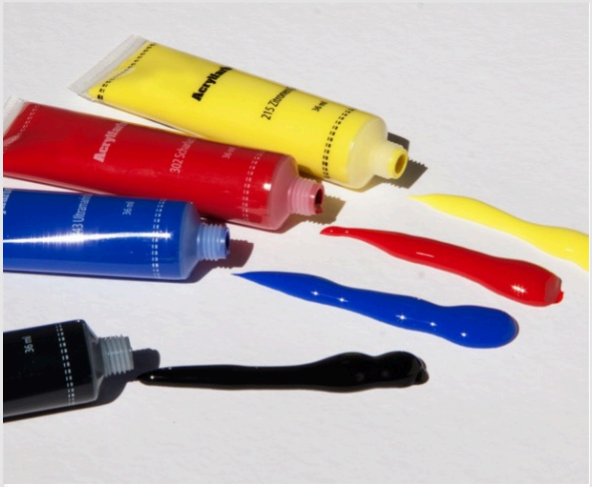
Does the colour black also belong to the components of white light?

- ○ No
- ○ Yes

Check



Is black also part of the colour spectrum of white light?

Slide	Score / Total
Slide 24: Refraction of light in the prism	0/5
Slide 25: Occurrence in everyday life	0/1
Slide 26: Black color	0/1

Total amount 0 / 7

Solutions | Repeat | Exporting text

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