Teacher packs in Experimental Science

Phy Pack 11

Investigation of the components of white light using a triangular prism

Pack contents:

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Curriculum areas covered:

Light Energy

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Title: Investigation of the components of white light using a triangular prism

Target group: Diploma in Basic Education

Also suitable for: B.Ed. Primary Education

Duration of Activity: 50 minutes plus discussion time

Learning outcomes:

At the end of the experiment the student should be able to

1. Knowledge and Understanding (KN)	KN1	Define dispersion.
	KN2	Define spectrum.
	KN3	Identify a triangular prism.
2. Cognitive Skills (CS)	CS1	Explain the principle of the dispersion of white light.
	CS2	State which component has the shortest wavelength.
	CS3	State which component has the longest wavelength.
3. Key Skills (KS)	KS1	Make and record observations; and report results.
	KS2	Relationship between wavelength and frequency.
	KS3	List the components of white light in order of increasing wavelength.
4. Practical Skills (PS)	PS1	Correct positioning of the triangular prism in the experimental setup.

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A. Teacher's Guide

Overview
Students are advised to set up the experiment as shown in the experimental diagram and carefully observed the components of light on the screen. Students should be able to explain why the colour red appears on the top with violet at the bottom.

Aim
The experiment is to enable students to observe the components of light produced when white light passes through a triangular prism. Also to explain to students the primary colours (i.e. red, green and blue).

Practical Skills Developed

1. Application of scientific method including the setting up of the experiment.
2. Making significant deduction from experimental observation.
3. Presenting observation in diagrammatic form.
4. Team work and oral communication

Equipment/ Material/ Apparatus
Triangular glass prism
Ray box
White screen

Advice to Tutors

1. Encourage students to repeat the experiment at all three sides of the triangular prism.
2. Create time to discuss the physics of what is going on.
3. Encourage each student in the team to set up the experiment.

SAMPLE ASSESSMENT QUESTIONS with ANSWERS

1. Define spectrum. (KN2)
   Answer: Spectrum refers to the components of white light. These are Red, Orange, Yellow, Green, Blue, Indigo and Violet (ROYGBIV).

2. What colour has the longest wavelength? (CS3)
   Answer: Red

3. Explain the formation of rainbow. (CS1)
   Answer: When white light from the sun passes through droplets of water, dispersion occurs which breaks the light into components?

4. List the spectrum of white light in order of decreasing wavelength. (KS3)
   Answer: Red, Orange, Yellow, Green, Blue, Indigo and Violet (ROYGBIV).

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B. Student Guide

Purpose: To show the components of light using a triangular prism.

Background Information

White light is a combination of seven colours of different wavelengths. This collection of colours is called the spectrum of white light. The longest wavelength is red light, which has a wavelength in air of about 700 nm ($700 \times 10^{-9} m$ or $0.7 \mu m$). The shortest wavelength is violet, which has a wavelength in air of about 450nm ($450 \times 10^{-9} m$ or $0.45 \mu m$).
In optics, a **prism** is a transparent optical element with flat, polished surfaces that refract light. The exact angles between the surfaces depend on the application. The traditional geometrical shape is that of a triangular prism with a rectangular base and triangular sides, and in colloquial use "prism" usually refers to this type. Some types of optical prism are not in fact in the shape of geometric prisms. Prisms are typically made out of glass, but can be made from any material that is transparent to the wavelengths for which they are designed.
A prism can be used to break light up into its constituent spectral colors (the colors of the rainbow). Prisms can also be used to reflect light, or to split light into components with different polarizations.

Light changes speed as it moves from one medium to another (for example, from air into the glass of the prism). This speed change causes the light to be refracted and to enter the new medium at a different angle (Huygens principle). The degree of bending of the light's path depends on the angle that the incident beam of light makes with the surface, and on the ratio between the refractive indices of the two media (Snell's law). The refractive index of many materials (such as glass) varies with the wavelength or color of the light used, a phenomenon known as *dispersion*. This causes light of different colors to be refracted differently and to leave the prism at different angles, creating an effect similar to a rainbow. This effect can be used to separate a beam of white light into its constituent spectrum of colors.

Equipment/ Materials needed
Triangular glass prism
Ray box
White screen

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Experimental Procedure

1. Set up the experiment as shown in the diagram below.
2. Switch on your light source.
3. Regulate the position of the light source until a clear and sharp image of the components of light is seen on the screen.

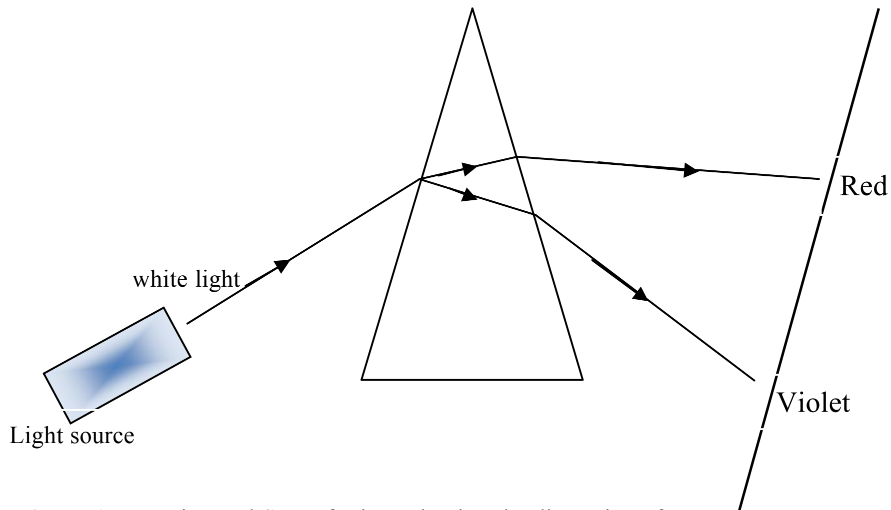

Figure 1: Experimental Setup for investigating the dispersion of white light.

C. Assessment – Student's sheet

On completion of the experiment, you should answer the following questions:

1. Define spectrum. (KN2)

2. What colour has the longest wavelength? (CS3)

3. Explain the formation of rainbow. (CS1)

4. List the spectrum of white light in order of decreasing wavelength. (KS3)

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D. Extensions to experiment

The experiment can be extended to determine the refractive index of the triangular prism and other prisms.

E. Reference and Useful links

1. Abbot A. F. (1980), *Ordinary Level Physics*, 3rd Edition, Heinemann Books International, London.

2. Moss G. L. (1963), *Ordinary Level Practical Physics*, Heinemann Books International, London.

3. Nelkon M. and Parker P., (1987), Advanced Level Physics, Heinemann Educational Publishers, London.