

Optics – The Study of Light

Refraction

Light *refracts* when passing between two substances at an *angle*.

Light slows down in glass. Here the left side slows down first causing the light to bend to the left.



Light speeds up in air. Here the left side speeds up first causing the light to bend to the right.

The right side hits first and slows down causing the light to bend to the right.



If the light does not enter at an angle, it does not bend.

Reflection

Light reflects at shiny boundaries we call mirrors.

Normal – an imaginary line 90° (perpendicular) to a surface.

Angle of Incidence – the angle between the incoming ray and the normal.

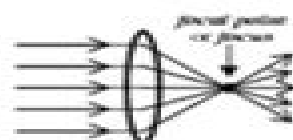
Angle of Reflection – the angle between the outgoing ray and the normal.



angle of incidence = angle of reflection

Focus

Every lens or mirror has a place where all of the parallel rays will meet. This is known as the *focal point* or *focus*.



Straight Lines

Mirrors and lenses can make things look bigger or smaller because our eyes always think that light comes from straight lines, even if they have been refracted or reflected.



Object vs. Image

The **object** is what you are looking at: the actual thing.

The **image** is what you think you see: the object enlarged, reduced, or moved.

Lenses

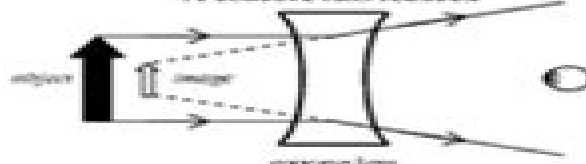
Lenses work by refraction, by the light bending when moving between two substances.

A convex lens magnifies.



A convex lens is **convergent** – the light rays come together.

A concave lens reduces.



A concave lens is **divergent** – the light rays spread apart.

Lenses and mirrors work opposite of each other. If a convex lens reduces, then a concave mirror magnifies.

Concave or Convex



Concave looks like the sides have curved in.



Convex – the middle is bigger than the ends.

Optical Systems



Microscopes and telescopes are **optical systems** that use combinations of lenses and/or mirrors to magnify light. Combining optical devices allows us to see very distant or very small objects.

Mirrors

Mirrors work by reflections, by the bouncing of light off of a shiny surface. **Images in mirrors always look twice as far away as the object.**

Ex. An image looks 20 m away in a mirror. How far away is the object?
 Answer: Half the distance: 10 meters.

A convex mirror reduces.



A convex mirror is **divergent**.

A concave mirror magnifies.



A concave mirror is **convergent**.

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M Woodhall



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Table of Contents Optics The Study Of Light Key

1. Understanding the eBook Optics The Study Of Light Key
 - The Rise of Digital Reading Optics The Study Of Light Key
 - Advantages of eBooks Over Traditional Books
2. Identifying Optics The Study Of Light Key
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Optics The Study Of Light Key
 - User-Friendly Interface
4. Exploring eBook Recommendations from Optics The Study Of Light Key
 - Personalized Recommendations
 - Optics The Study Of Light Key User Reviews and Ratings
 - Optics The Study Of Light Key and Bestseller Lists

5. Accessing Optics The Study Of Light Key Free and Paid eBooks
 - Optics The Study Of Light Key Public Domain eBooks
 - Optics The Study Of Light Key eBook Subscription Services
 - Optics The Study Of Light Key Budget-Friendly Options
6. Navigating Optics The Study Of Light Key eBook Formats
 - ePub, PDF, MOBI, and More
 - Optics The Study Of Light Key Compatibility with Devices
 - Optics The Study Of Light Key Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Optics The Study Of Light Key
 - Highlighting and Note-Taking Optics The Study Of Light Key
 - Interactive Elements Optics The Study Of Light Key
8. Staying Engaged with Optics The Study Of Light Key
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Optics The Study Of Light Key
9. Balancing eBooks and Physical Books Optics The Study Of Light Key
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Optics The Study Of Light Key
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Optics The Study Of Light Key
 - Setting Reading Goals Optics The Study Of Light Key
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Optics The Study Of Light Key
 - Fact-Checking eBook Content of Optics The Study Of Light Key
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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