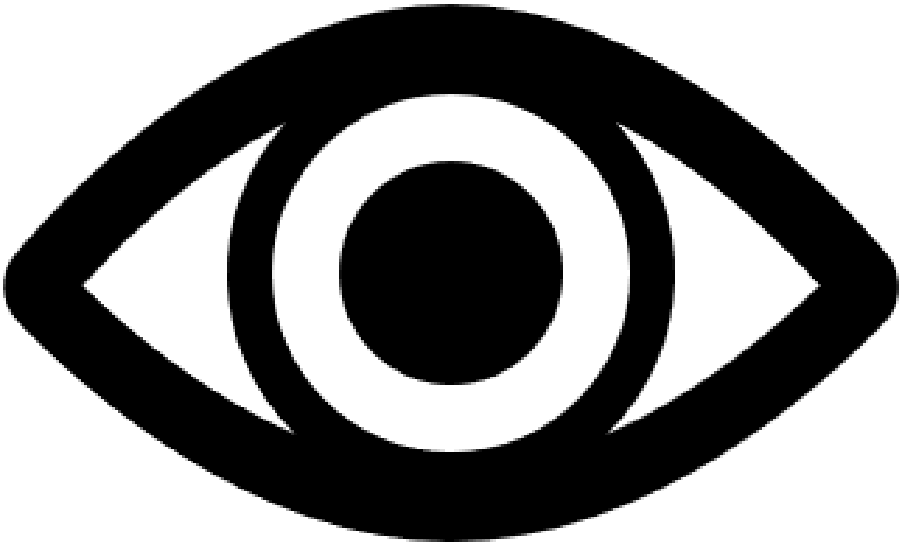
How we see and making images



L1 Refraction

Refraction is when light changes direction as it passes from one material to another. Think about when you put a straw in a glass of water. The straw looks bent or broken at the point where it enters the water. This happens because light travels differently in water than in air, so it changes direction. This change in direction of light is called refraction.

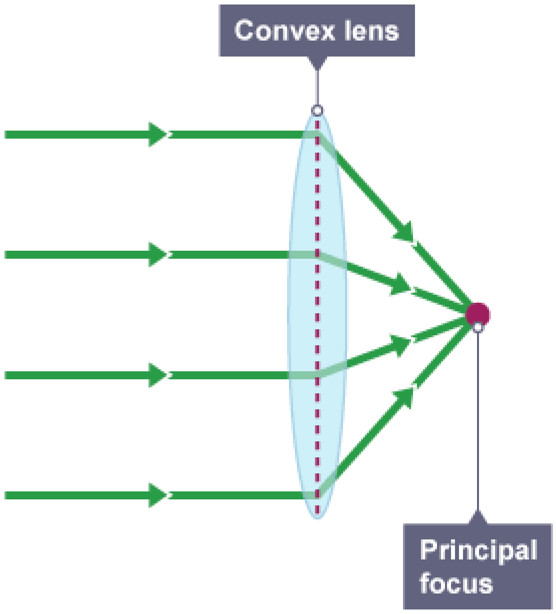
A convex lens is a lens that curves outward, like the shape of a football or a magnifying glass. It's thicker in the middle and thinner at the edges. Convex lenses are used in many things like eyeglasses, cameras, and telescopes.

- When light hits a convex lens, it first passes through the air and then into the glass (or plastic) of the lens. Since the glass is a different material than the air, the light bends when it enters the lens. This is the first refraction.

- The shape of the convex lens causes the light rays to bend inward as they pass through it. This happens because the lens is thicker in the middle, so light entering at different points bends at different angles. The light rays are bent towards a single point called the focal point.

- After the light rays pass through the lens, they move from the glass back into the air. This causes another change in direction, or a second refraction. The light rays continue to converge (come together) until they meet at the focal point.

When light rays meet at the focal point, they create a clear image. This is why convex lenses are used in things like magnifying glasses to make things look bigger and clearer, or in cameras to focus light and take sharp pictures.



Independent practice

1. What is refraction?
2. Can you give an example of refraction that you might see in everyday life?
3. What shape does a convex lens have?
4. Name some devices that use convex lenses.
5. What happens to light when it first enters a convex lens?
6. Why does the light bend when it enters the lens?
7. What is the focal point in the context of a convex lens?
8. How do the light rays behave as they pass through a convex lens?
9. What happens to the light rays after they exit the convex lens?
10. Why do convex lenses make things look bigger and clearer?
11. What would you see if you moved a magnifying glass (convex lens) up and down above a piece of paper?
12. How does refraction in a convex lens help cameras take sharp pictures?
13. Why is it important for light rays to converge at a single point?
14. What might happen if a lens didn’t refract light correctly?
15. How does the thickness of the convex lens affect the way light bends?

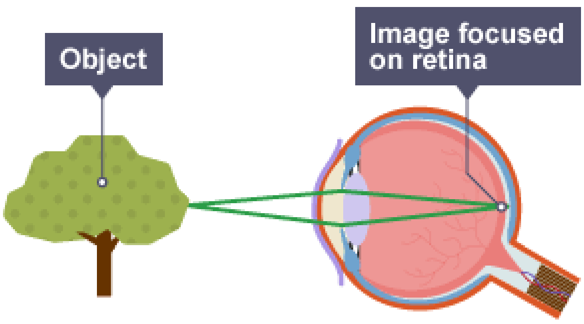
L2 The Eye

The Journey of Light

1. **Light Enters the Eye:**
   - Light from the sun, a lamp, or any other source bounces off objects and enters your eyes. This light passes through the clear, front part of your eye called the **cornea**.
2. **The Eye's Camera Lens:**
   - Just like a camera has a lens to focus light, your eye has a **lens** too. After light passes through the cornea, it goes through the **pupil** (the dark circle in the centre of your eye). The pupil can get bigger or smaller to let in more or less light.
   - The lens focuses this light onto the back of your eye. If the light isn't focused properly, you might need glasses to help you see better.
3. **The Retina – Your Eye's Screen:**
   - The back of your eye is called the **retina**. The retina has special cells called **rods** and **cones** that detect light.
     - **Rods** help you see in low light and see black and white.
     - **Cones** help you see colours and work best in bright light.
4. **Turning Light into Signals:**
   - The rods and cones convert light into electrical signals. Think of these signals as messages that need to be sent to your brain.
5. **The Optic Nerve – Your Eye's Messenger:**
   - These electrical signals travel from the retina to your brain through the **optic nerve**.
6. **The Brain – The Real Boss:**
   - Your brain receives the signals and processes them. It's like putting together a puzzle. The brain combines the information from both eyes to create one clear image. This is how you can see your friends, read a book, or watch a movie!

Cool Facts:

- **Blinking**: You blink about 15-20 times per minute to keep your eyes moist and clean.
- **Peripheral Vision**: You can see things out of the corner of your eyes, not just what you're looking at directly.
- **Depth Perception**: Your brain uses information from both eyes to figure out how far away things are.



<u>Independent practice</u>

1. Where does the light come from before it enters your eye?
2. What is the name of the clear, front part of your eye that light passes through?
3. What part of the eye controls how much light enters it?
4. How does the pupil change to let in more or less light?
5. What does the lens of the eye do to the light?
6. Why might someone need to wear glasses?
7. What is the name of the back part of your eye where light is focused?
8. What are the two types of special cells in the retina that detect light?
9. What do rods help you see?
10. What do cones help you see?
11. What do rods and cones convert light into?
12. How can you describe these signals that are sent to the brain?
13. Through which nerve do the electrical signals travel to reach the brain?
14. How does the brain create depth perception?
15. How many times do you blink per minute to keep your eyes moist and clean?
16. What is peripheral vision?
17. How does your brain figure out how far away things are?

L3 Reflection

Imagine you're playing with a bouncy ball. When you throw the ball against a wall, it bounces off and comes back to you. The way it bounces off the wall is similar to how light reflects off a surface.

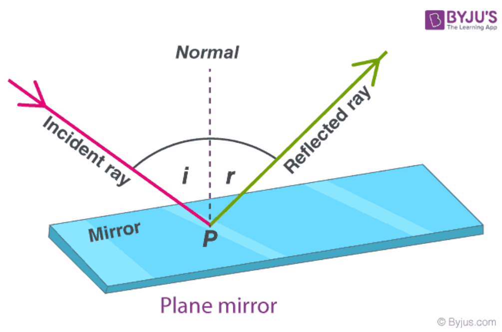
Here's how it works with light:

1. Light Beam (like the ball): Think of a light beam like a ball you're throwing. When it hits a mirror, it's like the ball hitting the wall.

2. Angle of Incidence (throwing angle): The angle at which the light beam hits the mirror is called the angle of incidence. Imagine you're throwing the ball at an angle toward the wall. The angle between the ball's path and an imaginary line that's straight up and down (called the normal line) is the angle of incidence.

3. Angle of Reflection (bouncing angle): When the light beam reflects (bounces) off the mirror, it does so at an angle called the angle of reflection. Just like the ball bounces off the wall at the same angle it hit, the light beam reflects off at the same angle it hit the mirror.

4. Equal Angles: The cool part is that the angle of incidence is always equal to the angle of reflection. If you throw the ball at a steep angle, it bounces back at a steep angle. If you throw it at a shallow angle, it bounces back at a shallow angle. Light does the same thing!



Summary

- The angle at which the light hits the mirror is the angle of incidence.

- The angle at which the light reflects off is the angle of reflection.

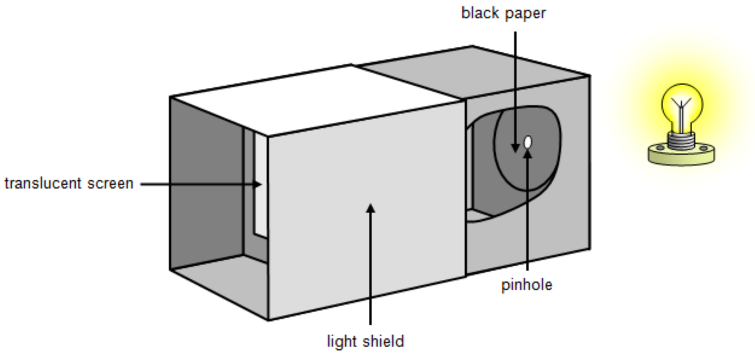
- These two angles are always the same!

So, when you look at yourself in a mirror, the light from your face hits the mirror and reflects straight back to your eyes because the angles of incidence and reflection are equal. This is why you see your reflection!

<u>Independent practice</u>

1. What is the law of reflection?
2. Define the angle of incidence.
3. Define the angle of reflection.
4. If a light beam hits a mirror at an angle of incidence of 30 degrees, what is the angle of reflection?
5. What is the normal line in the context of light reflection?
6. A light ray strikes a mirror at an angle of 45 degrees to the normal. What is the angle between the incoming and reflected light rays?
7. If a light ray hits a mirror at an angle of 60 degrees from the surface, what is the angle of incidence?
8. A light ray is incident on a mirror at an angle of 25 degrees. Calculate the angle between the incident ray and the reflected ray.
9. What happens to the direction of a light ray when it hits a rough surface compared to a smooth surface?
10. If the angle of incidence is 0 degrees, what is the angle of reflection?
11. A light beam strikes a plane mirror and is reflected such that the angle of reflection is 40 degrees. What was the angle of incidence?
12. How would you draw the path of a light beam that hits a mirror at an angle of 70 degrees to the surface?
13. If a light ray incident at 35 degrees from the normal hits a mirror, at what angle will it reflect off the mirror?
14. A light ray strikes a mirror at an angle of 55 degrees from the normal. What will be the angle between the incident ray and the reflected ray?
15. Calculate the angle of reflection for a light ray incident at 75 degrees from the surface of the mirror.

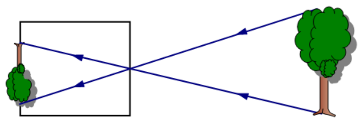
L4 Pinhole Cameras



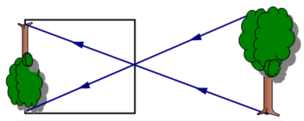
The pinhole camera is a very simple piece of apparatus that demonstrates several points about the physics of light. The pinhole camera was first used in about 1000 AD and since then it has been a simple way of producing a correct image of a scene. Artists from the sixteenth century onwards used a pinhole camera to help them get the correct proportions for a painting.

In its basic form it is simply a light-tight box with a pinhole in one end and a translucent screen of, say, tracing paper at the other.
Light from the object goes through the pinhole and produces an inverted image in full colour on the screen.

Changing the distance from the pinhole to the object will change the size of the image. If more than one pinhole is made in the end more than one image will be formed on the screen.

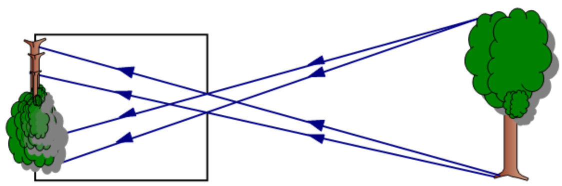


Clear upside down (inverted) image with a small pinhole



Camera closer to the object – a larger image

A bigger pinhole will allow more light to get in and so the image will become brighter, but it will also be blurred. This is because light from one point on the object can reach more than one point on the screen.



Fuzzy out of focus image with a large pinhole

Pinhole cameras need not be focused like ordinary cameras, they are always in focus. However, if you bring a pinhole camera very close to the object you are effectively increasing the size of the pinhole and the image will become blurred. You should notice that the inside of the pinhole camera is painted black to stop unwanted reflections inside. It is also helpful to have a light shield over the back to shade the screen. The fact that the pinhole camera gives a clear image is very good evidence for the fact that light travels in straight lines.

Independent practice

1. What is the function of the pinhole in the pinhole camera?
2. Why is black paper used in the construction of the pinhole camera?
3. What is the role of the translucent screen in the pinhole camera?
4. How does the size of the pinhole affect the image formed on the translucent screen?
5. Why is the image formed by the pinhole camera inverted?
6. What is the purpose of the light shield in the pinhole camera?
7. Can the pinhole camera capture moving objects clearly? Why or why not?
8. What would happen if the translucent screen was replaced with a solid opaque screen?
9. How would increasing the distance between the pinhole and the translucent screen affect the image?
10. What is the advantage of using a pinhole camera over a lens camera?
11. What kind of images (nature, architectural, etc.) are best suited for pinhole photography?
12. How does the material of the translucent screen affect the quality of the image?
13. What principle of physics does the pinhole camera illustrate?
14. Could a pinhole camera work underwater? What modifications might be needed?
15. What historical significance does the pinhole camera have in the development of modern photography?

L5 Title

Insert explanation.

Independent practice

Insert 14 questions including two extended writing questions.

L6 Title

Insert explanation.

Independent practice

Insert 14 questions including two extended writing questions.