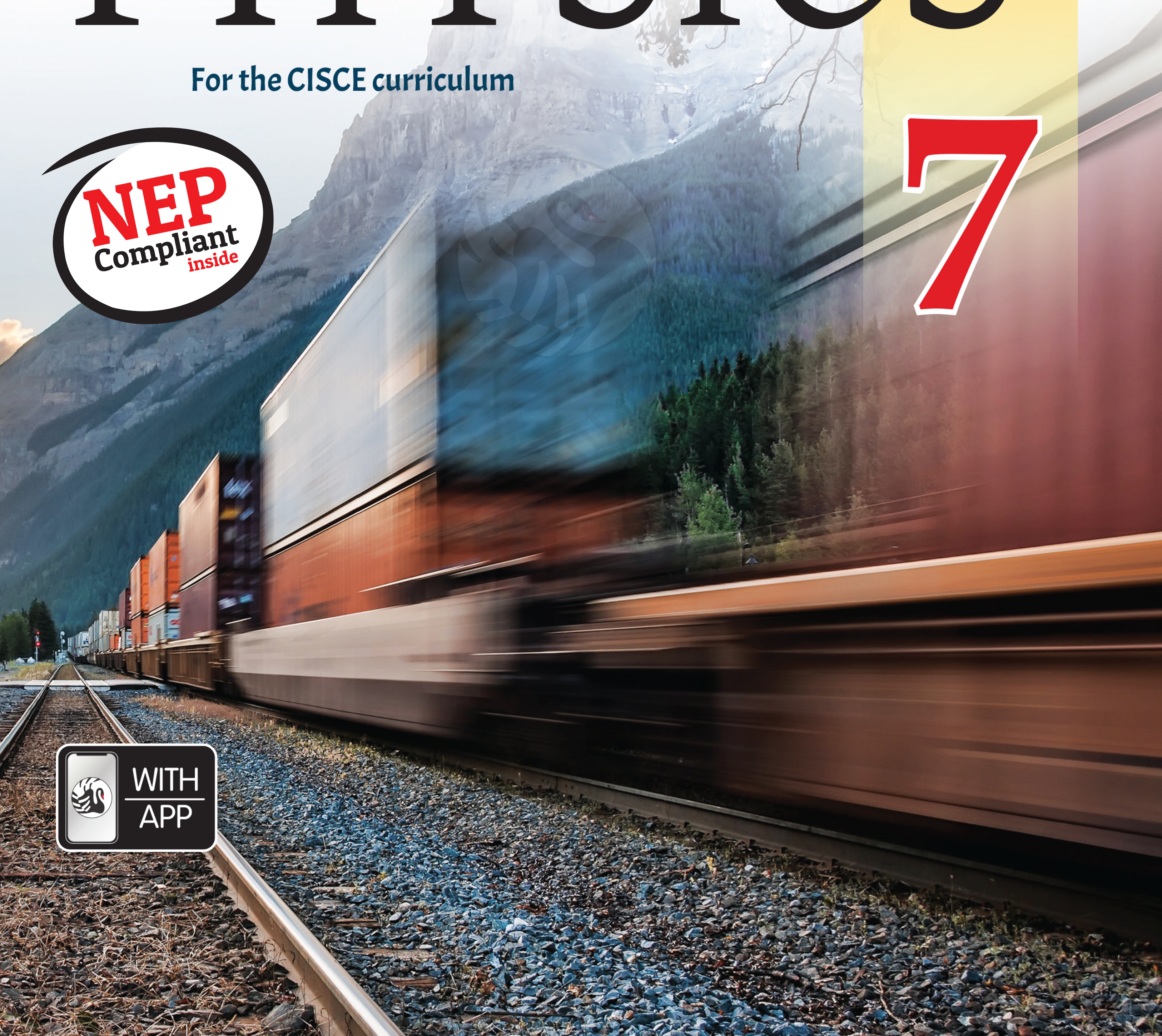
Orient BlackSwan

Inspired PHYSICS

For the CISCE curriculum

7

NEP Compliant inside



WITH APP

Inspired PHYSICS

7

Orient BlackSwan

Inspired Physics

has been developed in accordance with the CISCE Upper Primary Science (Physics) curriculum. Its aims are:

- to enable students to relate their daily life experiences and science by following a practical, thematic approach
- to focus on the development of scientific temper through skill and process development
- to encourage knowledge construction through information collection, organisation and reflection

Students' book

- complete syllabus coverage
- carefully graded text
- appropriate, well-labelled illustrations and photographs
- appropriate activities and exercises

Let's learn

Learning outcomes
encourage students to take responsibility for their learning

Get going
helps focus and direct students' attention to the lesson

Activities
help students learn through practical exercises

Stop and check
provides checkpoints for teachers and students to evaluate progress

Spotlight
focuses on important topics in greater detail

Go further
provides additional, interesting, relevant information

SciTech
links scientific concepts with real-life occurrences and applications

Eco corner
presents issues that are an environmental concern

Let's revise

In a nutshell
is a comprehensive revision corner

Concept map
is a graphic presentation of concepts linked logically

Summary
lists the main points of the lesson briefly

Keywords
lists important words and their definitions

Glossary
presents important words for quick revision at the end of the book

Teachers' resource pack

- lesson plans
- question bank with answers
- worksheets with answer key
- question papers with answer key
- answer key to the exercises in the students' book

Smart book for teachers

with exciting features such as:

- animations and videos
- interactive tasks
- presentations
- picture galleries
- teachers' resource corner
- question-paper generator

and more

Orient BlackSwan DIGITAL

Students' app

more practice for students of classes 3–8

Web support for teachers

a portal dedicated to the series with free access for teachers

Let's apply

Checkpoint

covers a variety of exercises (objective type, short answer and long answer)

Think and answer

encourages students to develop higher-order thinking skills necessary for the 21st century

Picture study

offers picture-based questions that encourage students to observe, identify and relate concepts to real life

Hands-on

offers a variety of projects that reinforce 21st century skills through experiments, model-making, discussion, role play, research work, report writing and so on

Subject integration

presents additional activities explicitly linking multiple subjects

Life skills and values

help children develop skills needed for everyday life and values needed to be well-adjusted members of society

Let's know more

Scientist in focus

describes the life and work of famous scientists to inspire students

Heritage corner

presents exciting and accurate information on India's scientific heritage

Internet links

provides sources for further study and research

Career watch

presents novel ideas for a career in science and technology

Let's work

- ***Worksheets*** a workbook corner with worksheets covering all lessons
- ***Test papers*** based on the ICSE pattern

CONTENTS

4 Light Energy

Learning outcomes

By the end of this theme, you will be able to:

- explain the phenomenon of reflection of light
- define terms related to reflection
- state the laws of reflection
- use the laws of reflection to explain the formation of images by plane mirrors
- describe the characteristics of images formed by plane mirrors
- state the value of the speed of light
- define primary colours
- describe the formation of secondary colours by the addition of primary colours
- explain how the observed colour of an object is based on the reflection, transmission and absorption of light
- explain the concept of colour subtraction

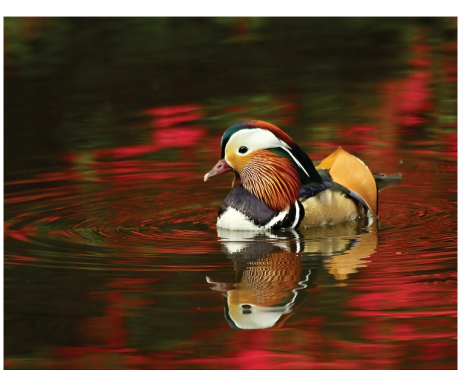
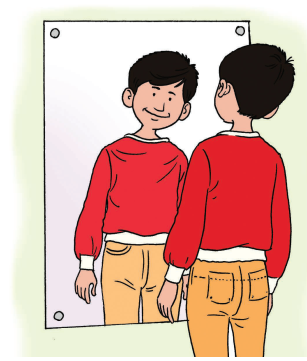


Fig. 4.1 Reflections in water



Get going

When you raise your right hand, your image in a mirror raises its left hand. When you bend to the right, it bends to the left. Why does this happen? Discuss it with your friends.

INTRODUCTION

You have learnt that light is a form of energy. It travels in straight lines. We need light to see objects. We see an object when light falling on the object bounces off it and reaches our eyes. The light creates an image in the eyes, and the brain interprets it as the object seen.

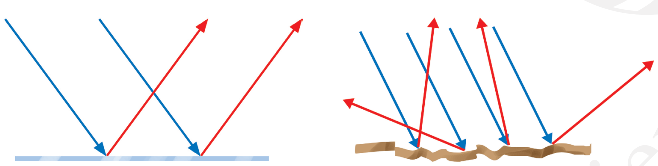
REFLECTION OF LIGHT

When light travels through a medium (say, air) and hits an object in its path, three things can happen: the light can pass through the object (for example, a glass of water); it can be absorbed by the object (for example, a black sweater); or it can return to the original medium (air).

The phenomenon of light returning to the original medium after touching a surface is known as ***reflection****.* When light falls on a shiny surface, most of it is reflected. A mirror is a good reflector as it turns back almost all the light that falls on it. Even transparent materials such as glass or water reflect a small part of light, while allowing most of it to pass through. Dark surfaces absorb most of the light that falls on them and reflect only a small part.

Regular and Irregular Reflection

When a beam of parallel rays falls on a smooth and polished surface and is reflected from it, the rays remain parallel. This is called **regular reflection**. The reflected beam of light travels in a definite direction. Regular reflection leads to the formation of clear and sharp images.



a. regular reflection   b. irregular reflection

Fig. 4.2 Types of reflection

When a beam of parallel rays falls on a rough and dull surface, the light rays are scattered in all directions. This is called **irregular** or **diffused reflection**. It produces a blurred image, or no image.

Real and Virtual Images

In the previous class, you constructed a pinhole. In the pinhole camera, you captured the image on a screen. *An image that can be caught on a screen is known as a* ***real image****.*

Now, observe a reflection from a flat mirror. No matter where you place a screen, the image will not fall on it. *An image that cannot be caught on a screen is known as a* ***virtual image****.*

Terms Related to Reflection

Let us learn some important terms used in studying the reflection of light at a smooth, plane[1] surface.

- **Incidence** (of a light ray) hitting a surface
- **Incident ray** the ray travelling towards the reflecting surface
- **Reflected ray** the ray coming back from the reflecting surface after striking it
- **Normal** the imaginary line perpendicular to the reflecting surface at the point of incidence
- **Angle of incidence** the angle between the incident ray and the normal ($\angle i$)
- **Angle of reflection** the angle between the reflected ray and the normal ($\angle r$)

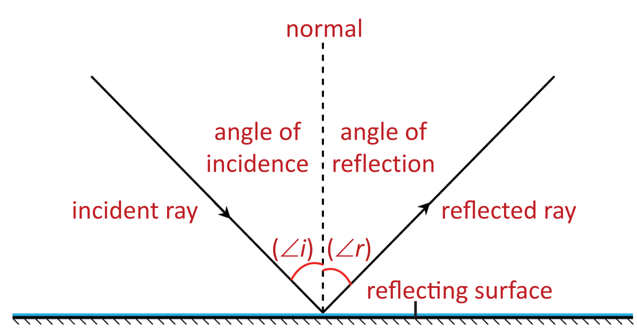


Fig. 4.3 Terms related to reflection

[1]**plane** (with reference to surfaces) flat

The Laws of Reflection

Reflection follows two basic laws.

1. **The incident ray, the reflected ray and the normal at the point of incidence all lie on the same plane.**
2. **The angle of incidence (∠*i*) is equal to the angle of reflection (∠r).**

Let us carry out an activity to verify these laws.

Activity 4.1

Aim: To verify that (1) the incident ray and the reflected ray lie on the same plane; (2) the angle of incidence and angle of reflection are equal

Materials required: rectangular mirror, four pins, sheet of paper

Method

1. Place a sheet of paper on the table.
2. Draw a line segment *LM* on it to represent the mirror (as seen from the top).
3. Draw a line segment *ON* perpendicular to it. This represents the normal at point *O*.
4. Draw a line segment at a convenient angle (say 40°) to the normal at point *O* to represent the incident ray. Mark two points *P* and *Q* on it with a gap between them, and fix a pin upright at each marked point.
5. Fix a mirror vertically on *LM*. Look into the mirror, closing one eye. Adjust the position of your eye so that you see the reflection of the two pins in a line in the mirror. (You should be able to see only one pin since the other will be hidden behind it.)
6. Fix two more pins in line with the image of *P* and *Q* at points *R* and *S*.
7. Remove the mirror and the pins.
8. Draw a straight line connecting *ORS*, which represents the reflected ray.
9. Measure the angle of reflection.
10. Repeat the activity by changing the angle of incidence to 30° and 60°.

Observations and conclusions

1. In step 5 you would have noticed that, your eye has to be at a particular height above the paper sheet to view the two images exactly one behind the other, so that they appear as a single image. If you view the images from higher or lower than this height, they do not appear as a single image. This is because the object and the image are on the same plane, meaning that the incident ray from the object and the reflected ray from the mirror are on the same plane.
2. The angle of reflection is equal to the angle of incidence for all angles of incidence.

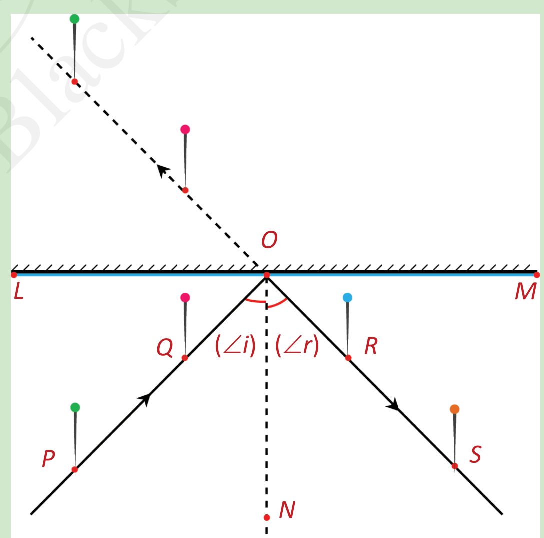


Fig. 4.4 Verifying the laws of reflection

Thus, the two laws of reflection are verified. From law 2, it follows that a ray travelling along the normal will return along the same path after reflection.

PLANE MIRRORS

*A mirror with a flat reflecting surface is a **plane mirror**.* Plane mirrors are commonly made of a flat glass plate with a coating of highly reflective aluminium or silver on one side. A coating of paint is often added to the metallised surface to protect it from corrosion.

Go further...

A mirror can also have a curved surface. A mirror with its reflecting surface curved outwards is a **convex mirror**. It makes a parallel beam of light falling on it diverge. Convex mirrors are used as rear-view mirrors in vehicles. A mirror with its reflecting surface curved inwards is a **concave mirror**. It has the capability to converge a parallel beam of light to a point. Hence, it can form real images that can be captured on a screen.

Image Formation by a Plane Mirror

Stand in front of a mirror and raise your right hand. Your image seems to raise its left hand. *The phenomenon by which left and right are interchanged is known as **lateral inversion**.*

Observe the height of your image in the mirror. It seems to be of the same height as you. Step towards the mirror and away from it. Your image also moves towards and away from the mirror.

Place a sheet of paper in front of the mirror and even behind it. No matter where you place it, you cannot capture your image on it.

From these observations, we can infer the characteristics of images formed by plane mirrors.

Characteristics of an image formed by a plane mirror

- The image formed by a plane mirror is erect (that is, upright, and not inverted or upside-down).
- It is of the same size as the object.
- The image has its right and left sides reversed compared to the object. That is, the image is laterally inverted.
- The image is formed behind the mirror, at the same distance as the object is in front of the mirror. That is, image distance is equal to object distance.
- The image formed by a mirror cannot be captured on a screen. It is a virtual image.

Spotlight

You might observe that as you move away from a mirror, the size of the image becomes smaller. This is because **apparent size** changes with distance. This is why any object (for example, a tree) seems to become smaller as you move away from it. The tree itself does not become smaller.

In Activities 4.2 and 4.3, we shall see how to use the laws of reflection to draw ray diagrams, and use these to determine the properties of images formed by plane mirrors.

The laws of reflection can be used to draw ray diagrams. From the ray diagrams, we

Activity 4.2

Aim: To verify the location of the image formed by a plane mirror using a ray diagram

Materials required: pencil, paper

Method

1. Refer to Fig. 4.4, obtained by carrying out Activity 4.1.
2. Produce *ORS* behind *LM*.
3. Draw perpendiculars to *LM* passing through *P* and *Q* such that they intersect *LM* at *X* and *Y* and the produced segment at *P′* and *Q′*.
4. Measure the lengths of *PX* and *P′X* and *QY* and *Q′Y*.

Observations and conclusions: Note that *PX* = *P′X* and *QY* = *Q′Y*. This proves that the image is as far behind the mirror as the object is in front of it.

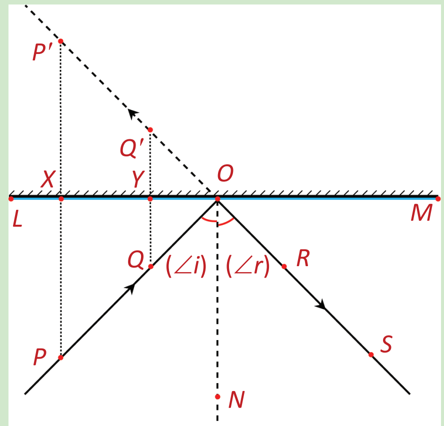


Fig. 4.5 Verifying the location of the image formed by a plane mirror

Activity 4.3

Aim: To verify the size and orientation of the image formed by a plane mirror using a ray diagram

Materials required: pencil, paper

Method

1. Instead of a point object, consider an object such as a pencil. Represent it using an arrow *AB* as shown in the diagram.
2. Draw two incident rays each from *A* and *B*, and construct the normals and reflected rays. (The normals are not shown in the diagram.)
3. Produce the reflected rays backwards to intersect at *A′* and *B′*.
4. Reconstruct the arrow at *A′B′*, paying attention to the direction in which it points.
5. Measure *AB* and *A′B′*.

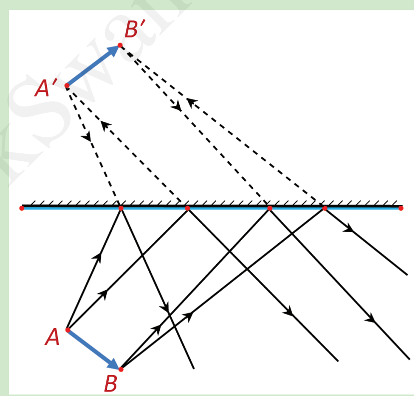


Fig. 4.6 Verifying the size and orientation of the image formed by a plane mirror

Observations and conclusions: Note that *AB* = *A′B′*. This proves that the size of the image is the same as that of the object in front of it. *A′B′* is also laterally inverted compared to *AB*.

can determine the location and size of images formed by a plane mirror.

Uses of Plane Mirrors

Plane mirrors are used as looking glasses (dressing mirrors). In solar cookers, plane mirrors are used to reflect sunlight onto the cooking vessel. They are also used in optical devices such as the **kaleidoscope** and the **periscope**.

Go further...

A **periscope** is an arrangement of two rectangular or square-shaped mirrors at the top and bottom of a long box. The mirrors form an angle of 45° to the length of the box and are open to the outside through cuts made in the box in front of the mirrors. Light entering through the top is turned 90° by each mirror in turn. Hence, a person looking at the bottom mirror can view what appears in the top mirror. Periscopes are used in submarines to look above the water surface. They can also be used to look above a barrier such as a wall.

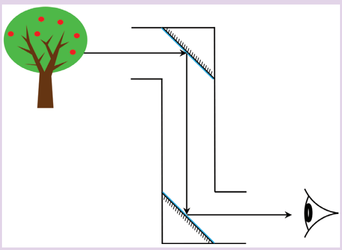


Fig. 4.7 Periscope

THE SPEED OF LIGHT

If you shine a flashlight on a wall, the light reaches the wall as soon as the switch is turned on. From our experience, light seems to spread without spending any time in travelling. Actually, light does take time to travel between two points; but this time interval is so small that light seems to travel instantaneously. This is because light travels at a tremendous speed. Indeed, nothing can travel faster than light.

Scientists have determined the speed of light in air and vacuum to be about **300,000,000 m/s**. It is usually written in short as **3×10^8 m/s**. Because of its great speed, light reaches the Earth from the Sun, travelling a distance of about 150 million kilometres, in approximately 8 minutes. It takes only 1.3 s for moonlight to reach the Earth!

In mediums other than air and vacuum, the speed of light is less than 3×10^8 m/s. The speed of light in water is 2.25×10^8 m/s, and in glass it is 2×10^8 m/s.

Eco corner

Light pollution is the excessive use of artificial outdoor light at night. It has many unwanted consequences, including **sky glow**, which makes stars and other heavenly bodies invisible. For example, we cannot see the Milky Way from urban areas. Light pollution also disrupts the natural sleep–wake cycle of animals and disrupts the movement of animals at night. It can also reduce low-light vision of the eye, resulting in poor visibility at night.

Stop and check

Fill in the blanks.

1. When a ray of light bounces back from a surface, we say it has been ___________.
2. Reflection from a smooth, polished surface is called ___________ reflection.
3. The angle of incidence is equal to the angle of ___________.
4. The image formed by a plane mirror is ___________ inverted.
5. ___________ images cannot be caught on a screen.

COLOURS

We see the objects around us because they reflect the light that falls on them, and the reflected rays reach our eyes. But why do they differ in colour? Why is an apple red and a banana yellow?

Sunlight is white light. It is made of different colours. In a classic experiment, the great scientist Isaac Newton passed white light through a glass prism, like the one shown in the figure. He showed that light split into different colours as it passed through the prism. *The band of colours is called a* ***spectrum****.* The colours are **violet**, **indigo**, **blue**, **green**, **yellow**, **orange** and **red** (**VIBGYOR**) from the bottom of the spectrum to the top.

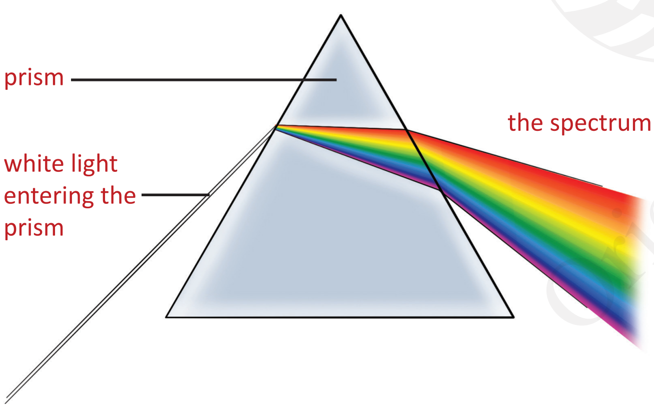


Fig. 4.8 The spectrum of sunlight

In nature, **rainbows** are formed when the sun is low in the sky and it is raining. The raindrops act as small prisms and split light into the seven colours described. Violet forms the bottommost band and red forms the topmost band.

Addition of Colours

Primary colours

Red, **green** and **blue** are known as the primary colours of light. They cannot be obtained by mixing lights of other colours in any proportion.

Light of other colours can be made by combining the primary colours in suitable proportions. When red, green and blue lights are projected on a screen, white light is obtained:

red (R) + green (G) + blue (B) = white

Secondary colours

A secondary colour is a colour of light obtained by mixing lights of any two primary colours in equal proportions. Yellow, cyan and magenta are the three secondary colours of light.

red	+	**green**	=	**yellow**
red	+	**blue**	=	**magenta**
blue	+	**green**	=	**cyan**

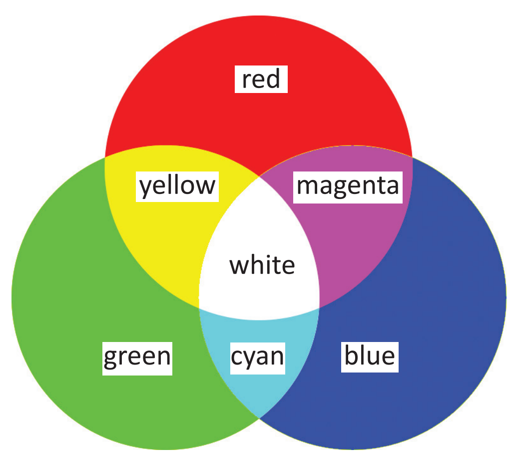


Fig. 4.9 Primary and secondary colours

Activity 4.4

Aim: To study the addition of primary colours

Materials required: three flashlights (with white LED[2] lamps); red, green and blue cellophane sheets; white paper or cloth

Method: Cover each of the flashlights with a cellophane sheet of a primary colour. Cover the top of a table with white paper sheets or cloth. Point the flashlights towards the white screen on the same area.

Observations and conclusions: The part of the surface where red and green lights overlap appears yellow; red and blue lights overlap to produce magenta; blue and green lights together produce cyan. The region where all the coloured lights overlap appears white.

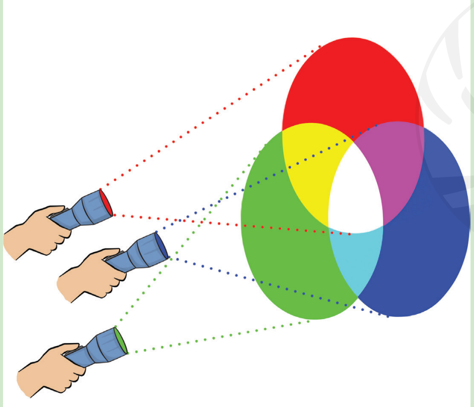


Fig. 4.10 Adding primary colours

Any desired colour can be obtained by combining the three primary colours in suitable proportions. This process is known as **additive colour mixing**.

Complementary colours

A pair of colours that, on mixing, produce white light are called ***complementary colours***. We can get white by mixing green and magenta in equal amounts. Thus, green and magenta form a complementary pair. Similarly, blue and yellow, and red and cyan, are pairs of complementary colours.

Relevance of additive colour mixing

The **retina** of the human eye (the inner part of the eyeball on which the image is formed by the lens of the eye) has three types of cone-shaped cells, each sensitive to one primary colour. The brain mixes the signals from the three types to interpret the colour of objects seen.

In **LED panels** used in TV and computer screens, pixels (dots) in the three primary colours are made to glow at different levels of brightness. This produces the required colour at a spot on the screen. An image is formed by millions of such spots.

Colours of Objects

The colour of an opaque object is the colour of the light it reflects. The colour of a transparent object is the colour of the light it transmits or allows to pass through. The perceived colour of an object also depends on the colour of the light that falls on it.

[2]**LED** light-emitting diode

White light falling on an opaque object

- When an object reflects all the primary colours of the white light falling on it, it appears white.
- When an object absorbs all the primary colours of white light and reflects none, it appears black.
- When an object reflects one of the primary colours and absorbs all other colours, it appears to be of the reflected colour.
- If the object reflects two primary colours, it appears to be of the secondary colour formed by those two primary colours.
- If the object reflects various component colours in different proportions, its colour is the resultant of their addition.

Thus, we see objects around us in millions of different colours.

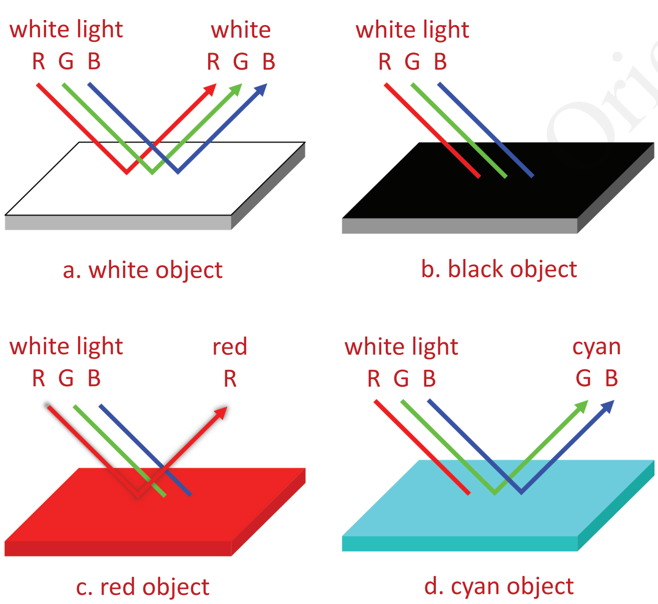


Fig. 4.11 Objects of different colours viewed under white light

Coloured light falling on an opaque object

A red object appears red as it reflects red light. It will appear red as long as the red component is present in the light falling on it. For example, a red brick will appear red when viewed under white light (**R** + **G** + **B**), yellow light (**R** + **G**), magenta light (**R** + **B**) and red light (only **R**).

Similarly, an object of any other colour will continue to have the same appearance if the light falling on it has that component.

A red object will appear black if the red component is not present in the light falling on it. Thus, a red brick will look black under green light (only **G**), blue light (only **B**) and cyan light (**G** + **B**).

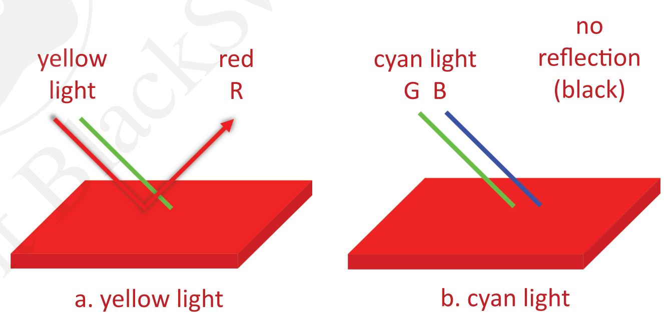


Fig. 4.12 A red object viewed under different lights

Likewise, an object of any other colour will appear black if the light falling on it does not have that colour component.

SciTech

Containers used in solar cookers are painted black. As black absorbs all the colours present in sunlight, it helps to maximise the heat produced. Similarly, solar cells are made in black or dark blue colours so that they absorb sunlight in full.

Stop and check

Identify the colour the object will appear to be.

1. red light shone on a white object: ________
2. blue light shone on a red object: ________
3. green light shone on a yellow object: ________
4. red light shone on a green object: ________
5. red light shone on a cyan object: ________

Subtraction of Colours

You saw that a magenta object reflects red and blue light, which add to form magenta. This can also be explained as a subtraction of colours: a magenta object subtracts (absorbs) green from white light. This results in magenta. That is,

(R + G + B) – G = (R + B)

Or, white – **green** = **magenta**

Consider a yellow-coloured object. Since yellow is made up of red and green, the object reflects these components of white light; it absorbs blue, which is not a part of yellow. We can say that a yellow object subtracts blue colour from white light.

(R + G + B) – B = (R + G)

Or, white – **blue** = yellow

Similarly a cyan object subtracts red from the light that falls on it:

(R + G + B) – R = (G + B)

If cyan light falls on the yellow object, the object will absorb the blue component and reflect the green component. Hence, the object will appear green.

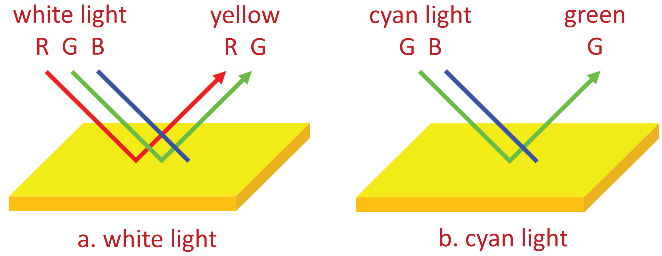


Fig. 4.13 A yellow object viewed under different lights

Filters

A ***filter*** *is a transparent sheet or plate of a particular colour.* It transmits that colour and blocks (absorbs) all other colours. A green filter allows only green light to pass through. A yellow filter passes yellow (R + G) and blocks blue. If two filters are combined, only the colour that can pass through both emerges from the combination.

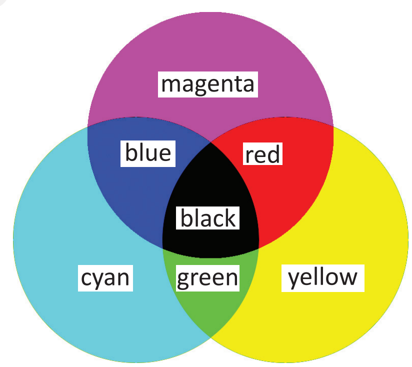


Fig. 4.14 Subtraction of colours

Starting with white, any desired colour can be obtained by a suitable combination of cyan, magenta and yellow filters that can pass their colours in the desired proportions. This process is called **subtractive colour mixing**. Cyan, magenta and yellow are regarded as the primary colours for subtractive colour mixing.

Applications of subtractive colour mixing

Subtractive colour mixing is used in printing. An image is split into cyan, magenta, yellow and black areas. Parts in the four colours are printed one over the other on white paper to produce the final image with thousands of colours.

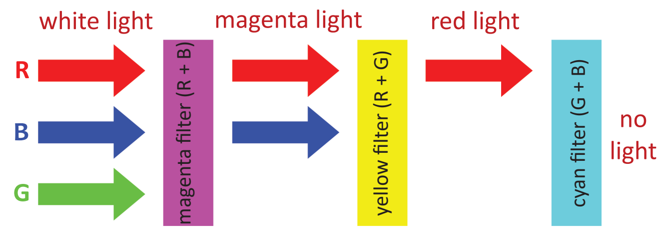


Fig. 4.15 Subtractive colour production

Go further...

Black print can be obtained by printing with cyan, magenta and yellow inks one on top of another. However, since printing in black is widespread, black ink is usually used as a separate colour. For example, in this textbook, all the black text has been printed using black ink alone. The pictures and other coloured parts have been produced by printing with cyan, magenta, yellow and black inks one on top of another.

Career watch

Colourist

A colourist is a professional who adjusts the colours in a movie on a computer. Colourists correct any colour-related defects such as too much or too little colour in different objects or people in a shot, to improve the visual appeal of the movie. To become a colourist, you have to get a degree in graphics design, digital arts or visual communication.

CHECKPOINT

A. Choose the correct option.

1. The angle of incidence is the angle between __________.
   a) the incident ray and the mirror
   b) the incident ray and the normal
   c) the incident ray and the reflected ray
   d) the reflected ray and the normal
2. When the angle of incidence is 40°, the angle of reflection is __________.
   a) 80° b) 50° c) 20° d) 40°
3. Which of these statements about the image produced by a plane mirror is incorrect?
   a) It is laterally inverted.
   b) It is of the same size as the object.
   c) It can be captured on a screen.
   d) It is behind the mirror.
4. The distance between an object and a plane mirror is 60 cm. The distance between the object and the image is __________.
   a) 60 cm b) 30 cm c) 120 cm d) 15 cm
5. For a ray incident along the normal, the angle of reflection is __________.
   a) 90° b) 45° c) 180° d) 0°
6. If the angle between the incident ray and reflected ray is 60°, the angle of incidence is __________.
   a) 60° b) 15° c) 30° d) 90°
7. If the angle of incidence is 45°, the angle between the incident ray and reflected ray is __________.
   a) 60° b) 45° c) 30° d) 90°

8. The speed of light is maximum in __________.
   a) vacuum b) water
   c) glass d) cellophane
9. Yellow light is made up of __________ light.
   a) red and blue b) red and green
   c) blue and green d) red and white
10. A blue shirt will appear __________ under cyan light.
   a) green b) black c) blue d) white
11. Which of these combinations will not produce white?
   a) blue and yellow b) green and magenta
   c) red and yellow d) cyan and red

B. Fill in the blanks.

1. The reflection of light by a smooth polished surface is called __________ reflection.
2. The __________ is the perpendicular to the mirror at the point of incidence.
3. The image formed by a plane mirror is at the same distance __________ the mirror as the object is in front of it.
4. A mirror is made by __________ one side of a glass sheet.
5. The speed of light in air is __________.
6. A pair of __________ colours gives white when mixed.
7. blue + __________ = cyan
8. green + __________ = white
9. white – red = __________
10. white – yellow = __________

C. Say if the statements are true or false.

1. The incident ray, the reflected ray and the normal do not always lie on the same plane.
2. The image formed by a plane mirror can be captured on a screen placed behind the mirror.
3. If you raise your right hand, your image in a plane mirror also raises its right hand.
4. The image seen in a plane mirror is a virtual image.
5. A green leaf in yellow light will appear blue.
6. White paper placed under coloured light will appear to have the colour of the light.
7. A black object in any light will be black.

D. Differentiate between the following.

1. Regular and irregular reflection
2. Real and virtual images

E. Define the following for a plane mirror.

1. incident ray 2. reflected ray
3. normal 4. angle of incidence
5. angle of reflection

F. Short-answer questions

1. State the laws of reflection.
2. How is a plane mirror made?
3. State any two uses of a plane mirror.
4. What is meant by lateral inversion?
5. Name the primary colours in additive mixing.
6. Name the secondary colours. How are they formed?
7. An object appears magenta. What are the primary colours it reflects and absorbs?
8. A bead appears blue in white light. What will be its colour in blue light?

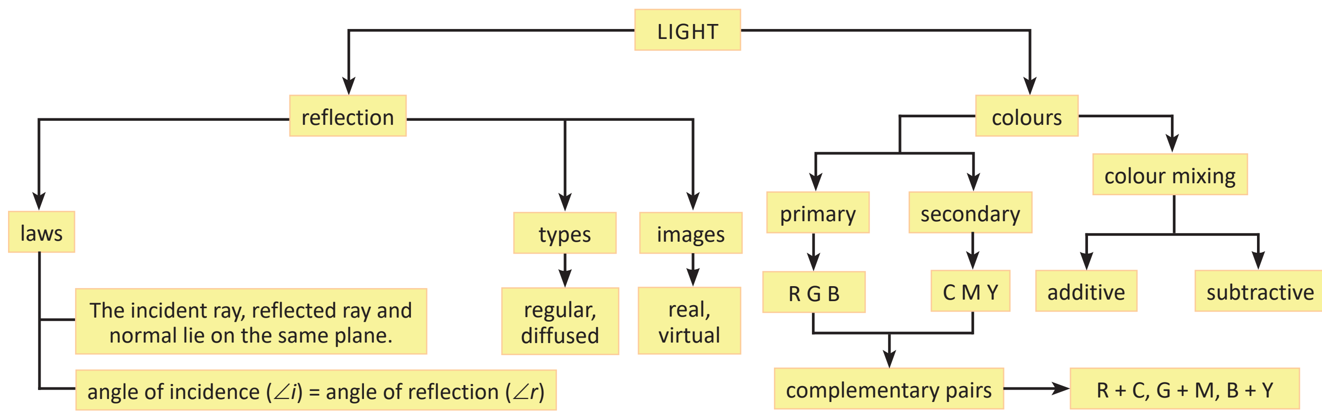
G. Long-answer questions

1. Describe an experiment to show that the angle of incidence is equal to the angle of reflection.
2. Explain how you will find the location of the image of a point object placed in front of a plane mirror.
3. State the characteristics of the image formed by a plane mirror.
4. Does the perceived colour of an object depend on the colour of light incident on it? Explain with an example.

5. A leaf appears green in sunlight. What will be its colour in: (i) red light; (ii) green light; (iii) yellow light; (iv) cyan light? Hence, explain colour subtraction.

In a nutshell

CONCEPT MAP



SUMMARY

- The turning back of light rays from a surface is called reflection.
- The reflection of light in a definite direction from a smooth polished surface is known as regular reflection.
- The reflection of light in various directions from a rough surface is called irregular or diffused reflection.
- A real image is one that can be caught on a screen. A virtual image is one that cannot be caught on a screen.
- The laws of reflection are:

  1. The incident ray, the reflected ray and the normal at the point of incidence lie on the same plane.
  2. The angle of incidence is equal to the angle of reflection.
- A plane mirror is a mirror with a flat reflecting surface. It is commonly a flat glass sheet silvered on one side.
- The image formed by a plane mirror is virtual; it is laterally inverted; it is of the same size as the object; and it is at the same distance behind the mirror as the object is in front of it.
- Plane mirrors are used as looking glasses, and in solar cookers, kaleidoscopes and periscopes.
- The speed of light in air and vacuum is 3×10^8 m/s.
- Red, green and blue are called primary colours since any colour can be produced by mixing these colours in suitable proportions. This process is called additive colour mixing.
- A secondary colour is a colour obtained by mixing any two primary colours in equal proportions. Yellow, cyan and magenta are the three secondary colours.

  red + blue = magenta; red + green = yellow; green + blue = cyan
- Complementary colours are pairs of colours that produce white when mixed in equal proportions.
- The colour of an opaque object is the colour of the light it reflects. It also depends on the colour of the light that falls on it.
- An object appears black when it absorbs all colours contained in the light falling on it.
- An object appears white when white light falls on the object and it reflects all three primary colours.

- The colour of a transparent object like a cellophane sheet is the colour of light it allows to pass through it. Colour filters are made from transparent materials.
- In subtractive colour mixing, a colour is formed by subtracting cyan, magenta or yellow from white.

KEYWORDS

additive colour mixing the production of a desired colour by mixing primary colours

angle of incidence the angle between the incident ray and the normal at the point of incidence

angle of reflection the angle between the reflected ray and the normal at the point of incidence

complementary colours a pair of colours that, on mixing, produce white light (green and magenta, blue and yellow, and red and cyan are complementary pairs)

incident ray a ray of light that strikes the reflecting surface

irregular reflection the reflection of light in various directions from a rough surface

normal the perpendicular to the reflecting surface at the point of incidence

plane mirror a mirror with a flat reflecting surface

primary colour a colour of light that cannot be produced by mixing other colours (red, green and blue); any colour can be produced by mixing primary colours in suitable proportions

reflected ray a ray of light that turns back to the original medium after touching a surface

reflection the turning back of light from a surface

regular reflection reflection in a definite direction from a smooth polished surface

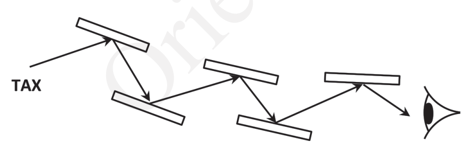
secondary colour a colour obtained by mixing any two primary colours in equal proportions (yellow, cyan and magenta)

subtractive colour mixing the production of a colour by subtracting secondary colours from white

virtual image an image that cannot be captured on a screen

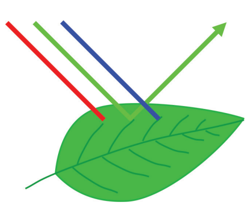
Picture Study

1. Look at the picture. How will the observer see the word—as TAX or XAT?

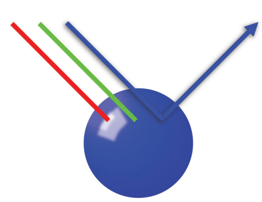


2. Explain the colour formation shown in the figures.

i.



ii.



Think and Answer

1. We have natural light inside the home even when there is no direct sunlight entering it. Can you explain how this happens?

2. Suppose two mirrors are placed almost parallel and facing each other. An object (say, a lighted candle) is placed between the mirrors. This setup produces a large number of images in a row in both mirrors. How will you explain this?
3. People going out in sunlit areas are advised to wear dark sunglasses. Why?

Life Skills and Values

Samuel always makes sure that the curtains are opened and the house is naturally lit. He says it is one way to reduce the amount of electricity spent. Is he right? Why is saving electricity important? Discuss this with your friends.

Hands-on

Make a simple periscope using cardboard and two plane mirrors.

Subject Integration

(Art, Maths, Technology in daily life)

A kaleidoscope makes beautiful symmetric patterns. It is made of three rectangular mirrors arranged at 60° to each other to form a triangle. At one end, glass or plastic pieces of irregular shapes and various colours are put into a round box, with glass plates on either side. When viewed through the open end, symmetric patterns are seen due to multiple reflections by the three mirrors. The pattern changes if the kaleidoscope is rotated or tapped. Artists and designers use kaleidoscopes to create designs. The kaleidoscope is also used as a toy.

Scientist in Focus

C V Raman

Chandrasekhara Venkata Raman (1888–1970) was an Indian physicist. He studied the behaviour of sound and light extensively. Raman discovered that when light travels through a liquid, some of the light scattered at right angles has a different wavelength. This phenomenon is named the **Raman effect** in his honour. Raman was awarded the Nobel Prize in Physics in 1930 for this discovery.

Raman was associated with the Indian Institute of Science and later founded the Raman Research Institute, both in Bengaluru. He founded the Indian Academy of Sciences. Raman was one of the first three recipients of the Bharat Ratna in 1954.

Internet Links

https://www.bbc.com/bitesize/guides/zw42ng8/revision/1

Inspired PHYSICS

For the CISCE curriculum

CLASS 7

Orient BlackSwan

The National Education Policy (NEP) 2020 emphasises certain crucial parameters based on content and pedagogy. The Inspired Physics series provides a rich range of exercises and activities for each of the parameters.

Here is a quick reference guide to some of the examples in this book.

The Inspired Physics series is mapped perfectly to the National Education Policy 2020.

21st Century Skills

A broad set of skills, knowledge, work habits and character traits that are important for success in the 21st century

The NEP parameters	Features	Page nos.
The 4Cs		
Critical Thinking	Think and Answer	100
Collaboration	Activity	87
Communication	Get Going	33
Creativity	Life Skills and Values (2)	45
Social and Emotional Learning	Life Skills and Values (2)	81
Multiple Intelligences	Activity	84
	Picture Study	14

Experiential/ Constructivist Approach

Learners construct their knowledge, based on what they already know, through experience or by doing and reflection

The NEP parameters	Features	Page nos.
Experiential/Constructivist Approach	Hands-on	15
	Activity 2.1	17
	Activity 3.1	37

Integrated Approach

An approach to teaching and learning that works by connecting knowledge and skills across the curriculum, by bringing real life examples to the classroom

The NEP parameters	Features	Page nos.
Subject Integration	Subject Integration (Biology)	82
	Subject Integration (Technology in daily life)	95
	Subject Integration (Geography)	119
Art Integration	Subject Integration	60
	Hands-on	60
	Hands-on	100
Health and Wellness	Life Skills and Values	100
Values	Life Skills and Values (2)	15
	Life Skills and Values	60

Sustainable Development Goals

A framework of 17 global goals designed to be a blueprint to achieve a better and more sustainable future for all

The NEP parameters	Features	Page nos.
Life Skills	Life Skills and Values (2)	100
	Life Skills and Values (2)	45

The NEP parameters	Features	Page nos.
Sustainable Development Goals	Life Skills and Values (2)	118
	Eco Corner	41

The NEP parameters	Features	Page nos.
Know more about India	Heritage Corner	119
	Scientist in Focus	60

India Knowledge

A strong focus on ancient knowledge from India, traditional values, modern developments and future aspirations

Digital Integration

The use of digital tools to enhance and support the teaching–learning process

ICT/Digital resources

Orient BlackSwan Smart App - Interactive Tasks and Games for Practice and Revision

Teacher's Smart Book - Flipbook, Animations, Videos, Presentations, Picture Galleries, Interactive Tasks, Embedded Questions, Lesson Plans, Students' Book Answer Key, Worksheets with Answer Key, Question Paper Generator

Teacher Empowerment

Teachers' Resource Pack - Lesson Plans, Students' Book Answer Key, Question Bank with Answer Key, Worksheets with Answer Key, Test Papers

Teachers' Portal - Chapter e-Book, Presentations, Picture Galleries, Animations, Videos, Students' Book Answer Key, Worksheets with Answer Key, Interactive Tasks, Lesson Plans, Question Bank with Answer Key

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