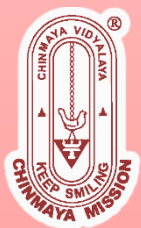


HUMAN EYE AND THE COLOURFUL WORLD

Class X Science Graphic Novel



**CHINMAYA VIDYALAYA
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1064CH11



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LEARNING OBJECTIVES

- ❖ Relate changes in focal length of eye lens to vision of distant and nearby objects.
- ❖ Relate changes in focal length of eye lens to vision of distant and nearby objects.
- ❖ Describe the structure of an eye and functions of various parts that help humans to see.
- ❖ Identify the causes of defects of vision in human eye and suggest correction procedures.
- ❖ Examine the path of light rays through prism and identify various rays/angles formed.
- ❖ Demonstrate that white light is dispersed into seven colours by a prism and explain the reasons for the same.
- ❖ Provide scientific explanation for twinkling of stars, advanced sunrise and delayed sunset.
- ❖ Describe the structure of an eye and functions of various parts that help humans to see.

LEARNING OUTCOMES

- ❖ Explains processes and phenomena, such as nutrition in human beings and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.
- ❖ Draws labelled diagrams/ flow charts /concept map/graphs, such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flowchart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.
- ❖ Draws conclusion, such as traits/ features are inherited through genes present on chromosomes, a new species originates through evolutionary processes, water is made up of hydrogen and oxygen, properties of elements vary periodically along the groups and periods in periodic table, potential difference across a metal conductor is proportional to the electric current through it, etc.



PREFACE

This graphic novel aims at adopting a child centric approach with focus on understanding of concepts through learning by doing and relating the concepts with real life examples. The novel is an effort for an experiential learning which enables the learners to deal with real life problems, thereby developing vital skills of critical thinking, problem solving and decision making. It advocates innovation for good pedagogical and research-based reasons to have a positive impact on the learning capabilities of the learners. The novel aims at explaining in a simple way the structure of the human eye, the defects in vision and some atmospheric phenomenon.

The novel also includes practice material for the learners to check their knowledge after completion of each concept. To access the comic book and additional interactive digital content, download the DIKSHA app from Google Play Store on your Android smartphone or tablet and scan the QR code using DIKSHA app.

A red ribbon banner with a white outline, featuring a central rectangular box.

DISCLAIMER

The graphic novel, **Human eye and the colourful world** is a work of fiction. Unless otherwise indicated, all the names, characters and views expressed in this novel are either the product of author's imagination or used in a fictitious manner. Any resemblance to actual persons, living or dead, or actual events is purely coincidental.

HUMAN EYE AND THE COLOURFUL WORLD

STORY BOARD



CHARACTERS

Nayan and Tara



*A pair of bubbly , energetic , observant
and enthusiastic twins who are eager
and curious to know about everything.*

They are 15 years old



Parents of Nayan and Tara



**Tweyety: The two eyed
friend from space**

CHARACTERS



Principal



**Friends of Nayan
and Tara**



**Dr. Shroff
(Eye Specialist)**



Dr Veena



Teacher

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Good morning children. Today we have invited a team of eye specialists.

KNOW YOUR EYE

The Principal welcomes the team of doctors and briefs the students about the purpose of the doctors' visit.



KNOW YOUR EYE

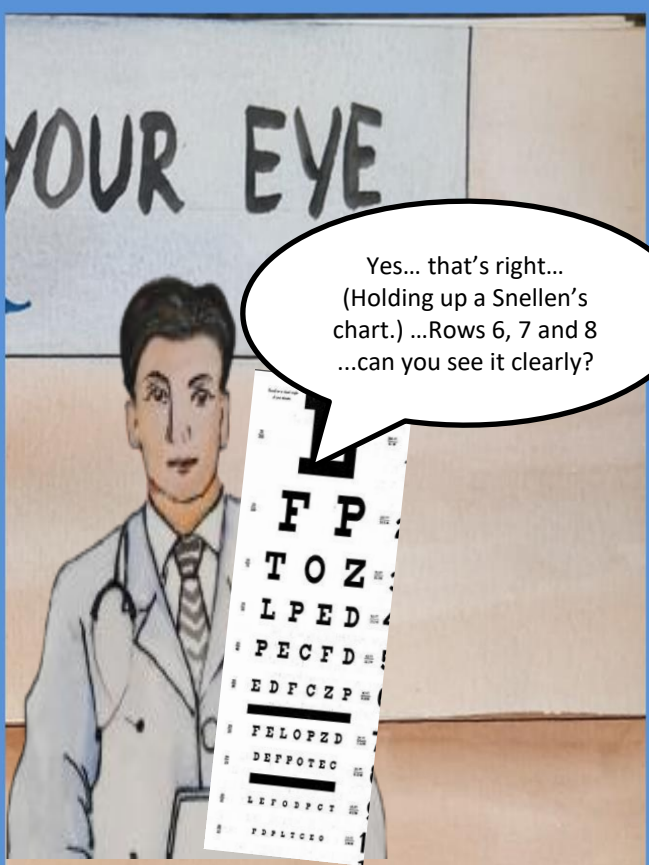
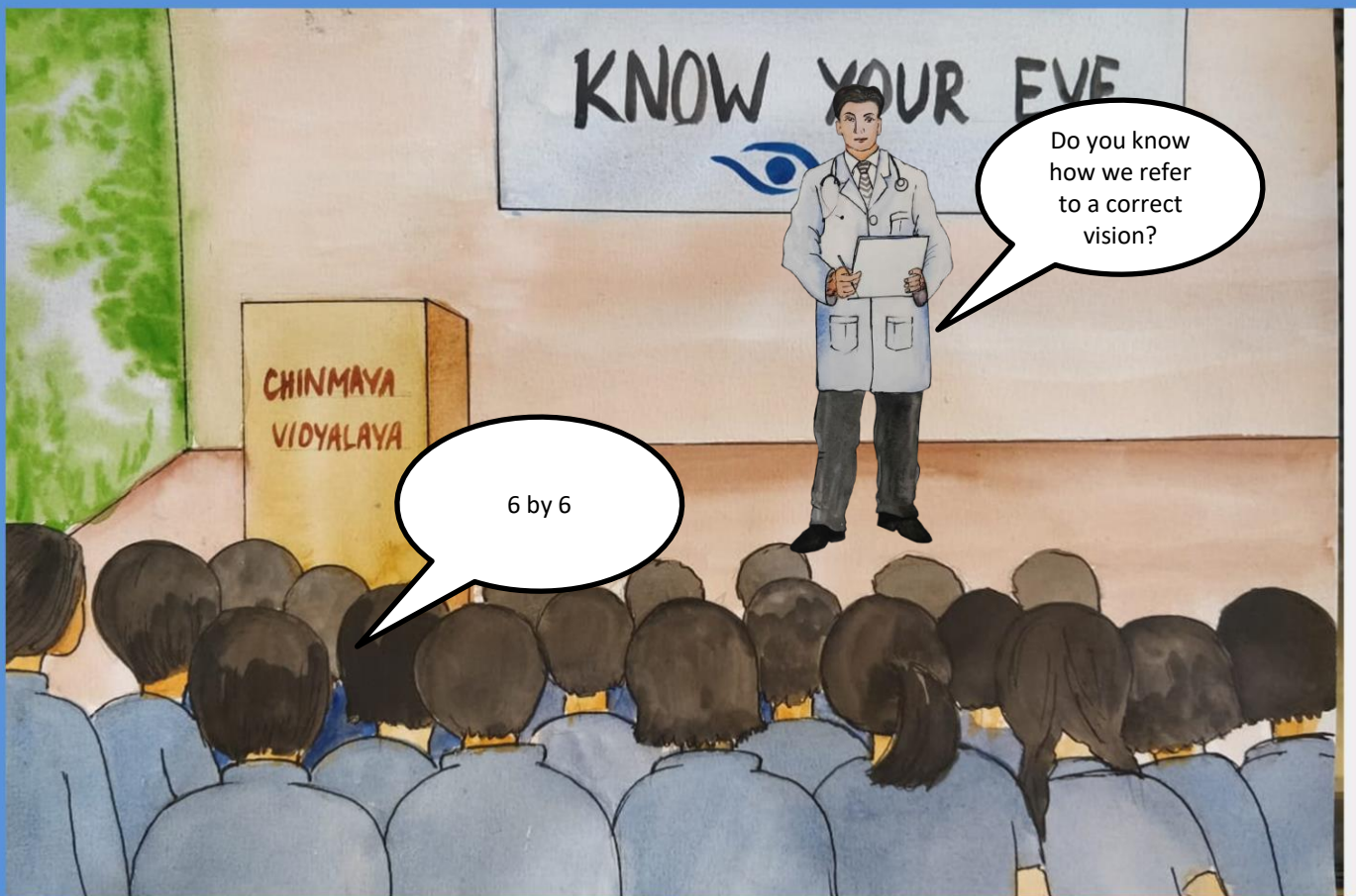
Good morning children. Today we have specially come to your school to raise awareness on one of your most priceless assets... Any guesses?

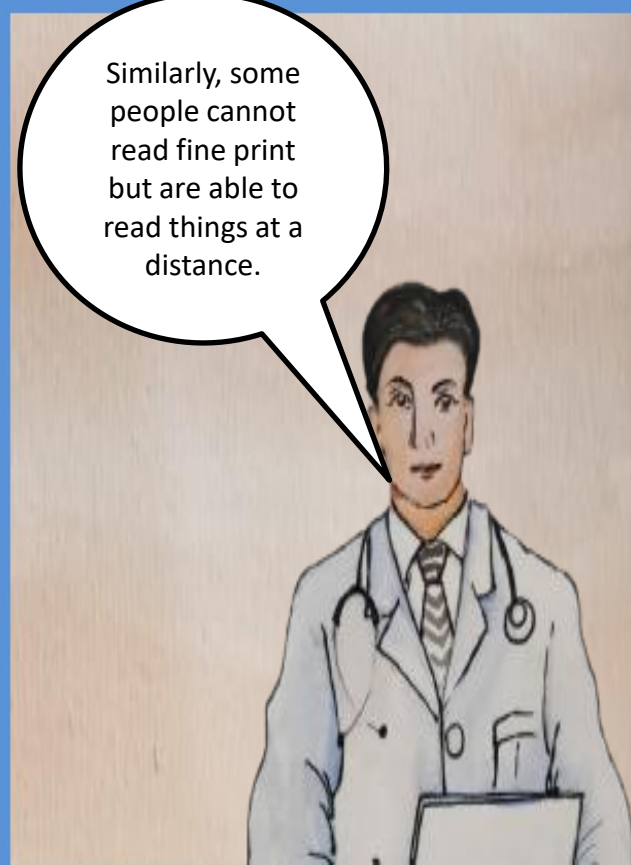
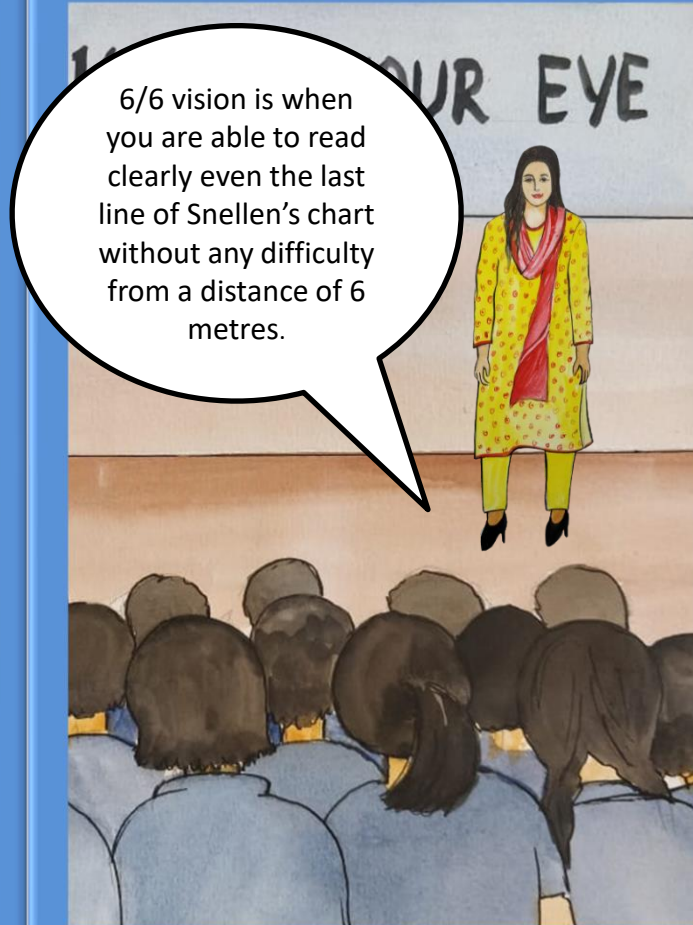


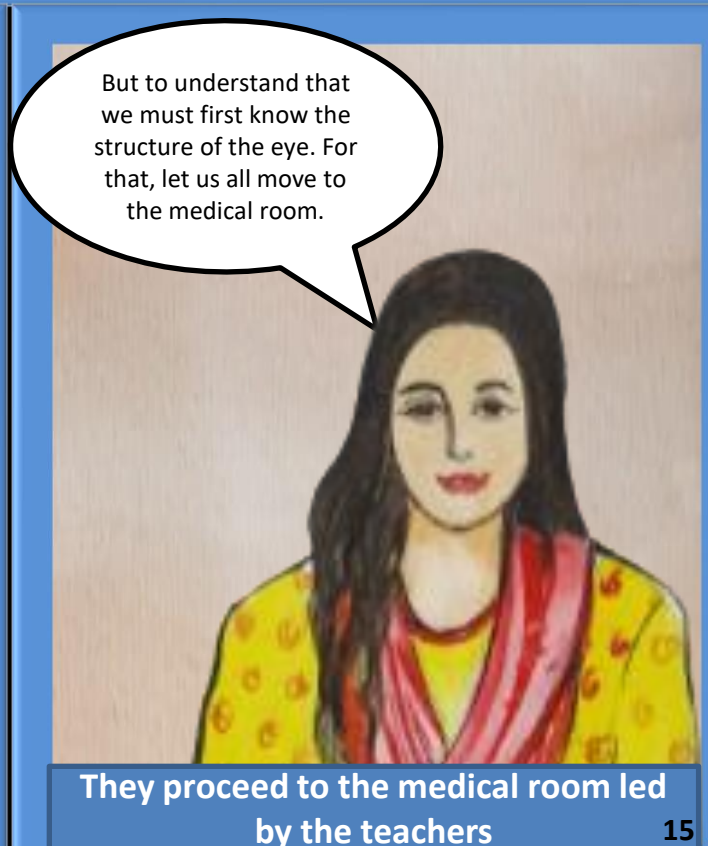
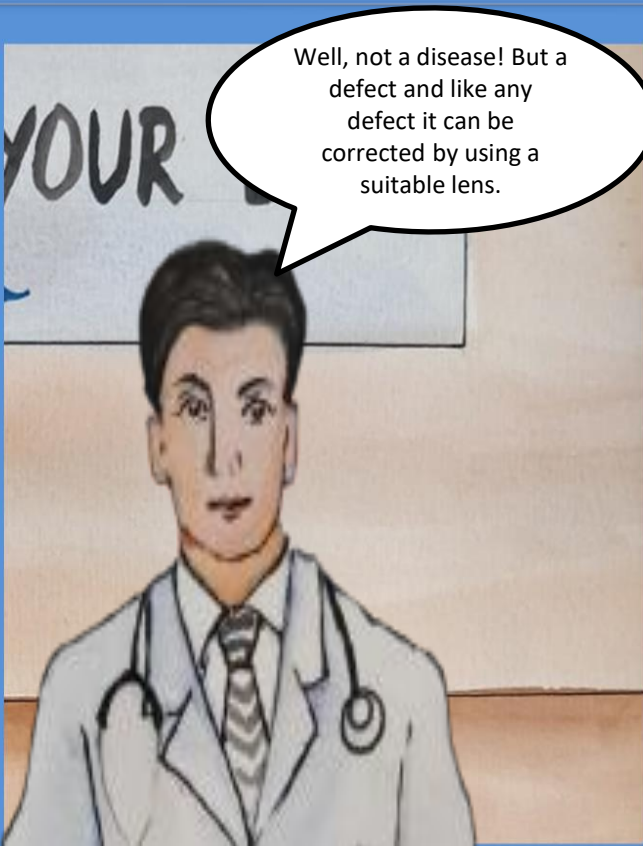
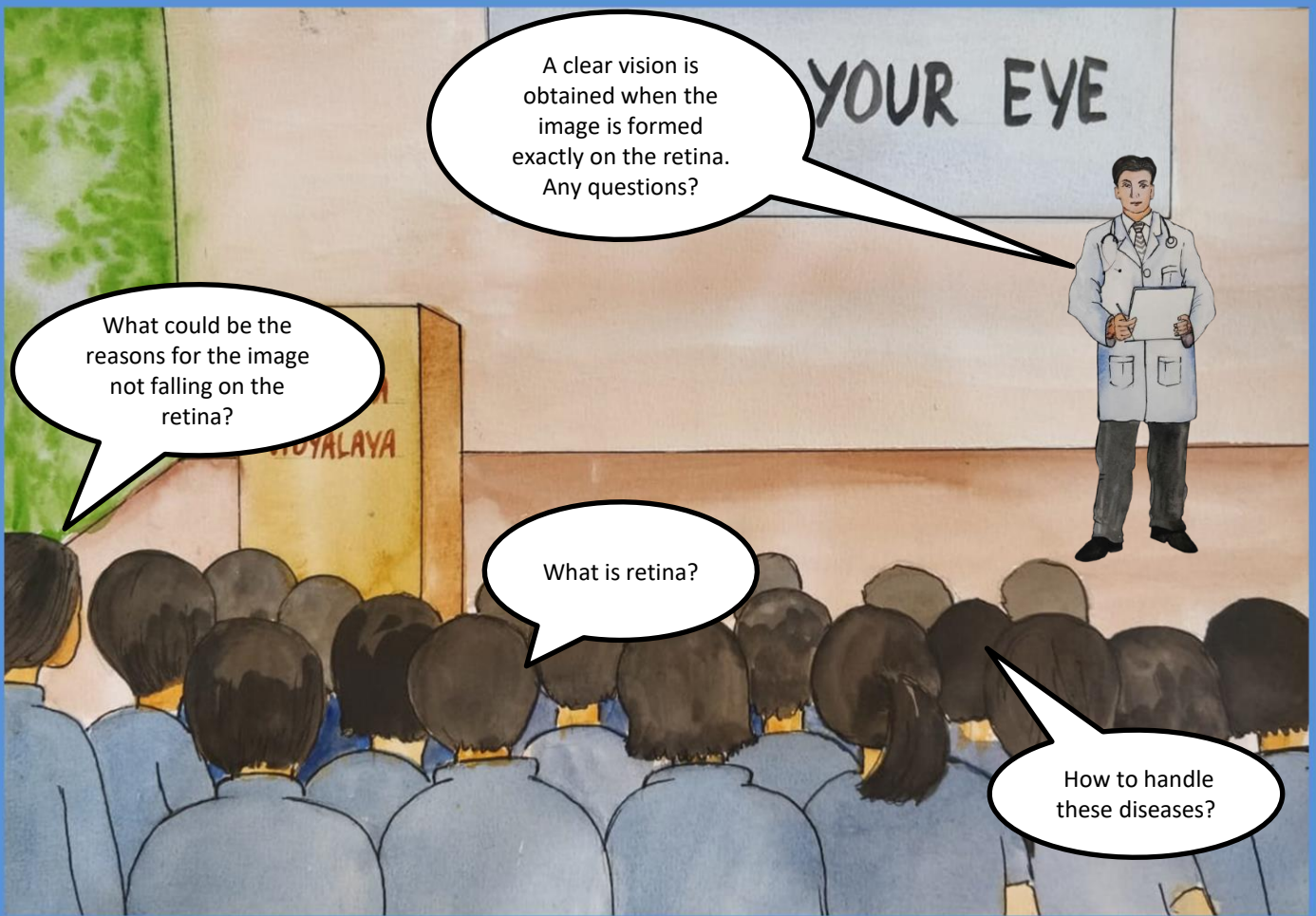
EYES!!

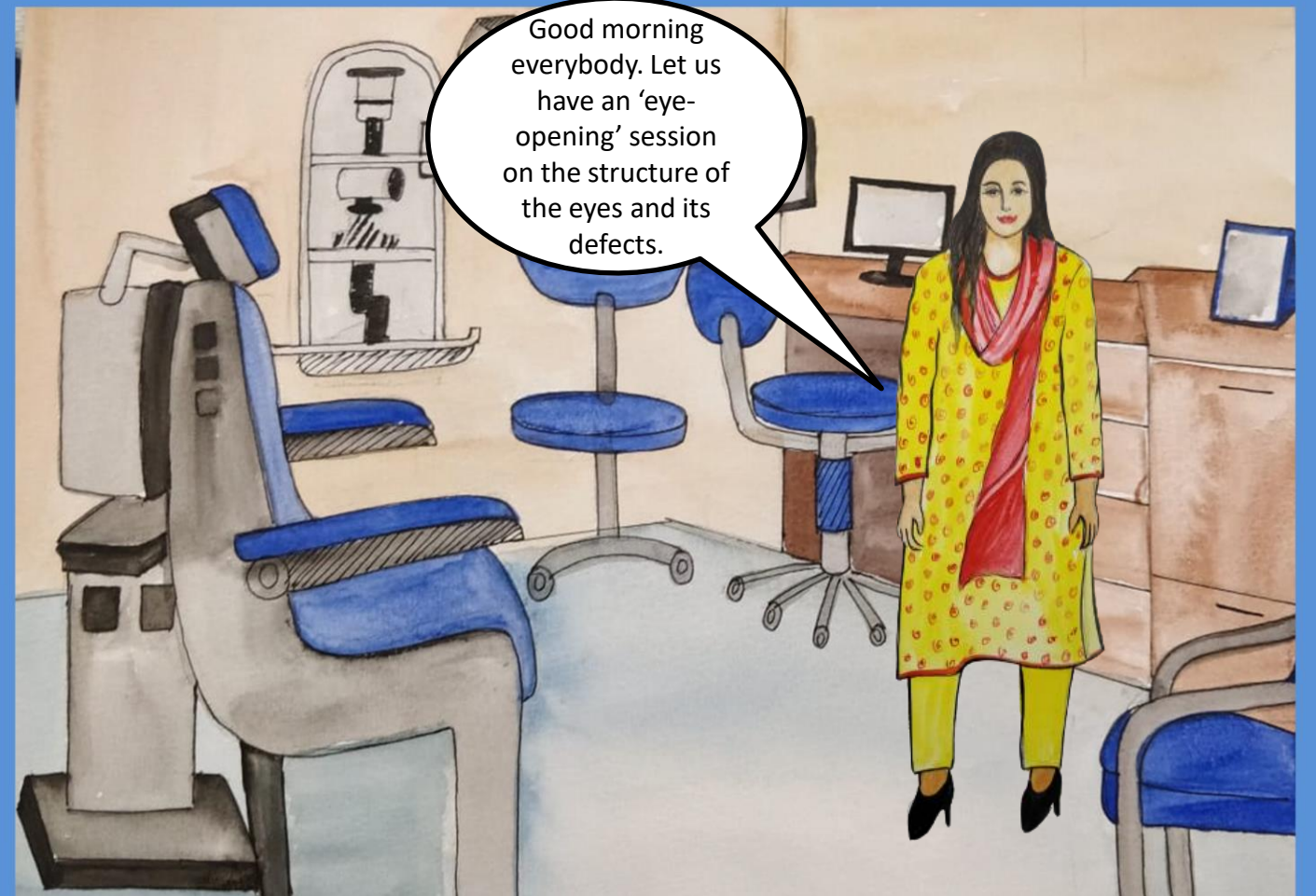
EYES!!

EYES!!

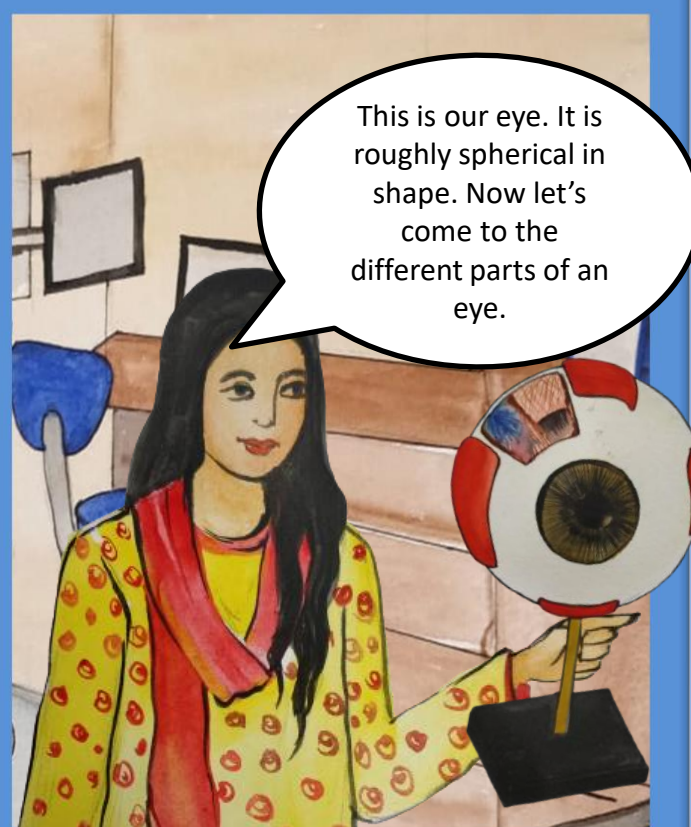




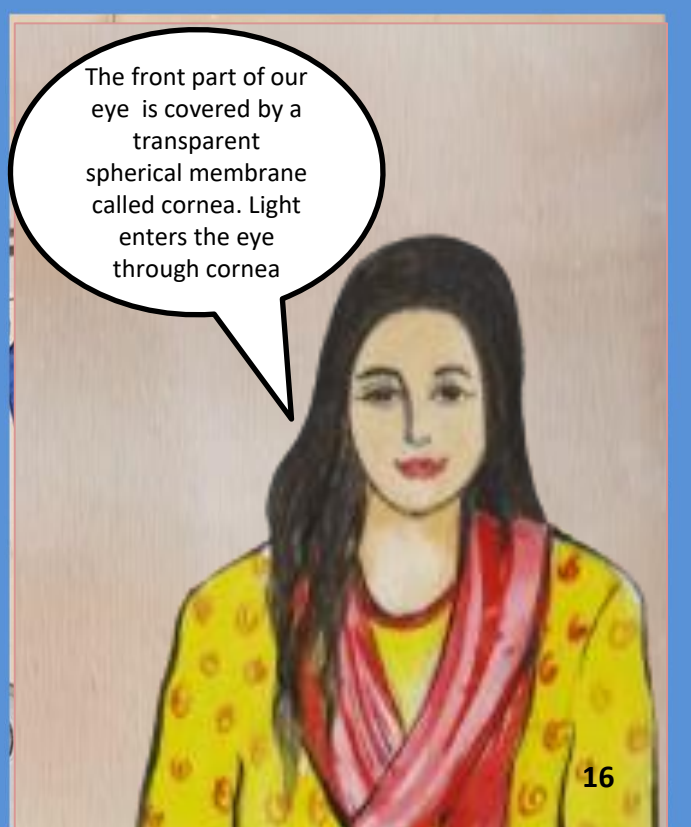




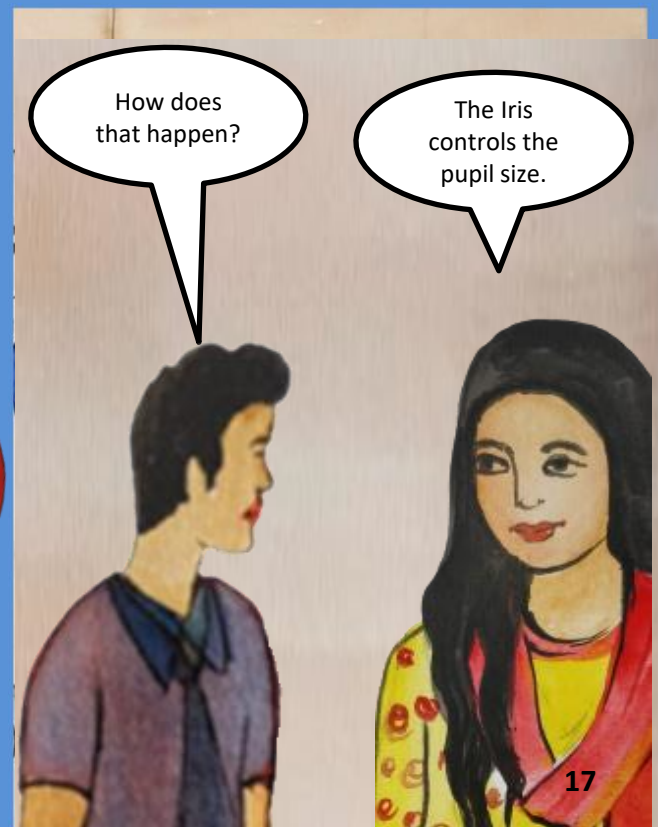
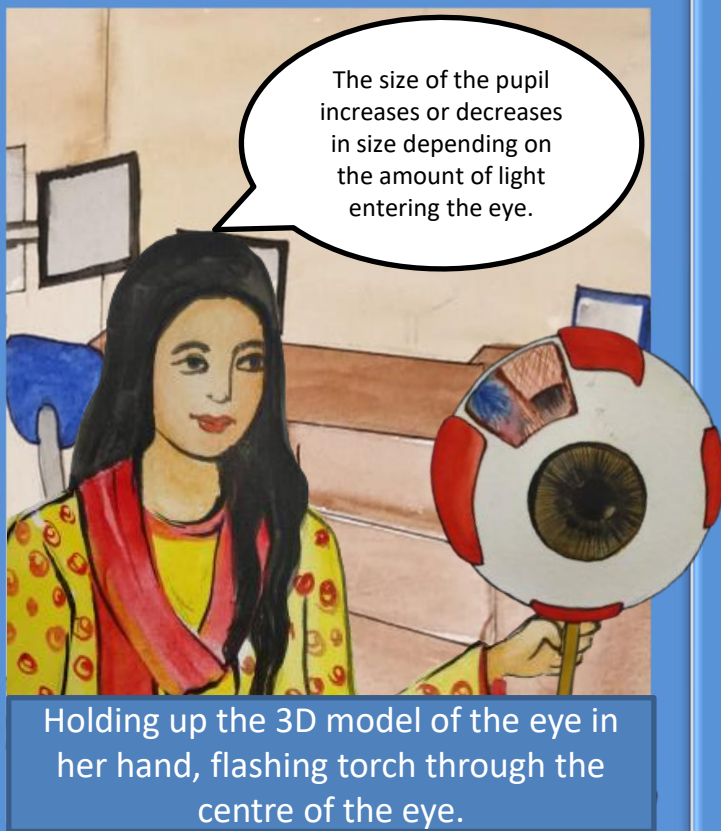
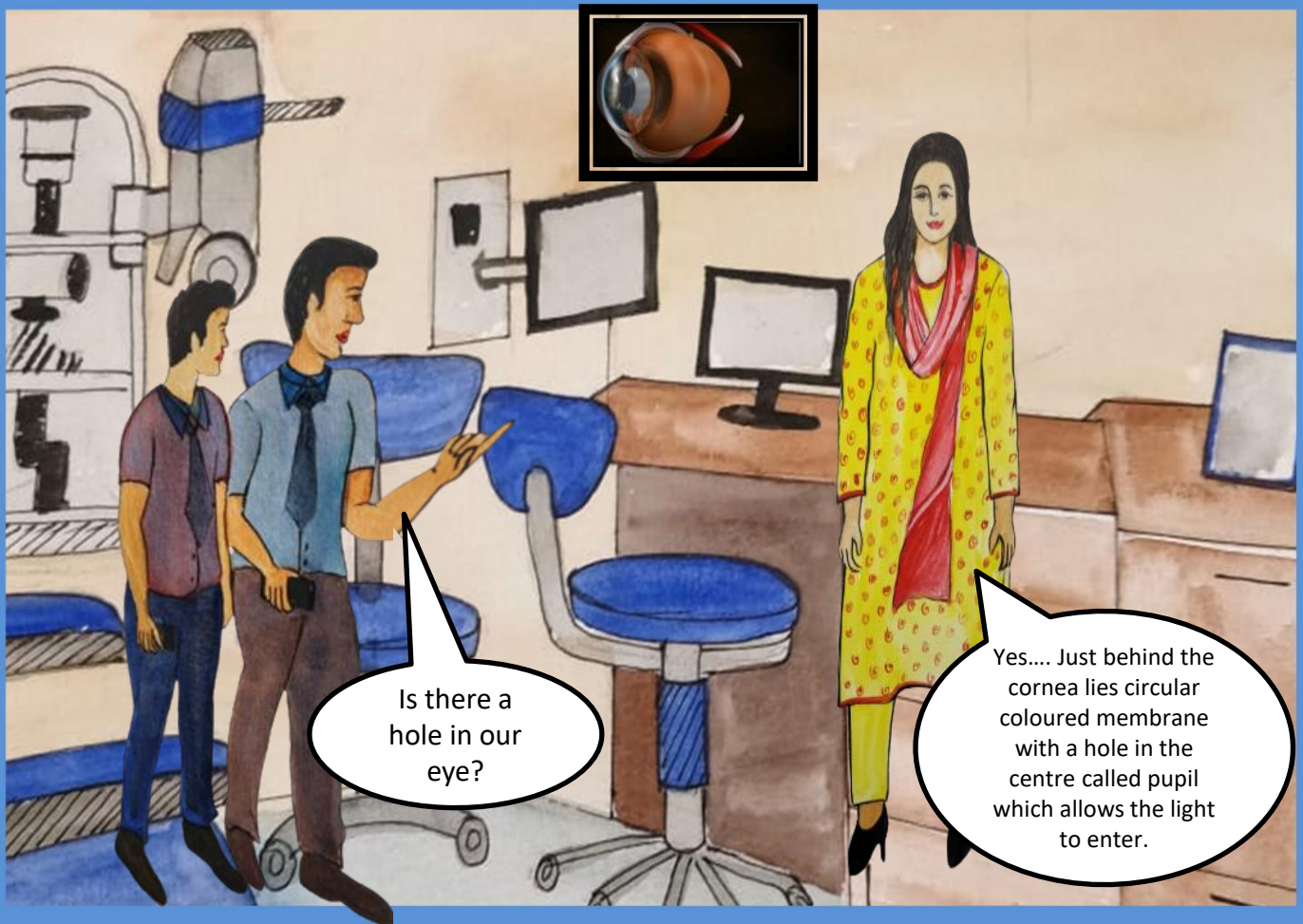
Good morning everybody. Let us have an 'eye-opening' session on the structure of the eyes and its defects.

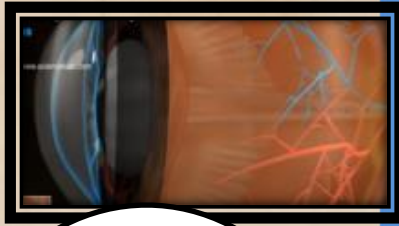


This is our eye. It is roughly spherical in shape. Now let's come to the different parts of an eye.



The front part of our eye is covered by a transparent spherical membrane called cornea. Light enters the eye through cornea





Behind the pupil we have the **EYE LENS**. It is a crystalline biconvex lens which along with cornea helps to focus light on the retina.. It is controlled by contraction and relaxation of the Ciliary Muscles

The ciliary muscles holds the lens in place and helps in focussing on both distant and near objects by the curvature and focal length of the eye lens. This is called accommodation.



Light after refraction through the eye lens falls on the retina. It is the transparent light sensitive inner back membrane of the eye. It is equivalent to the camera- screen

RETINA is the inner back membrane where the image is formed...There are light receptor cells...the rods and the cones which transmit these images as electrical signals to the brain via the **OPTIC NERVE....**

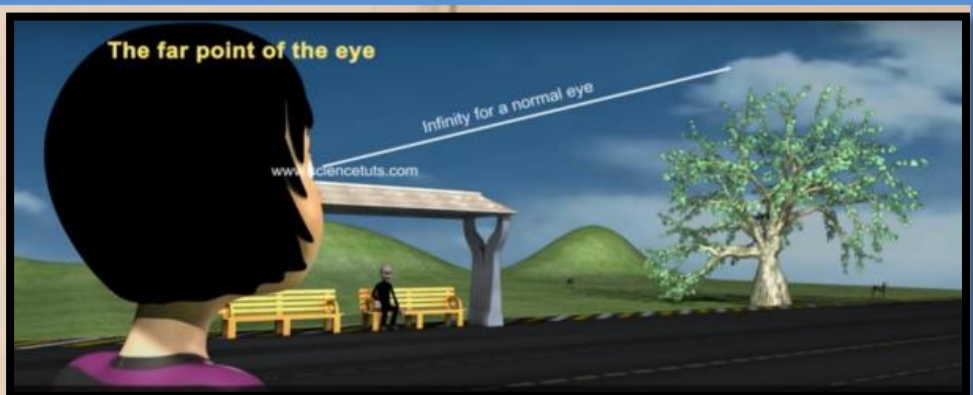


Okay and we are able to see distant objects clearly.

Yes... The spot from where the optic nerve branches off to brain is called **BLIND SPOT** and is insensitive to light.



The far point of the eye



Infinity for a normal eye

www.science4u.com

The far point of the eye is the **maximum distance** to which the eye can see **objects clearly**. The far point of a normal person's eye is infinity.

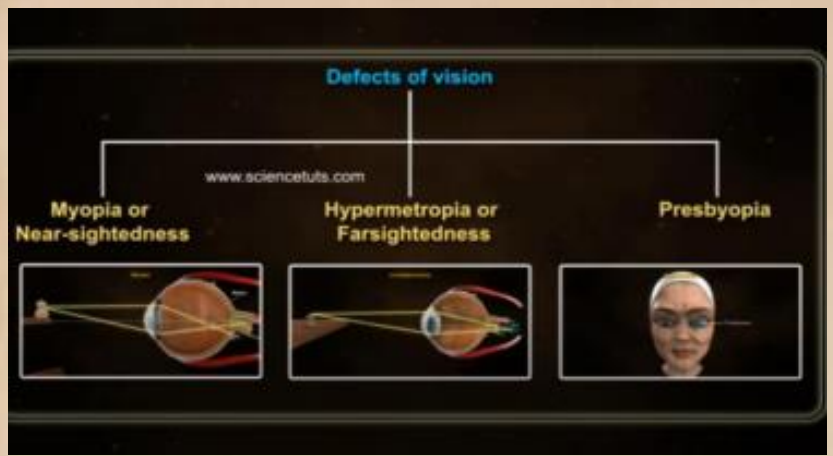
What about objects which are near?



I was coming to that. The near point or the least distance distinct vision is 25 cm.

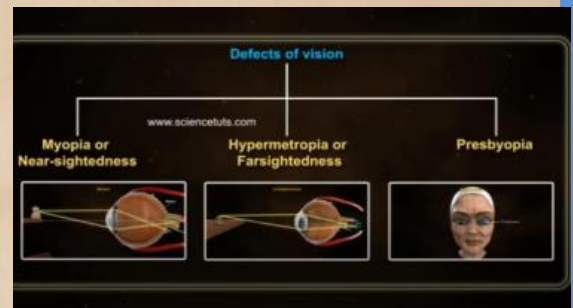
The ability to focus on near and far object by adjusting the focal length or curvature of the lens is called accommodation of the eye.

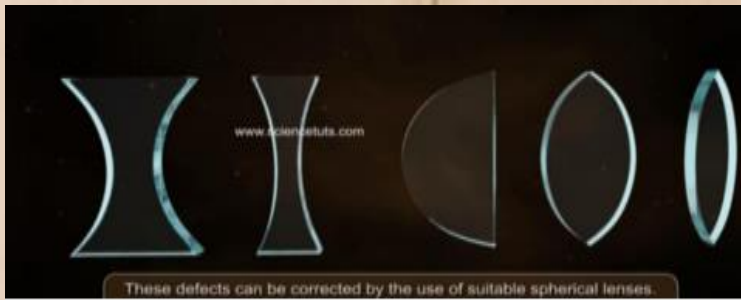
Ok...got it. Then why do we need spectacles?



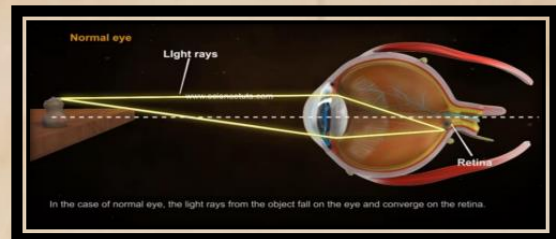
Sometimes the eye loses the power of accommodation, so the objects at varying distances cannot be seen clearly and distinctly

. This causes a refractive defect in vision which may be broadly described as Myopia, Hypermetropia and Presbyopia.

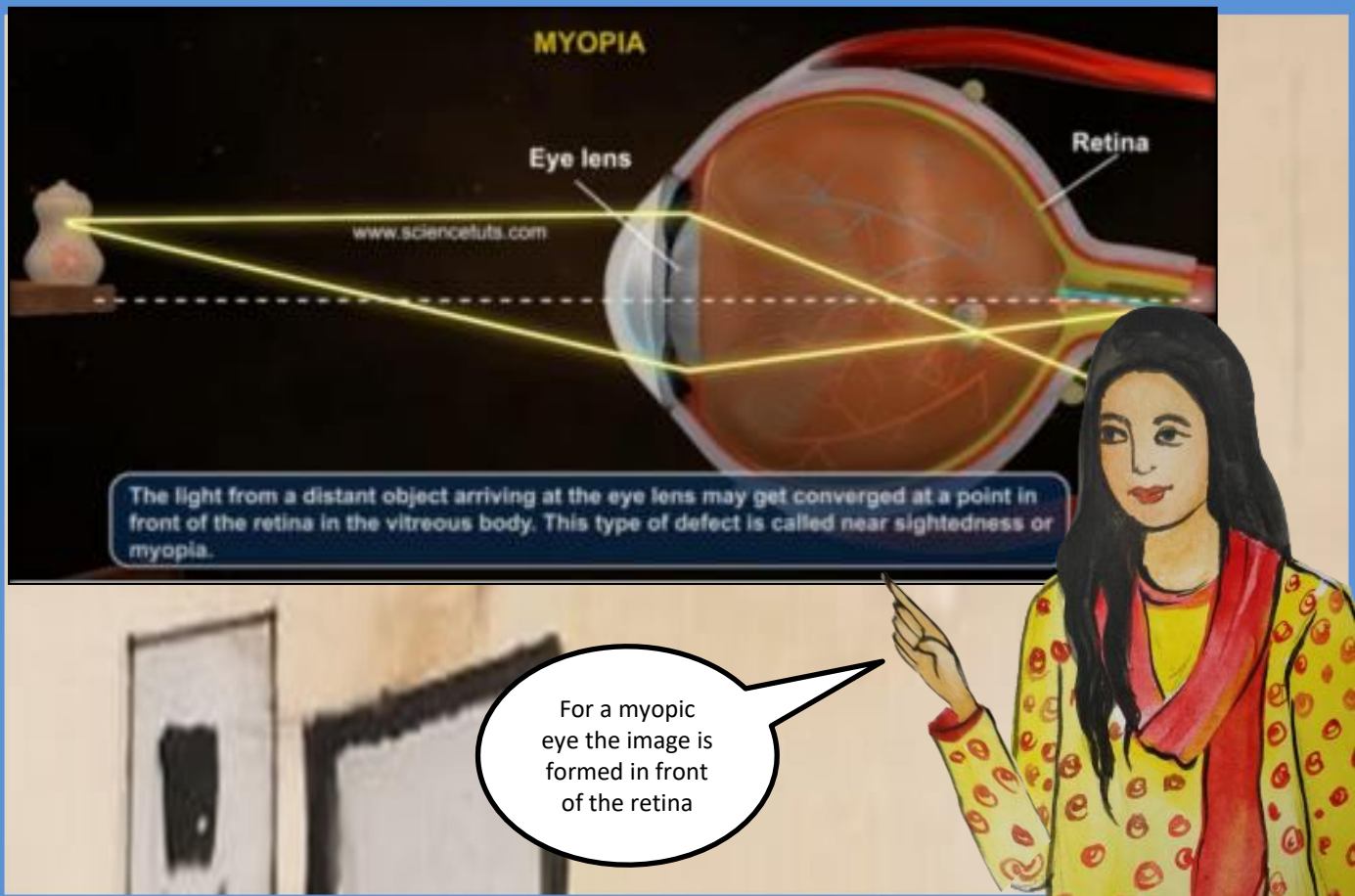


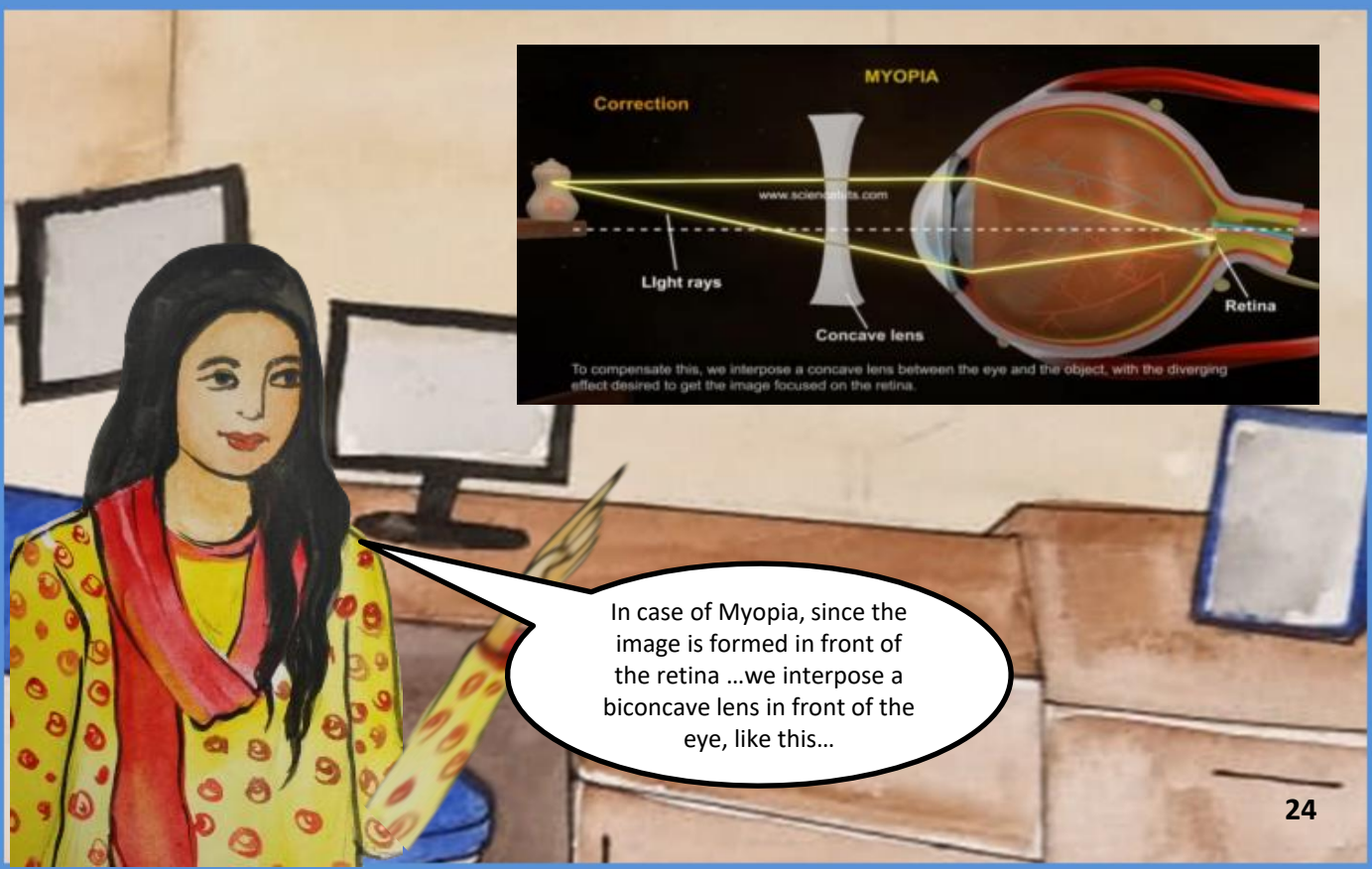
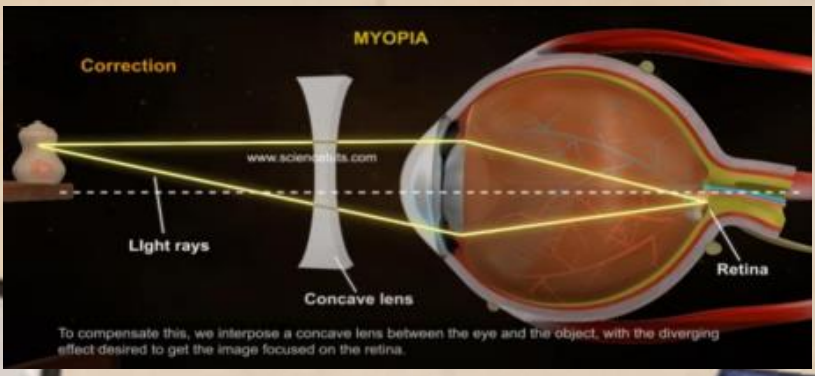
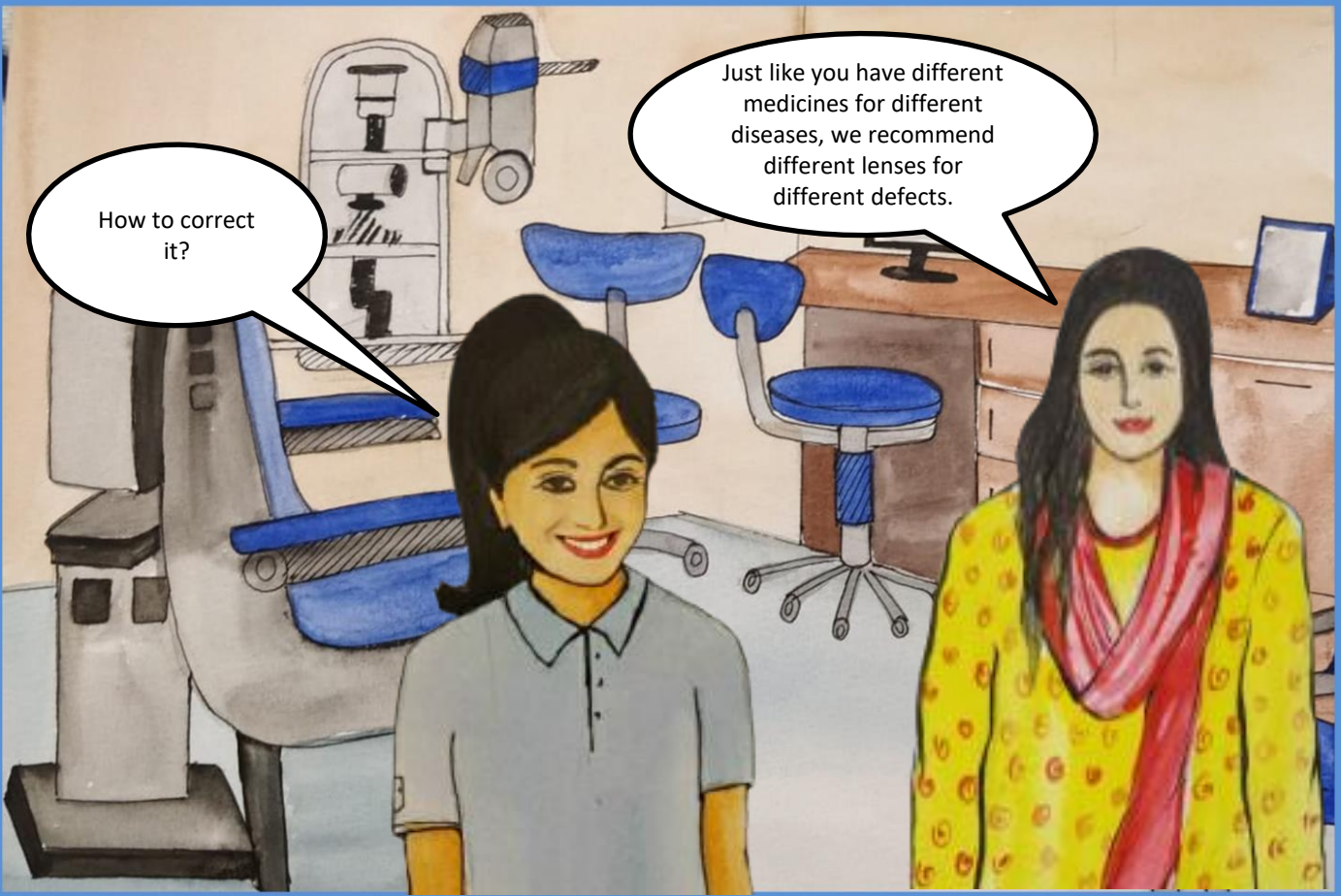


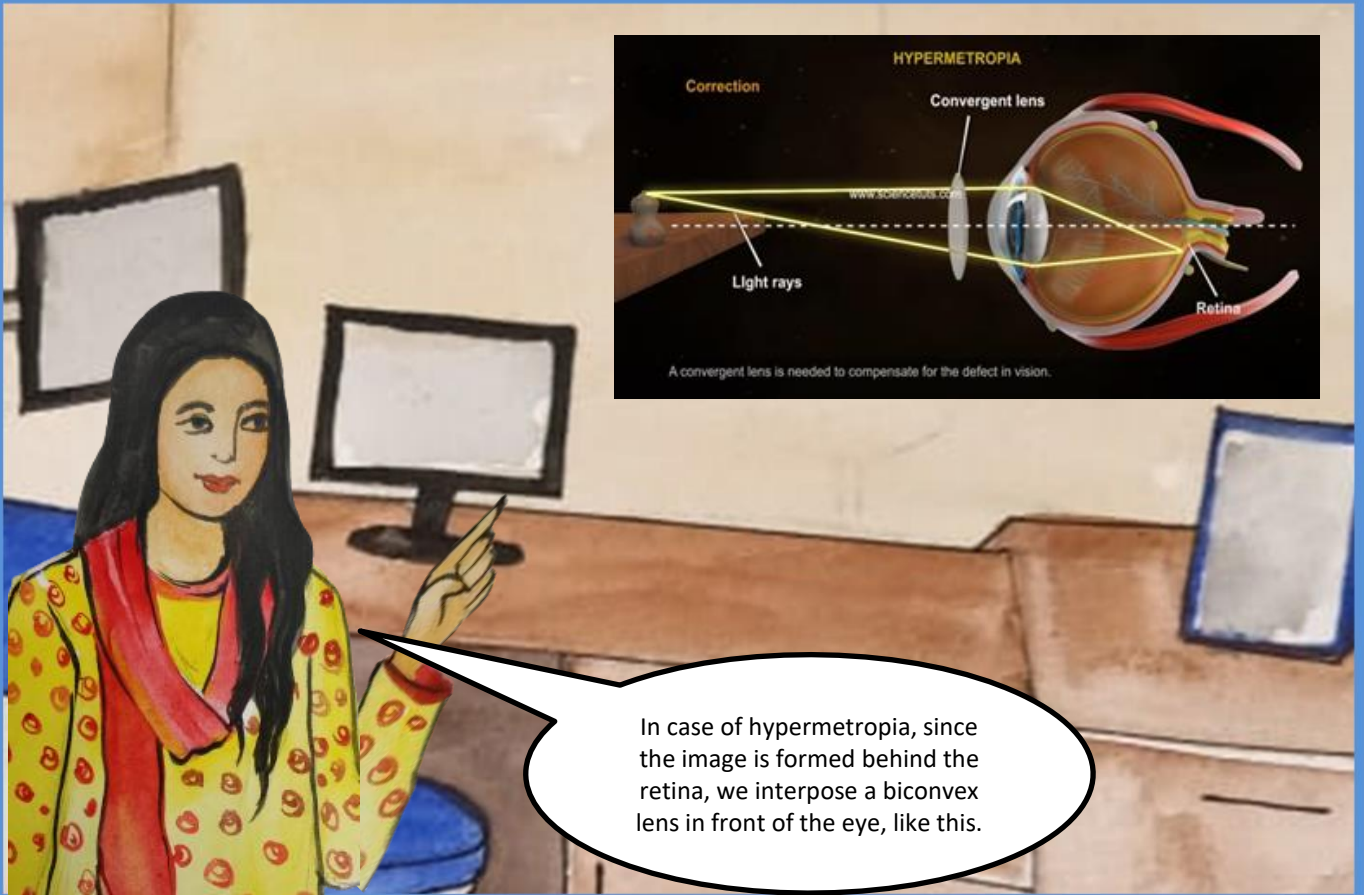
They can be corrected by using suitable lenses of suitable power.



For a normal eye the image is formed exactly on the retina.

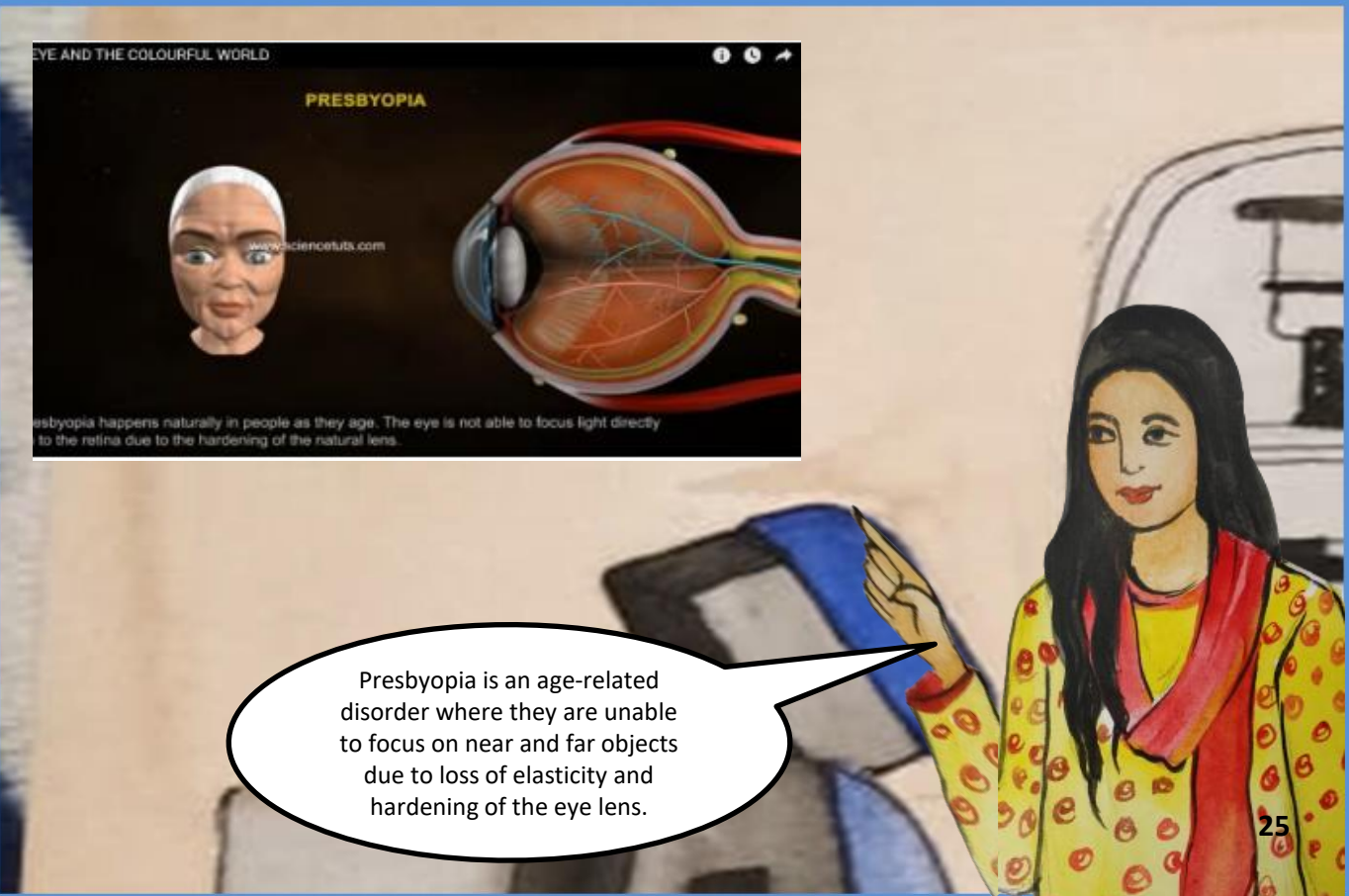






The diagram, titled "HYPERMETROPIA", shows the correction of nearsightedness. It features a cross-section of an eye where light rays from a near object focus at a point behind the retina. A "Convergent lens" is placed in front of the eye to pre-converge the light rays so they focus exactly on the "Retina". Labels include "Correction", "Convergent lens", "Light rays", and "Retina". A caption at the bottom states: "A convergent lens is needed to compensate for the defect in vision."

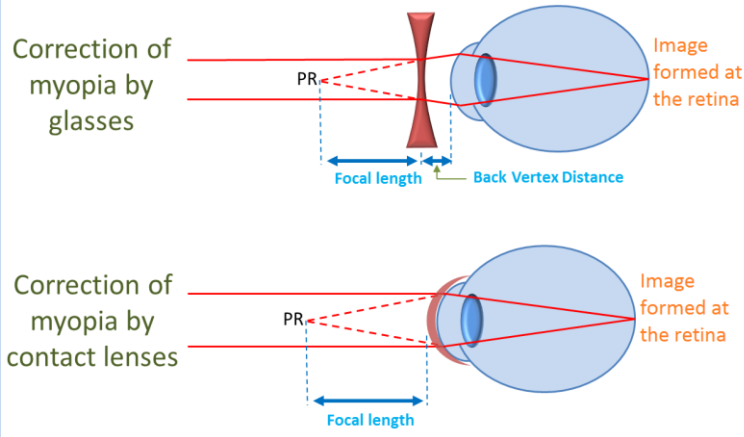
In case of hypermetropia, since the image is formed behind the retina, we interpose a biconvex lens in front of the eye, like this.



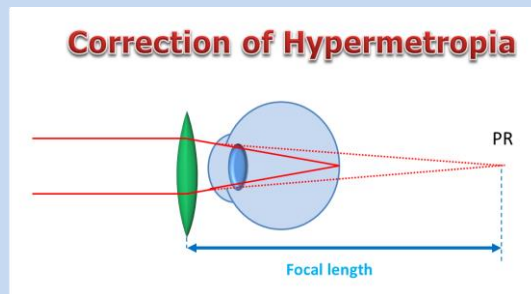
The diagram, titled "PRESBYOPIA", shows an elderly person's face and a cross-section of the eye. The eye diagram illustrates that the lens is unable to become sufficiently convex to focus light from near objects onto the retina. A caption at the bottom explains: "Presbyopia happens naturally in people as they age. The eye is not able to focus light directly to the retina due to the hardening of the natural lens."

Presbyopia is an age-related disorder where they are unable to focus on near and far objects due to loss of elasticity and hardening of the eye lens.

Correction of Myopia

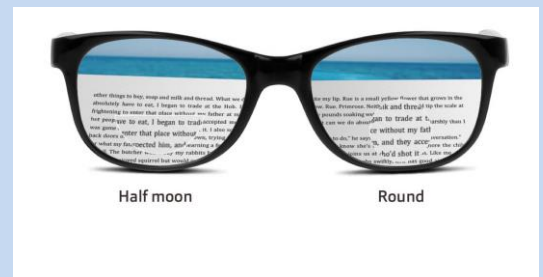


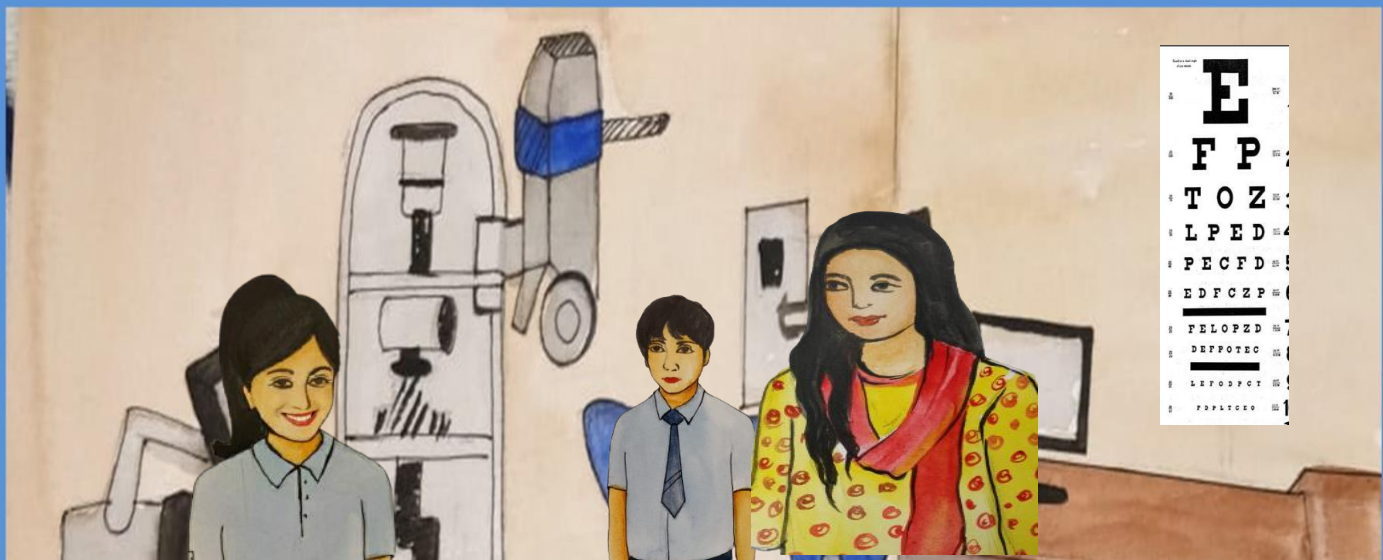
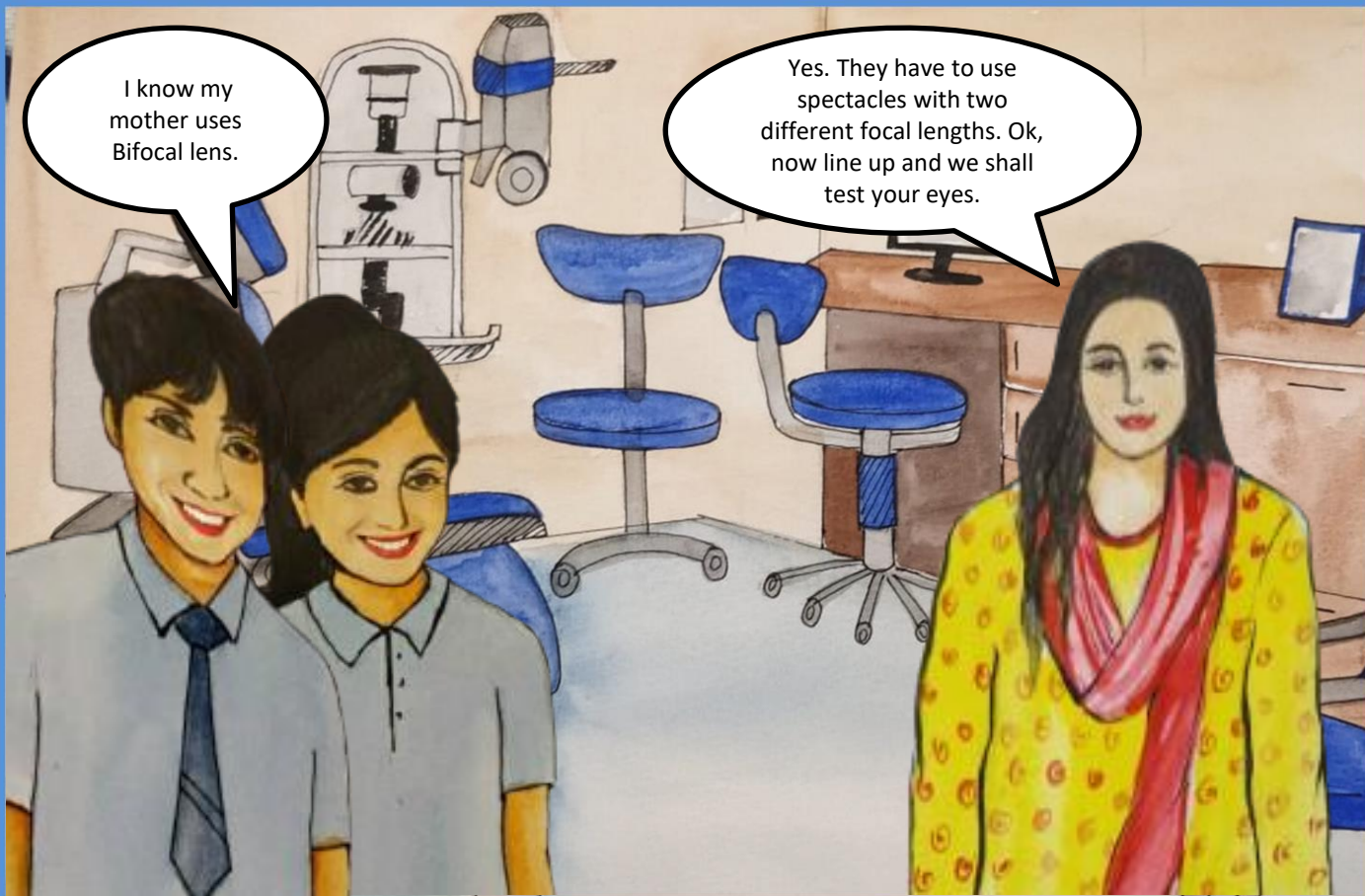
CORRECTION OF HYPERMETROPIA



CORRECTION OF PRESBIOPIA

When both near and far vision is affected, correction is done using a bifocal length

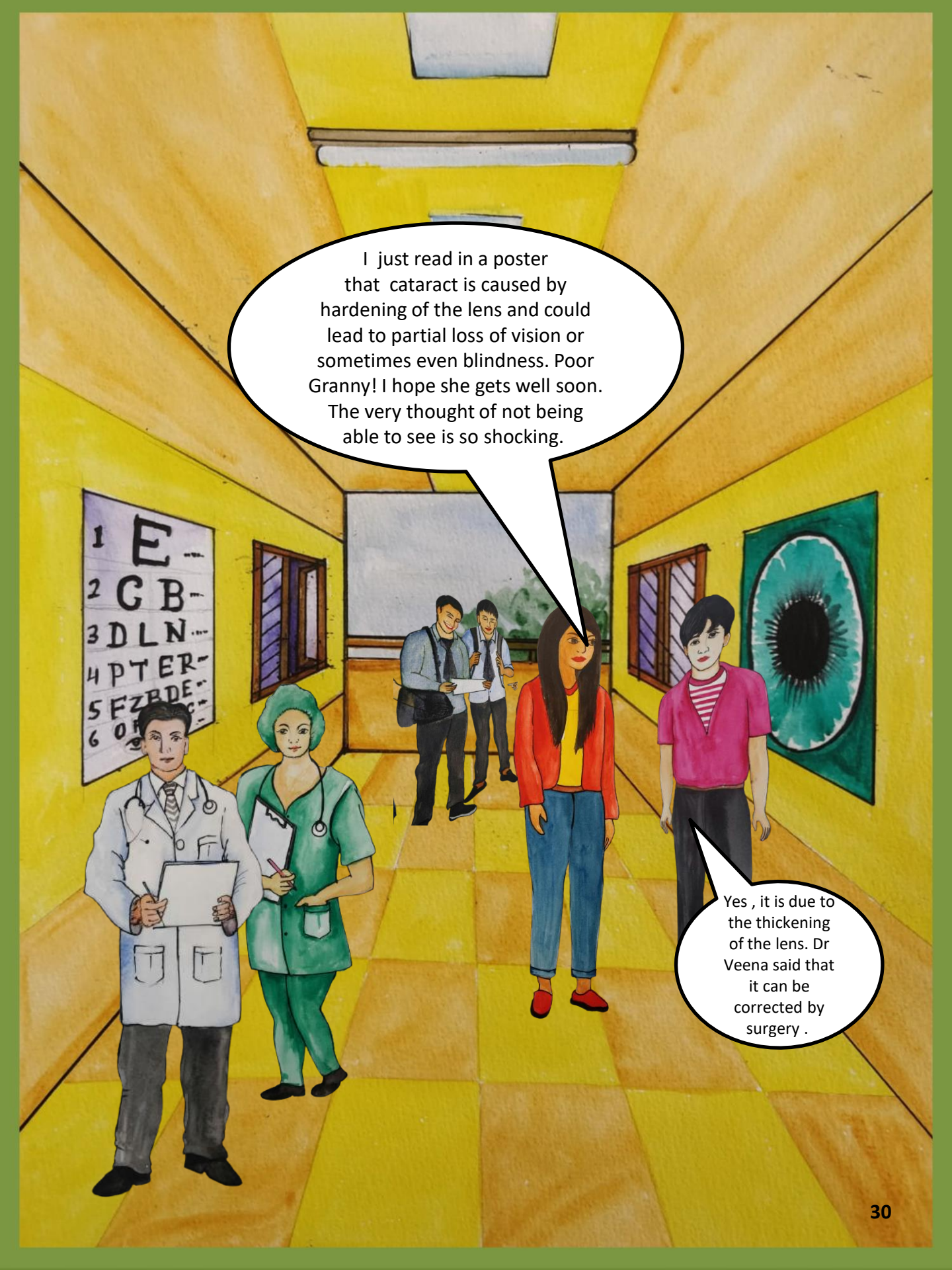




Eye checkup starts...the doctors use the different reading charts for the checkup and hand out the recommendations. When Tara's turn comes, the doctor takes a little more time than others. After the check up, he informs that Tara will have to go to an eye clinic for a thorough eye check-up as she has a cylindrical eye defect.



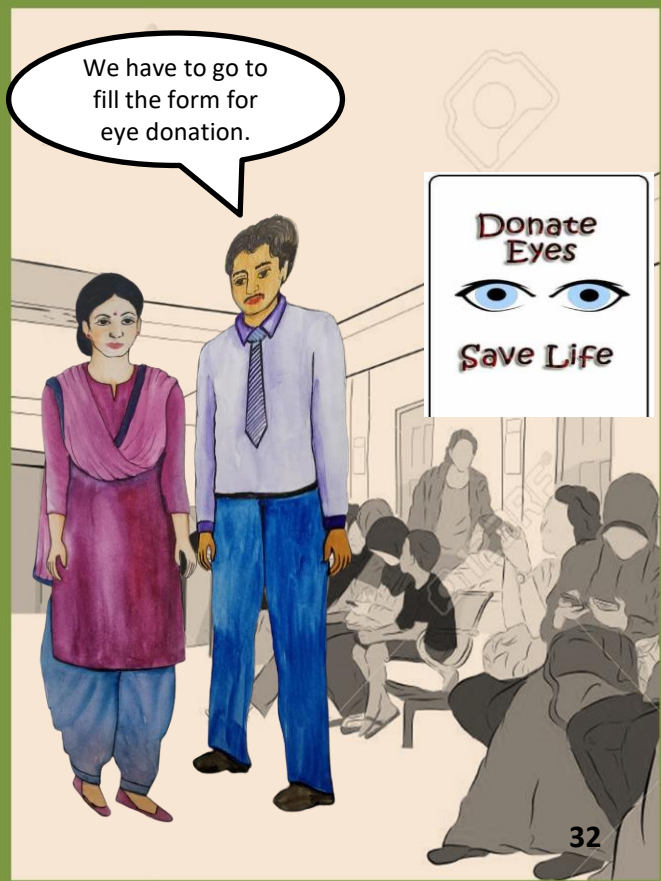




I just read in a poster
that cataract is caused by
hardening of the lens and could
lead to partial loss of vision or
sometimes even blindness. Poor
Granny! I hope she gets well soon.
The very thought of not being
able to see is so shocking.

Yes , it is due to
the thickening
of the lens. Dr
Veena said that
it can be
corrected by
surgery .







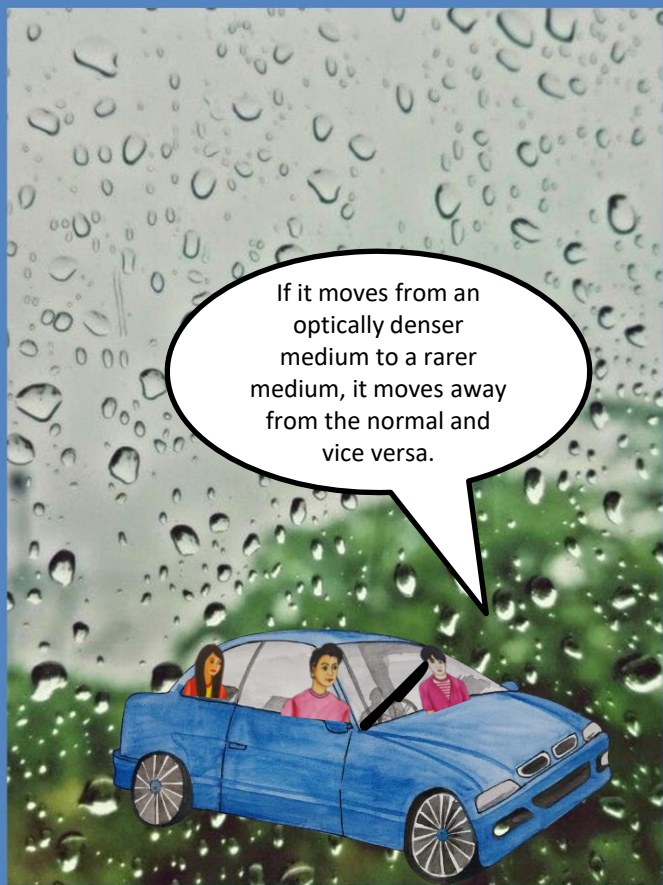
Since it was raining, Deepanjan had to use the wipers to see the road clearly.





No, not just like that. Recall the last chapter we studied. There is a rule...

Bending? You mean the light bends? Just like that...

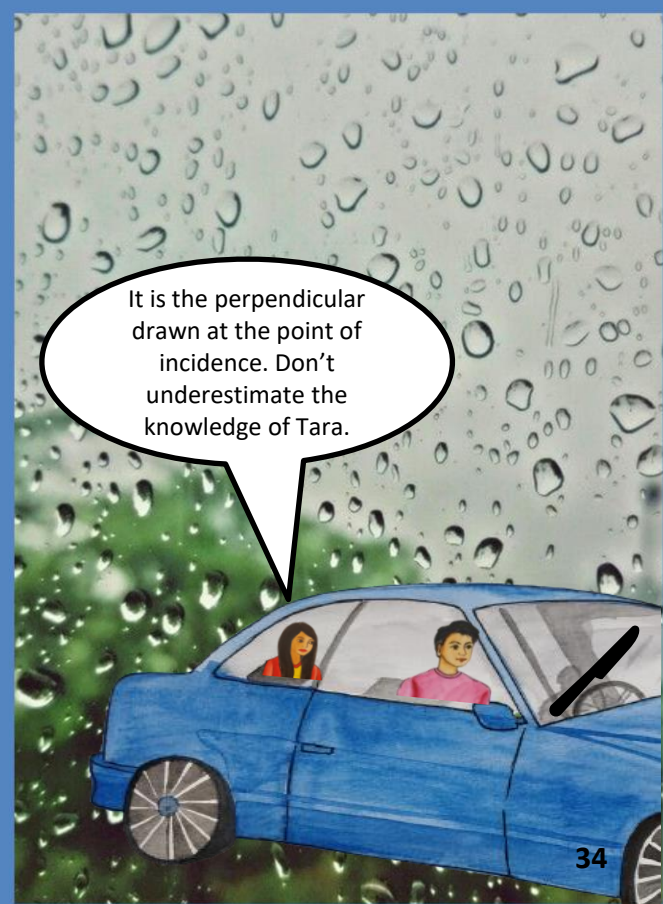


If it moves from an optically denser medium to a rarer medium, it moves away from the normal and vice versa.



Tara, I hope you know what a normal is?

Of course, I do. We studied it in the previous chapter



It is the perpendicular drawn at the point of incidence. Don't underestimate the knowledge of Tara.

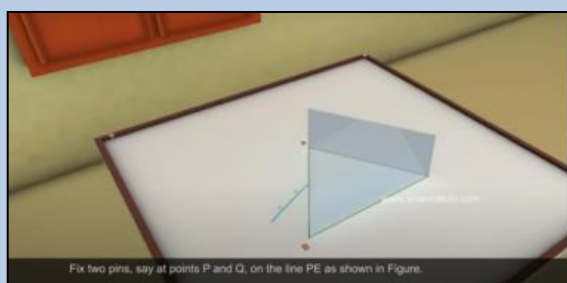
ACTIVITY 1

Take a source of white light (bulb) and allow the light to fall on face of one glass prism through a single slit, observe the splitting of light into its constituent colours.



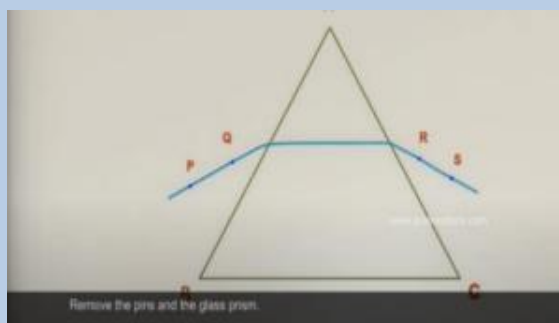
ACTIVITY 2

Place a glass prism with its triangular face on the paper and trace its outline.

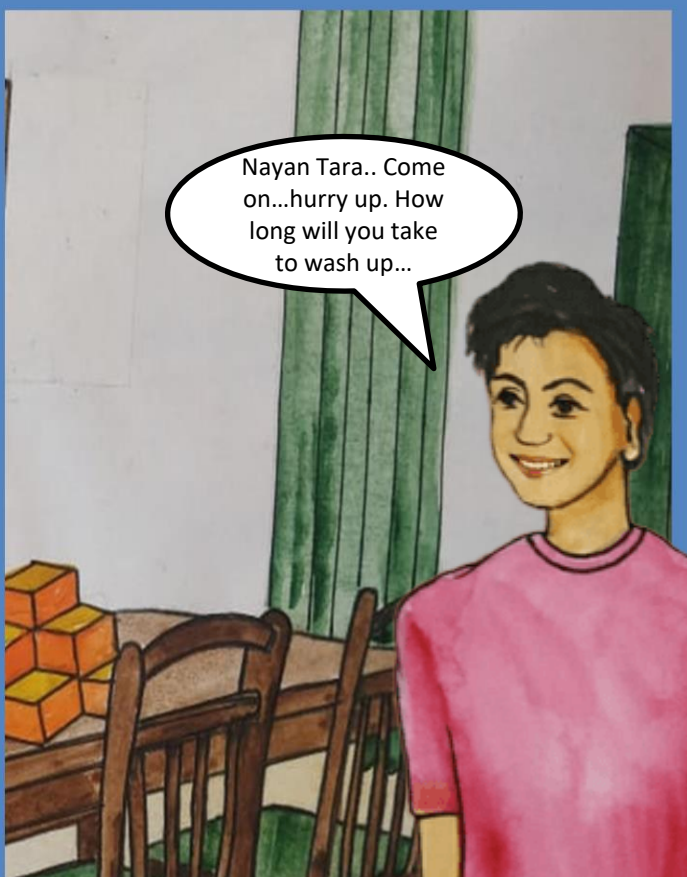


Draw a slanting line PE to the prism and place two pins AB on it. From the other side place two pins such that the four appear to be in a straight line.

Remove the pins and prism. Join the points. Draw normals at the point of incidence E and F respectively, identify and compare the angles of incidence and emergence. Extend the incident ray forward and emergent ray back ward to get the angle of deviation.



Everybody reaches home and the kids are thrilled to be with their cousins



All of them sit on the dining table to eat it....a picture of bliss...Happy expression on all their faces...They are eating the food that they have ordered.



Just then they hear a banging on the door



They run out excitedly and see a weird looking creature....







May I stay here
till the rain
stops...?



Come in
please.



Would you
like to have
lunch with us?

No thanks, I am
powered by
sunlight. Please
let me stay here
till the sun
shines again

All of them come inside the
house and talk about the
different things on Earth and
planet Ocular.



There we have the
sunshine again....

One hour later....

I have to go out
and check the
status of my
spacecraft



If it is ready, I will
have to start my
journey again.





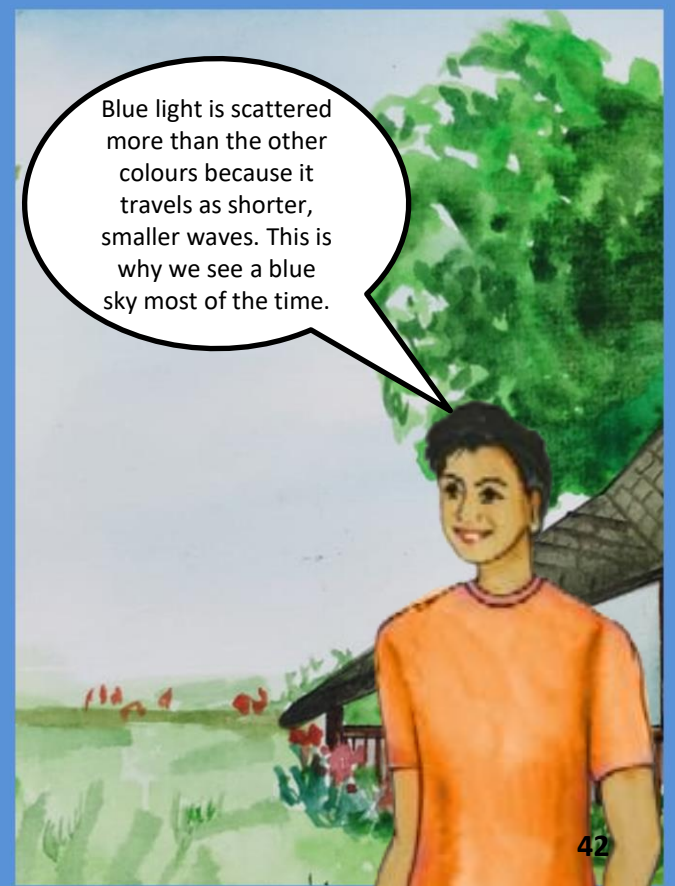
By the rings of Saturn!!! Why is the sky blue? We see our sky black!!

A comic panel showing an alien on the left and two humans on the right. The alien is a yellow-skinned being with large, oval eyes, wearing a black dress with a red belt and a red headband with white polka dots. The two humans, a man and a woman, are standing together. The man is wearing a purple shirt and black pants, and the woman is wearing a red jacket over a yellow shirt and blue jeans. They are in a rural setting with a small house and trees in the background.



Seriously...that's weird ...Bhaiya what on earth could be the reason?

A comic panel showing a close-up of the alien and the two humans. The alien is on the left, looking towards the humans. The man and woman are on the right, looking at the alien. The man is wearing a purple shirt and the woman is wearing a red jacket. The background shows a rural setting with a house and trees.





Nayan and Tara start admiring the sky after a brief fight. It is around 6:00 PM now and the sky turns red as it was nearing sunset.

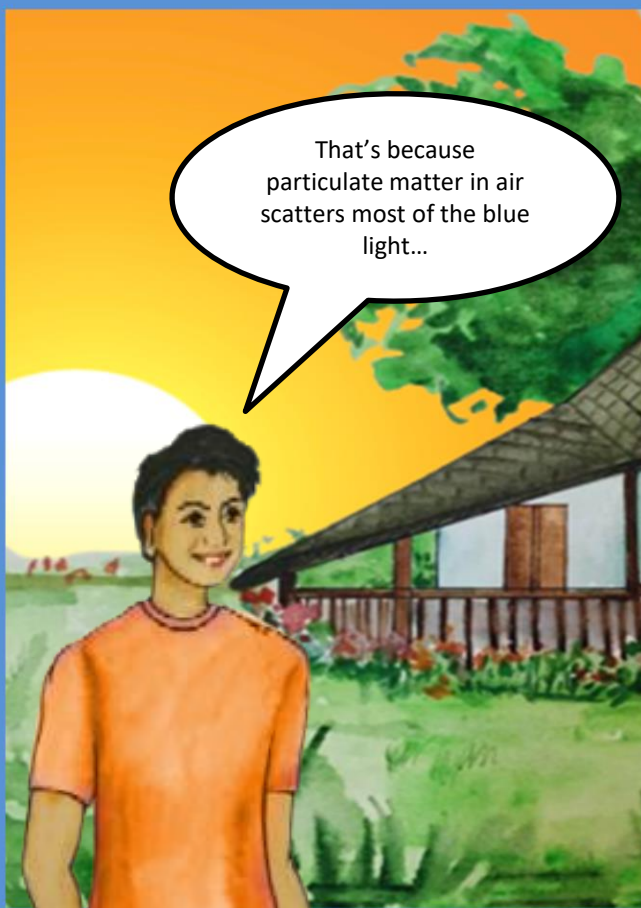


Ok ...so sunrays travel a longer distance...



Exactly...so the oblique rays travel longer through the atmosphere to reach you

But why red? The sky appears red.



That's because particulate matter in air scatters most of the blue light...



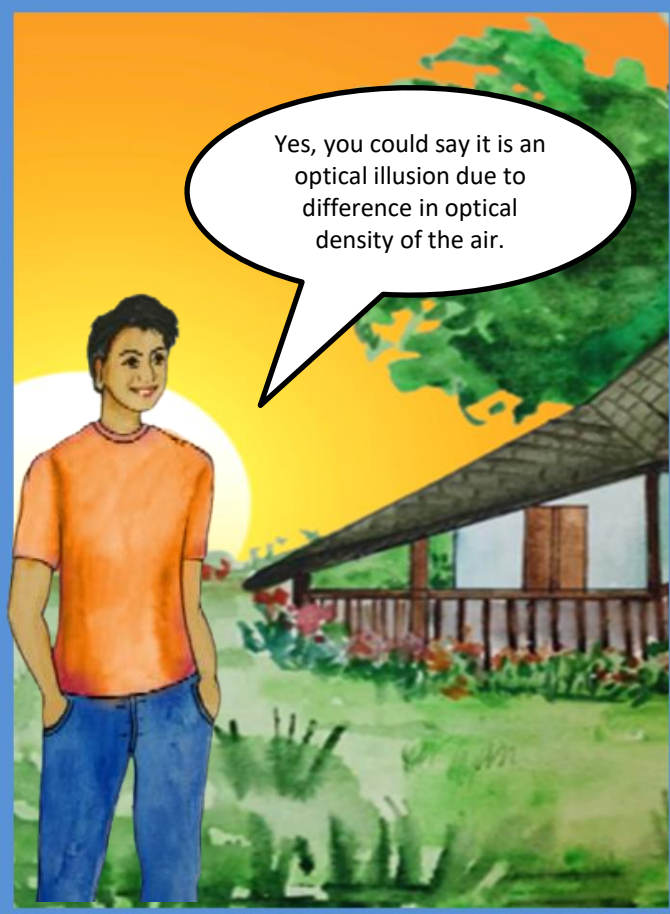
So that leaves only red and yellow light to penetrate through the atmosphere

I see....that's simple



Am I
imagining
things or is
the sun
actually
appearing
flatter than
usual?

And what
brings
about this
variation?



Yes, you could say it is an
optical illusion due to
difference in optical
density of the air.



So, light travels through
layers of the
atmosphere with
different temperatures,
that causes...



By now the spacecraft has received enough sunlight to revive. Tweety tries to revive the engine and the space craft starts with a jarring sound. Tweety is visibly relieved and the children visibly disappointed at the thought of Tweety going .

No friends, I have to go. But I must say that the feeling of friendship that you are experiencing is mutual.

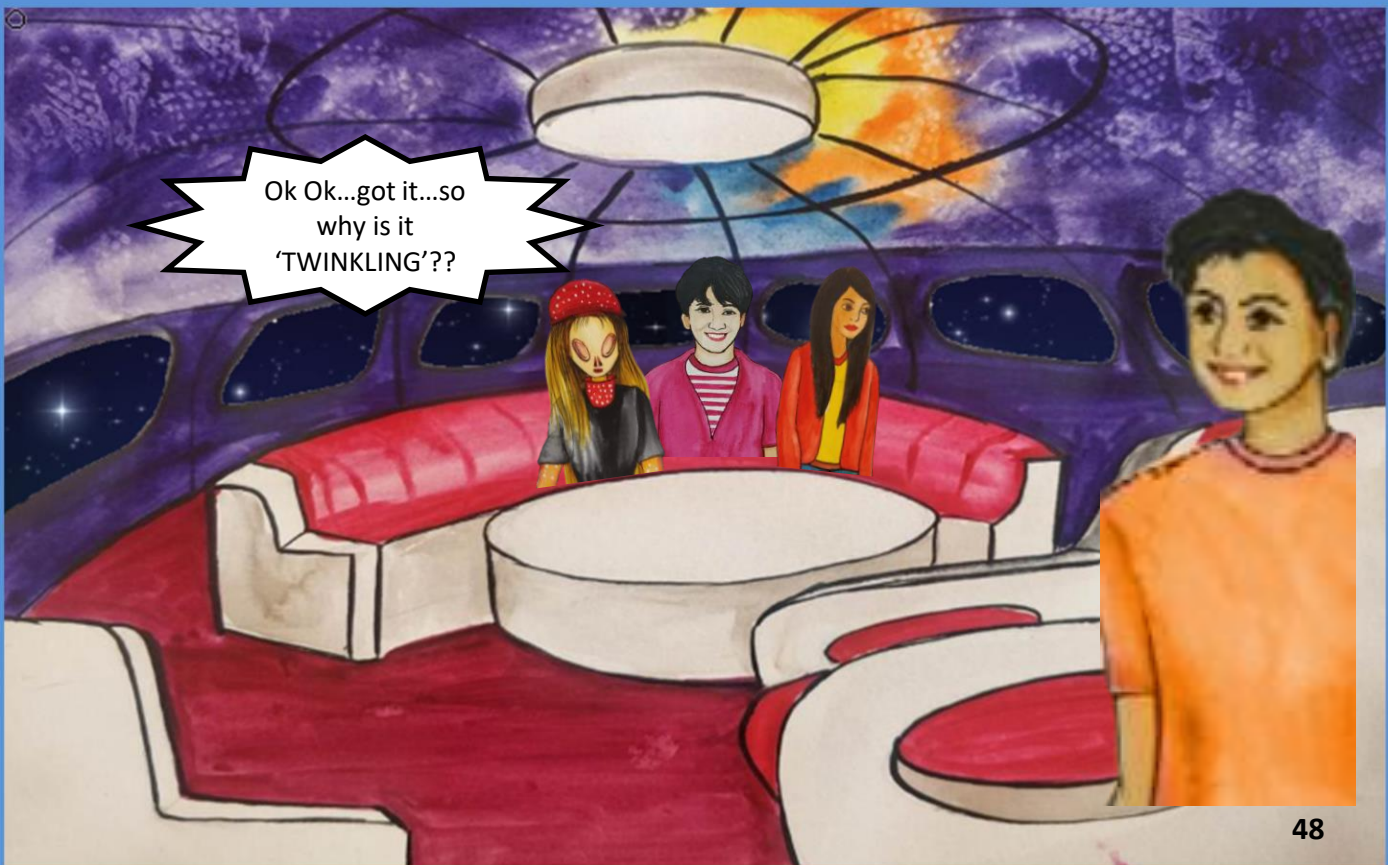
Yes, why don't you stay for a while?

Come on let us take a ride in my spacecraft together before I leave for my planet. Hop on!!!

Tweety is boarding it and motioning others to follow him inside.....

Why are the stars sort of flickering?

All of them board the spacecraft and start their trip in space. The spacecraft is moving at a high speed and they enjoy the ride so much that they lose the track of time. It was almost 1AM and the sky was studded with twinkling stars. This was strange for Tweety as he had never seen twinkling stars.





As a star's light penetrates the Earth's atmoosp here, there is multiple refraction

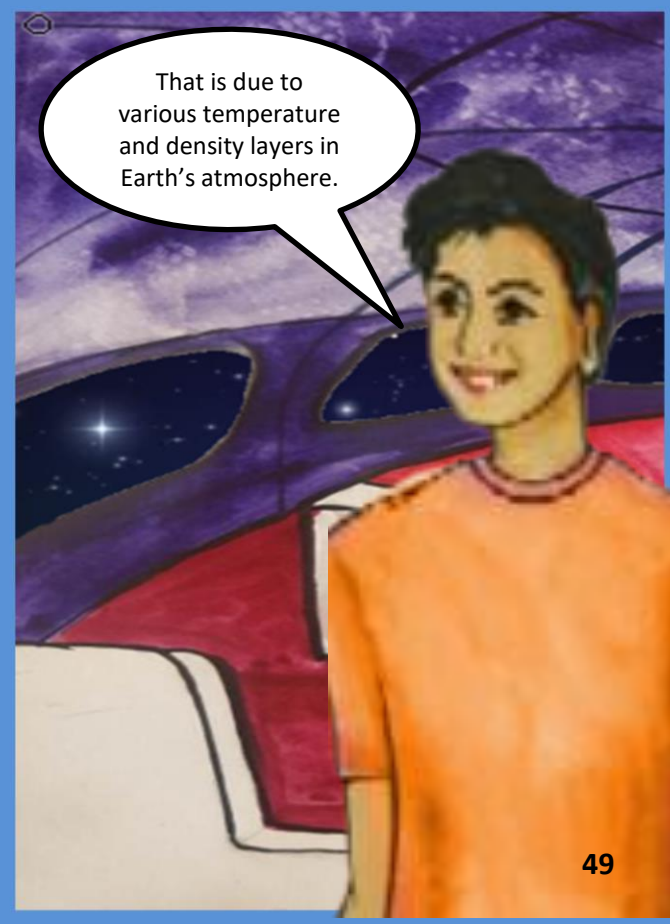


ATMOSPHERIC REFRACTION IS RESPONSIBLE FOR SO MANY THINGS...



Every stream of light bends due to atmospheric refraction.

But why do they do so?



That is due to various temperature and density layers in Earth's atmosphere.



So it like light travelling
a zig-zag path to our
eyes.



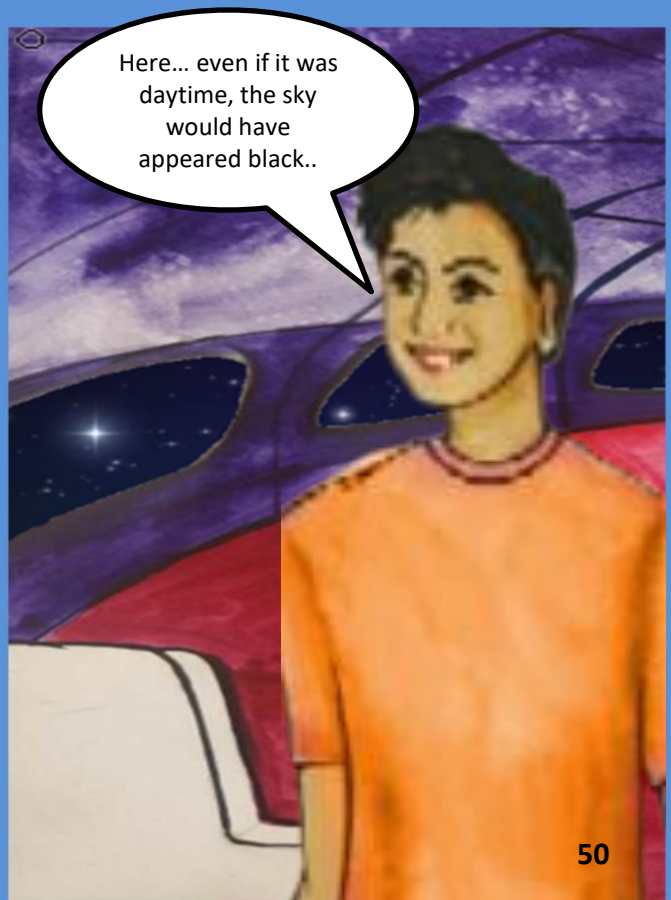
OOKKKAYYY.....



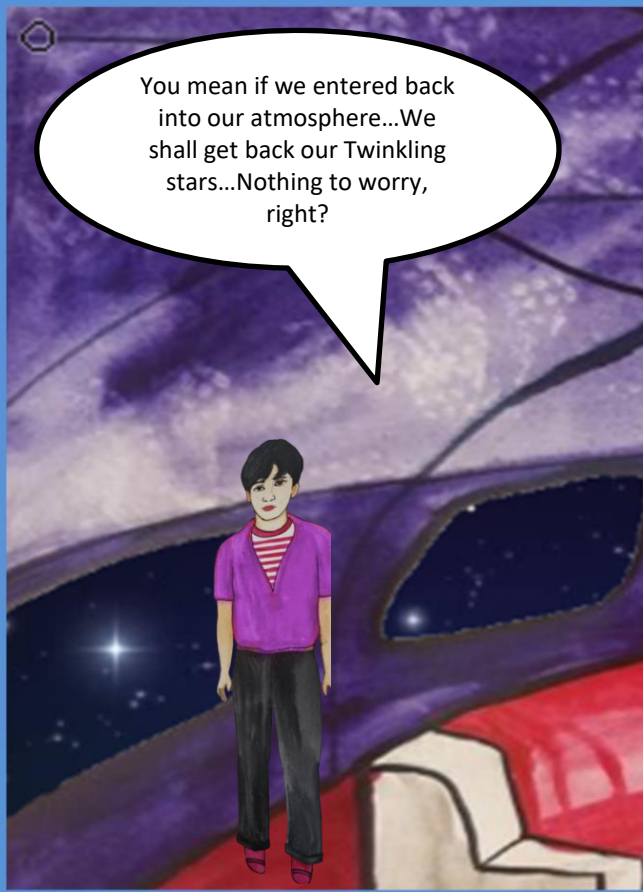
Just noticed that
the stars aren't
twinkling today....
What could be the
matter?

Hold your breath
everybody...we
have crossed the
Earth's atmosphere

After around another two hours, Nayan and
Tara observe that the stars were not twinkling
anymore.



Here... even if it was
daytime, the sky
would have
appeared black..



Since Deepanjan knew that Nayan and Tara's parents will return around 9 in the morning, he wanted to return home without any delay.





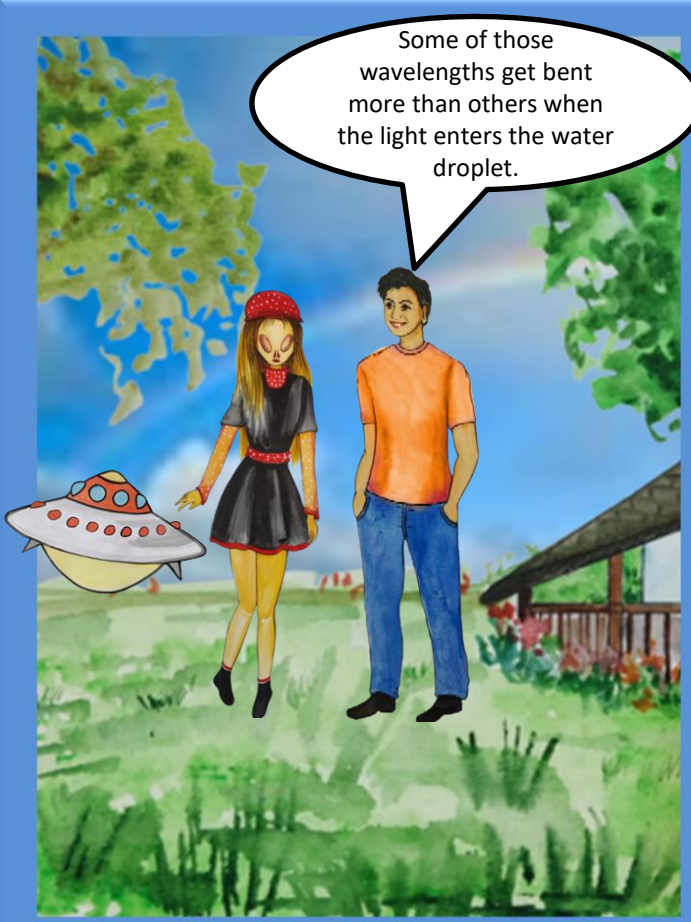
Goodness gracious!!! Just look at that amazing arc of colour.

O that! that's called a rainbow.



Why are rainbows formed?

Sunlight splits into its seven component colours after passing through the water droplets.



Some of those wavelengths get bent more than others when the light enters the water droplet.



That's fine but why are they semi-circular?



A full rainbow is actually a complete circle, but from the ground we see only part of it.



Is there no way we can see it?

They continued to talk and even before they realized, they reached home.



Well maybe from an airplane, in the right conditions, one can see an entire circular rainbow.



Now I must really go...was wonderful meeting all of you.



See you soon.

We will miss you.

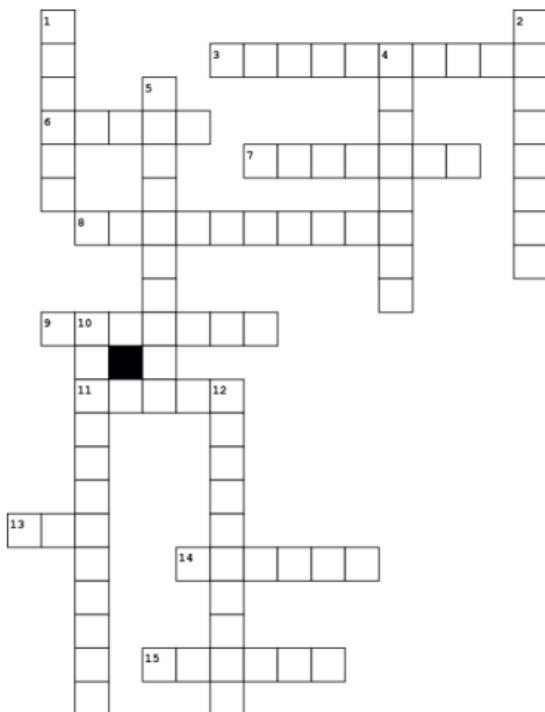
Have a safe journey.

The day was bright and Nayan and Tara were expecting their parents any time. Tweyety also wanted to reach his planet as soon as possible. The brief halt at earth has given all of them a bagful of memories and of course new friends. All of them bid goodbye to Tweyety.



CROSSWORD

HUMAN EYE AND THE COLOURFUL WORLD



Across

3. STARS APPEAR TO SHIFT FROM THEIR ACTUAL POSITION DUE TO THIS PHENOMENON
6. IRIS CONTROLS THE SIZE OF THIS
7. LENS USED TO CORRECT MYOPIA
8. THE INABILITY AMONGST ELDERLY TO SEE NEARBY OBJECTS CLEARLY
9. WHEN THE EYE IS FOCUSED ON AN OBJECT VERY FAR AWAY THE FOCAL LENGTH IS
11. THE SENSORY CELLS THAT DETECT COLOUR
13. THE COLOUR WHICH DEVIATES THE LEAST WHEN WHITE LIGHT FALLS ON A GLASS PRISM
14. THE HUMAN EYE FORMS IMAGE AT THIS POINT
15. THE LENS USED TO CORRECT PRESBYOPIA

Down

1. IDENTIFY THE DEFECT IF THE OPTICIAN PRESCRIBED SPECTACLES OF POWER $-3.5D$ FOR THE EYES
2. THE DISTANCE WHERE NORMAL EYE CAN SEE CLEARLY
4. DISEASE CAUSED DUE TO THE THICKENING OF THE EYE LENS
5. THE PHENOMENON OF WHITE LIGHT SPLITTING INTO ITS COMPONENT COLOURS
10. ADJUSTING THE FOCAL LENGTH OF LENS FOR CLEAR VISION
12. PHENOMENON DUE TO WHICH SKY APPEARS BLUE

QUESTION ANSWERS

Answer the following questions:

1. The least distance of distinct vision for a normal eye is
 - (a) infinity
 - (b) 25 cm
 - (c) 2.5 cm
 - (d) 25 m

2. The defect of vision in which a person cannot see the distant objects clearly but can see nearby objects clearly is called
 - (a) Myopia
 - (b) Hypermetropia
 - (c) Presbyopia
 - (d) Bifocal eye

3. The splitting of white light into different colours on passing through a prism is called
 - (a) reflection
 - (b) refraction
 - (c) dispersion
 - (d) deviation

4. The splitting of white light into different colours on passing through a prism is called
 - (a) reflection
 - (b) refraction
 - (c) dispersion
 - (d) deviation

5. At noon, the Sun appears white as
 - (a) blue colour is scattered the most
 - (b) red colour is scattered the most
 - (c) light is least scattered
 - (d) all the colours of the white light are scattered away

QUESTION ANSWERS

6. Twinkling of stars is due to
- (a) reflection of light by clouds
 - (b) scattering of light by dust particles
 - (c) dispersion of light by water drops
 - (d) atmospheric refraction of starlight
7. When white light enters a glass prism from air, the angle of deviation is least for
- (a) blue light
 - (b) yellow light
 - (c) violet light
 - (d) red light
8. When white light enters a glass prism from air, the angle of deviation is maximum for
- (a) blue light
 - (b) yellow light
 - (c) red light
 - (d) violet light
9. The amount of light entering the eye can be controlled by the
- (a) Iris
 - (b) Pupil
 - (c) Cornea
 - (d) Ciliary muscles
10. What type of image is formed by the eye lens on the retina?
- (a) Real and erect
 - (b) Virtual and inverted
 - (c) Real and inverted
 - (d) Virtual and erect

QUESTION ANSWERS

11. The medical condition in which the lens of the eye of a person becomes progressively cloudy resulting in blurred vision is called
- (a) Myopia
 - (b) Hypermetropia
 - (c) Presbyopia
 - (d) Cataract
12. The defect of the eye in which the eyeball becomes too long is
- (a) Myopia
 - (b) Hypermetropia
 - (c) Presbyopia
 - (d) Cataract
13. The defect of vision in which the image of nearby objects is formed behind the retina, is
- (a) Myopia
 - (b) Short-sightedness
 - (c) Hypermetropia
 - (d) Presbyopia
14. Which of the following is a natural phenomenon which is caused by the dispersion of sunlight in the sky?
- (a) Twinkling of stars
 - (b) Stars seem higher than they actually are
 - (c) Advanced sunrise and delayed sunse
 - (d) Rainbow
15. Name the scientist who was the first to use a glass prism to obtain the spectrum of sunlight.
- (a) Isaac Newton
 - (b) Einstein
 - (c) Kepler
 - (d) Hans Christian Oersted

QUESTION ANSWERS

Fill in the Blanks.

1. The ability of the eye to focus both near and distant objects, by adjusting its focal length, is called the of the eye.
2. of light causes the blue colour of sky and reddening of the Sun at sunrise and sunset.
3. Most of the refraction of light rays entering the eye occurs at the outer surface of the
4. Due to the greater converging power of the eye lens in a myopic eye, the image of distant object is formed the retina.
5. A person suffering from both myopia and hypermetropia uses
lenses



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APPLICATIONS USED:

MS POWERPOINT
MS PAINT
FACE APP
DRESS COLOUR CHANGER

FROM PRINCIPAL'S DESK



The creation of this Graphic Novel has been a unique learning experience for all of us. It has given wings to our imagination and creativity. It has converted facilitator centric pedagogy of concepts into a learner centric pedagogy involving the 21st century skills. I think the Graphic Novel is now the tool of learning for today's learners where concepts/topics are explained to them through stories which are more relatable to them. My sincere thanks to the worthy team of Ms. Anita Karwal, Secretary, Department of School Education, Ministry of Human Resource and Development, Mr. Manoj Ahuja, Chairman, Central Board of Secondary Education and Mr. Sandeep Sethi, whose constant support and guidance has motivated the team of facilitators to work and think differently for creating this unique Graphic Novel. I am sure that this will definitely bring a change in the teaching-learning environment. My congratulations to the team of Chinmaya Vidyalaya teachers who, in a time-bound frame, produced this phenomenal work of not only the content but also a visual treat for all the readers and viewers.

Happy Reading!

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