Mirrors, Magnifiers and Telescopes

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Course Description

- This course will present an overview of mirrors, magnifiers, and telescopes and where they fit into the optical practice, improving your patients' vision. The presentation will begin with information regarding mirrors and the different types. It will continue with information regarding magnification and magnifiers, and conclude with optical telescopes and when they can be used to improve your patient's vision.

Learning objectives/outcomes

At the completion of this section, the student should be able to:

- Discuss the differences between first surface mirrors and second surface mirrors.
- Explain how convex mirrors and concave mirrors are similar to lenses and how they differ.
- Explain the principles of magnification of lenses
- List at least 3 different magnifiers and how they benefit vision
- Have a better understanding of the principles of a telescope
- Identify how telescopes can improve a patient's vision

Introduction

- Low Vision – What is it?
- Mirrors
- Magnification – the effects on vision
- How magnifiers improve vision
- The principles of a telescope
- Putting it all together
- Conclusion

Low Vision – What is it?

- A significant reduction of visual function that cannot be fully corrected by glasses, contact lenses, surgery, medical treatment or medicine

- Not to be confused with blindness

Low Vision – What is it?

- Affects people of all ages
- About 14 million Americans have low vision
- People with low vision are classified as partially sighted and/or legally blind

Low Vision – What Causes it?

- AMD
- Diabetic Retinopathy
- Glaucoma
- Cataracts
- Other eye diseases and conditions

Normal Vision

Central Field Loss

Causes include AMD and Optic Atrophy

Multiple field loss

Causes include diabetic retinopathy, glaucoma, retinal detachment and trauma.

Tunnel Vision

Causes include glaucoma, retinitis pigmentosa and stroke.

Contrast loss and glare problems

Causes include cataracts, glaucoma, corneal disease and albinism.

Blurred vision

Causes include AMD, diabetic retinopathy, cataracts or corneal disease

Distortion

Causes include AMD, diabetic retinopathy, and retinal detachment

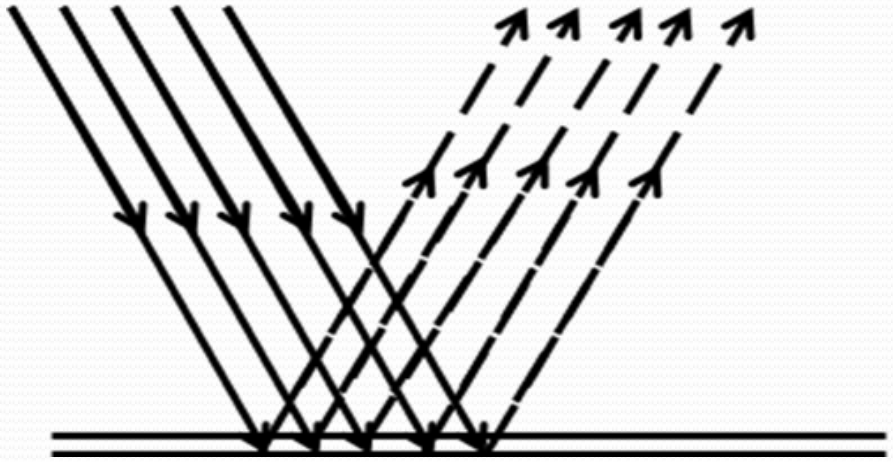
Mirrors, Magnifiers, Telescopes

Mirrors

- A little review of the laws of reflection
- Front surface mirrors
- Second surface mirrors

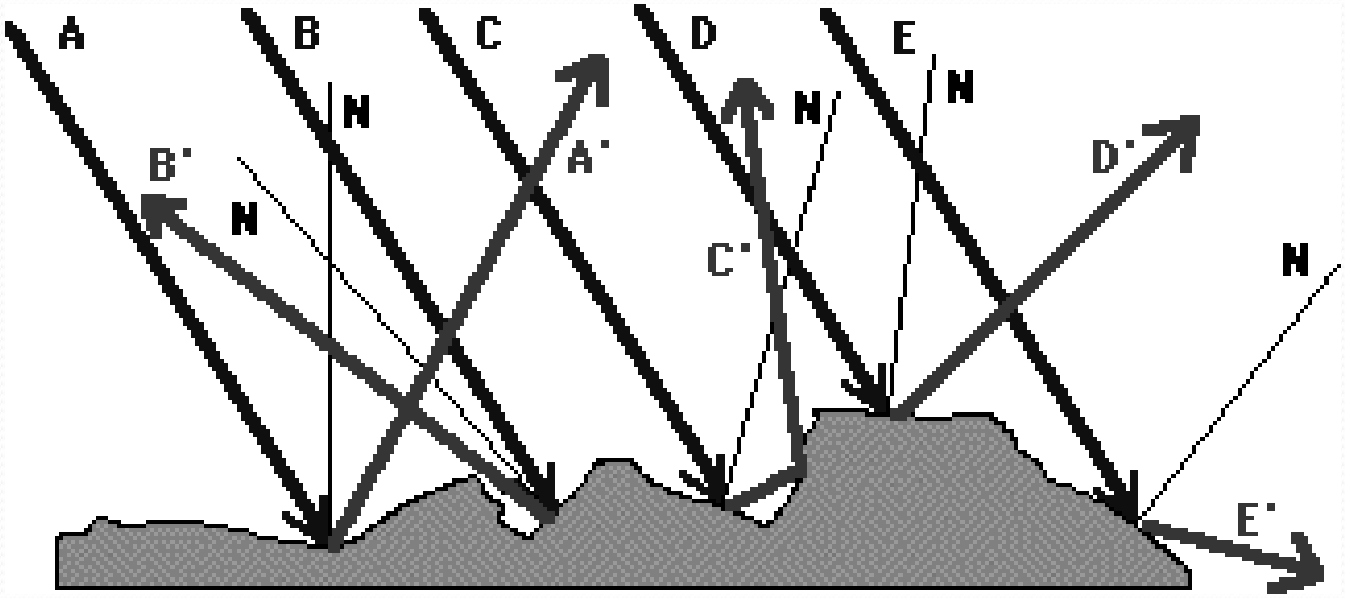
Mirrors

- The law of reflection is:
- The angle of incidence = the angle of reflection



Diffused Reflection

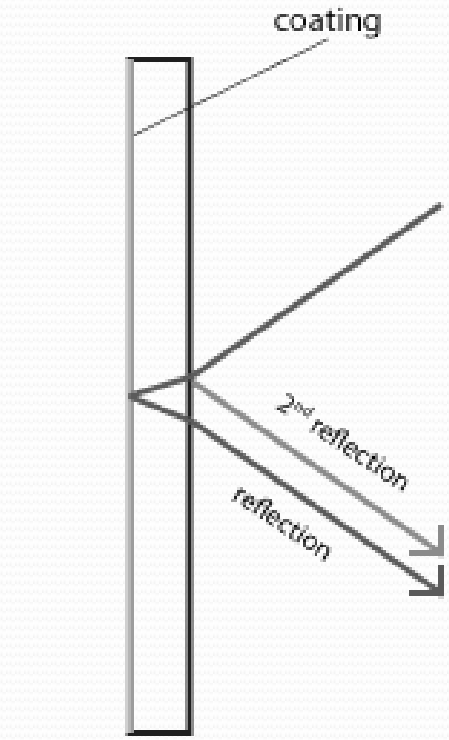
- Light falling on opaque or irregular surface, will be reflected in a random manner, not creating a perfect reflection.



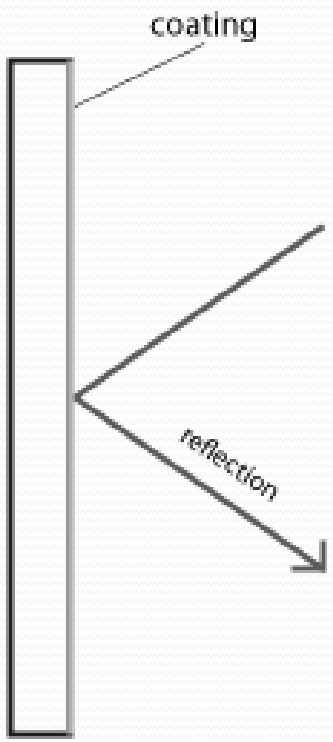
Specular Reflection

- A smooth/polished surface produces a specular reflection.

Types of Mirrors



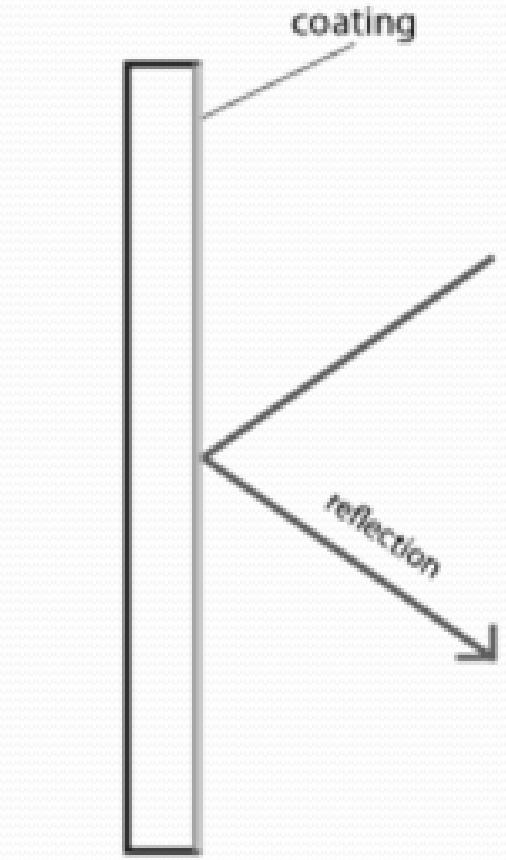
Second Surface Mirror



First Surface Mirror

First Surface Mirrors

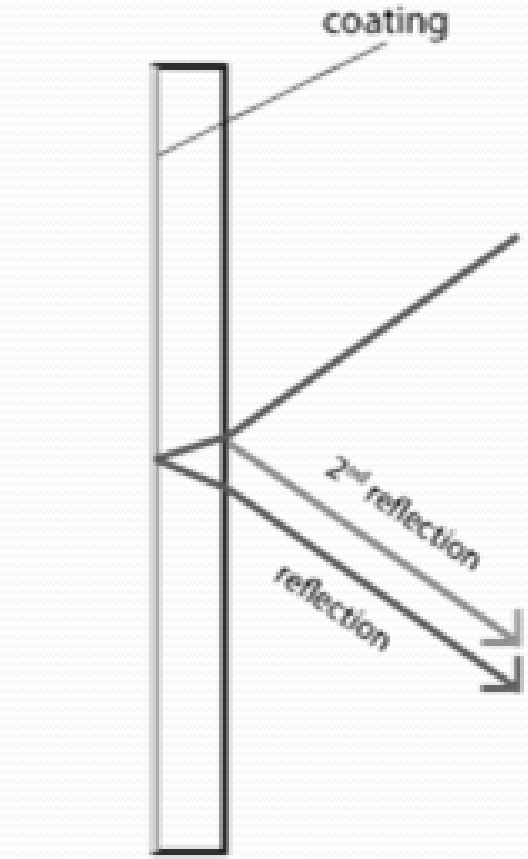
- Used for strict reflection without ghosting effect
  - Telescopes, projection televisions and periscopes use this type
- Advantage
  - Produces clearer image
  - Images are reflected at full intensity and brightness
- Disadvantages
  - More easily damaged
  - Cost is usually higher



First Surface Mirror

Second Surface Mirrors

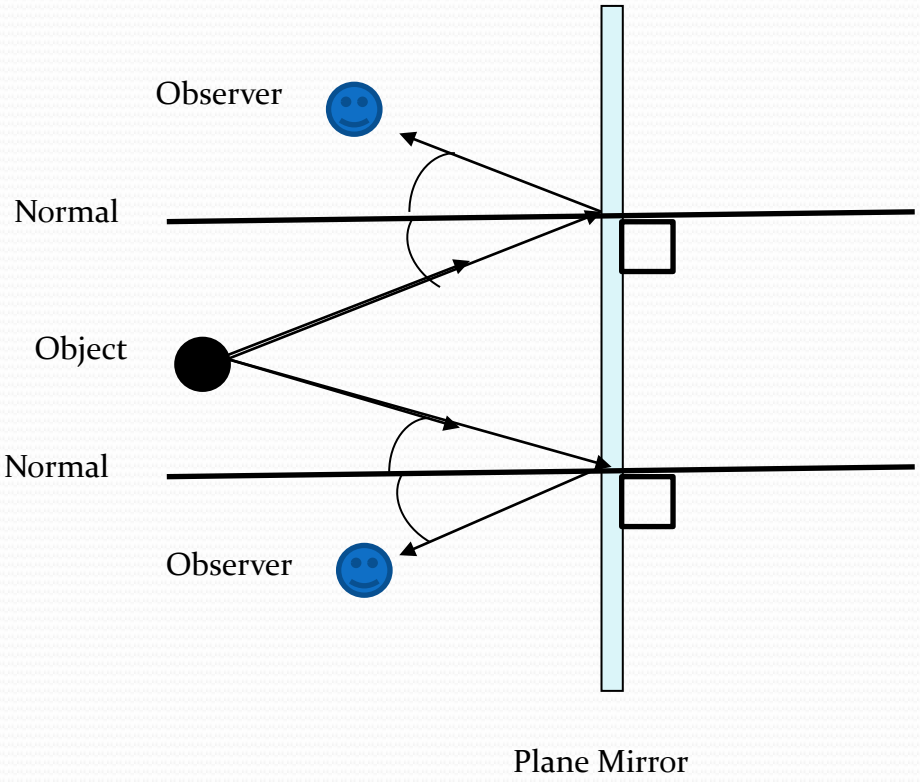
- Most of what we use today
- Generally constructed of protective clear glass or acrylic over silvered coating on back surface
- Advantage
  - Silver is protected
  - Cost is less
- Disadvantage
  - Ghost image due to front reflection (about 4%)
  - Internal reflection



Second Surface Mirror

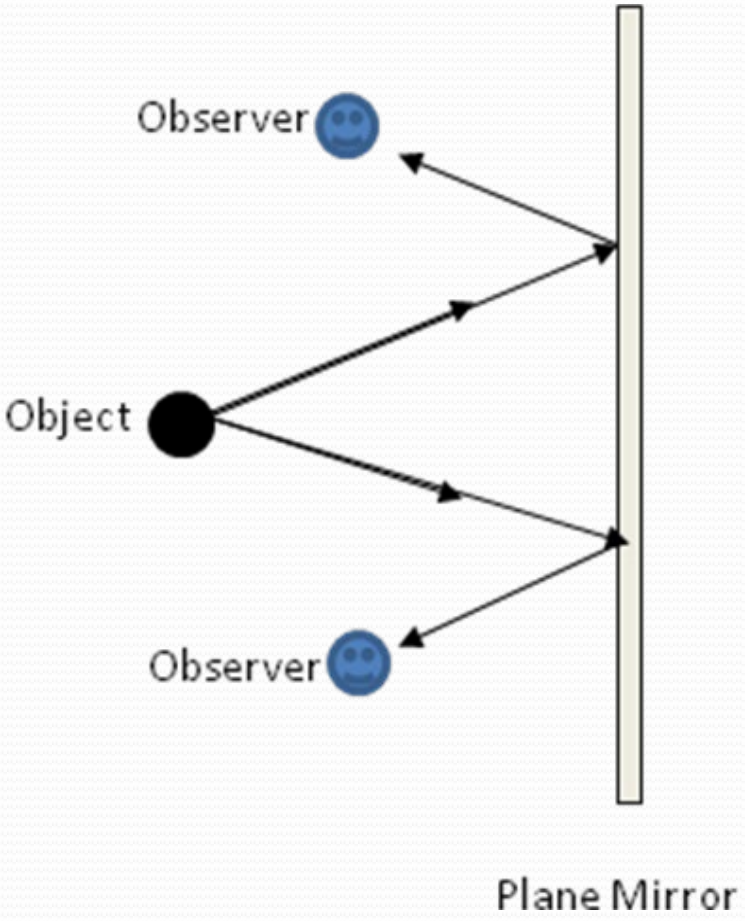
Total internal reflection (through prism)

- Critical Angle
  - Defined as 42 degrees



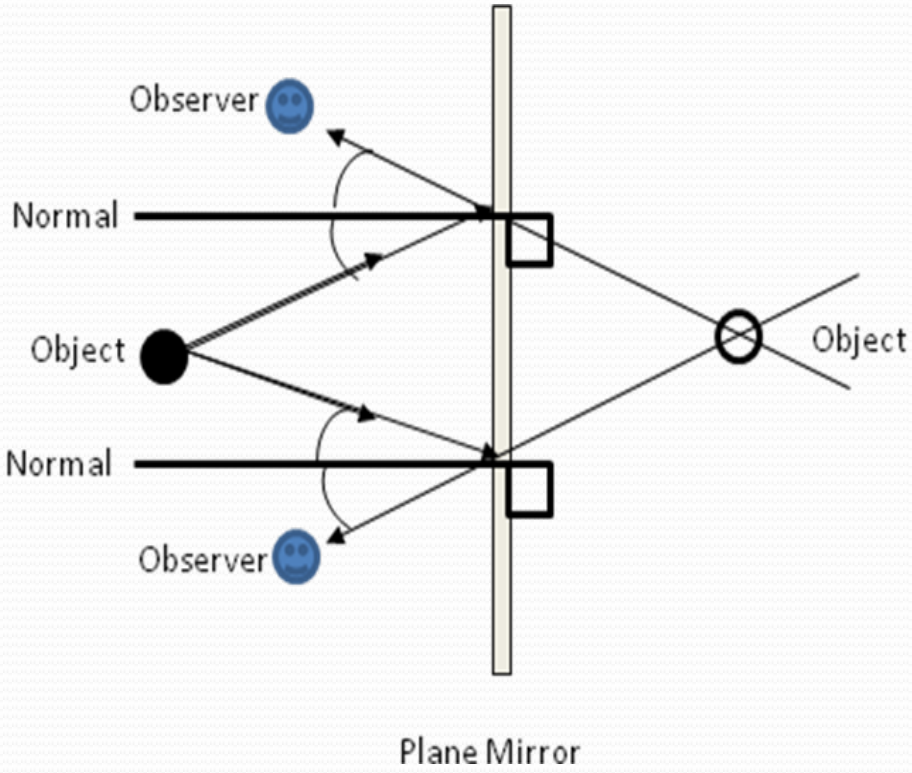
Plane Mirrors

- Mirrors that are flat
- Plano surface



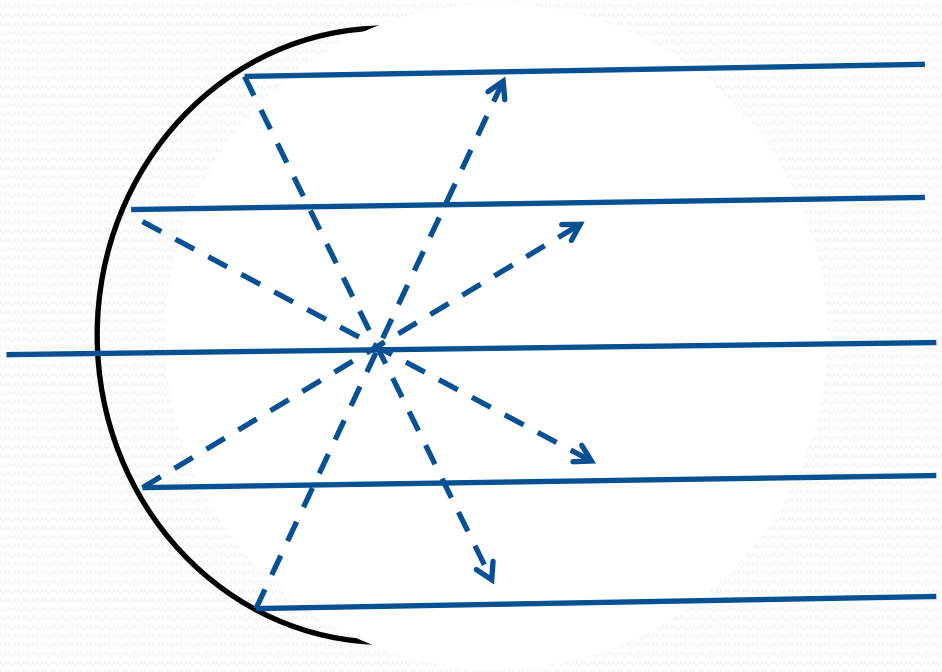
Plane Mirrors

- Produce virtual images
- Image appears to be the same distance behind the mirror
- Size and perspective is the same



Curved Mirrors

- Convex mirrors are known as diverging mirrors, while concave mirrors cause parallel light rays to converge. This is opposite from ophthalmic lenses. The name of the mirror indicates the side of the sphere that is reflective.



Curved Mirrors

- Convex mirrors produce smaller images, so the image may appear further away.
  - The kind of mirror used in the rear-view mirror must therefore be a convex lens.

- Concave mirrors produce images which are larger than they actually are.
  - Makes them useful as makeup mirrors.

Magnification

The effects on vision

- When bigger is better and when it's not
- How to increase magnification
- How to decrease magnification

How magnifiers improve vision

- The use of hand held magnifiers
- When to use them

Optical Aids

- Generally as magnification increases; field of view, working distance, and working space are reduced.
- To estimate required magnification, divide the best corrected acuity by the required acuity.

- Example:
  - Best Corrected = 20/200
  - Required acuity = 20/40
  - Estimated Magnification = 5X

Types of magnification

- Relative Size Magnification: Increasing the size of the object - Large print books.
- Relative Distance Magnification: Reducing the distance from the object.
- Angular Magnification: Telescopes and Magnifiers
- Projection & Electronic Magnification: CCTV, Overhead Projector, Computer

Microscopes

- Plus spectacle lenses from 4.00 to 64.00 diopters.
- Focal length in cm = $\frac{100}{D}$
- Shorter focal distance creates relative distance magnification.

Hand Held Magnifiers

- Hand magnifiers should be used with distance glasses.
- Labeled magnification is usually equal to the dioptric power divided by four.
- Example:
  - +16.00 D = 4 X magnification.

Microscopes

- Advantages:
  - Both hands free
  - Wide field of view
  - Astigmatic correction
  - Binocular vision, less than 10 diopters.

- Disadvantages
  - Fixed focal length
  - Short working distance
  - Close distance may cause fatigue

The principles of a telescope

- Different types of telescopes
- How to construct a telescope

Types of Telescopes

- Refractor
  - focuses light using lenses
- Reflector
  - focuses light using mirrors
  - used exclusively in professional astronomy today

Types of Telescopes

- Galilean Telescopes
- Keplerian Telescopes

Galilean Telescopes

- The telescope Galileo used was a refracting telescope. It consisted of two lenses, one converging (which causes parallel light from the sun to converge to a focal point) and one diverging (which causes parallel light to diverge from a focal point)
- Image will be right-side-up
- Field of view is small

Keplerian Telescopes

- First lens (objective) will focus the object just beyond the focal point of the second lens (the eyepiece)
  - Creates a real image
- Image is inverted.
- Field of view is larger (not more magnified) than with a Galilean telescope

Telescopes

- Telescopic lenses bend the rays of light so when they leave the telescope, they appear to be coming from the same direction as an object closer to the eye; thus, the object appears much larger.

Telescopes

- Label indicates power and field of view ex: 7X20, 7.5.
  - The image is 7 times larger than normal, objective lens is 20mm, and the field of view is 7.5 degrees.

Telescopes

- Advantages:
  - The only aid which provides distance magnification.
- Disadvantages:
  - Reduced field of view
  - Exaggerated movement of objects viewed.
  - Spatial orientation.

Putting it all together

- Improving your patients' vision

Low Vision

Electronic and Closed Circuit TV Image Enhancement

- Enlarging the image, and reversing the text may allow the ARMD patient to read

Hand Held Magnifiers

- Easy to use by elderly
- May be illuminated
- Should be aspheric for best optics

Illuminated Stand Magnifier

- Uses halogen lamp
- Has wide field due to lens size and aspheric design

Portable Pocket Magnifier

- Easy to carry in pocket or pocketbook
- May be illuminated (like this one)
- Tends to draw little attention to user

Hand-held Telescope

- Used for distance viewing
- Compact and portable
- Unobtrusive
- Good for reading street signs or identifying people or places

Mounted Telescopes

- For distance viewing
- May be fit with reading cap for near
- Can be mounted into the upper part of standard distance lens

Protection from Light

- Patients need protection from intensity of light
- Protection from U.V.
- Protection from I.R.
- May need improved contrast

Selective Absorption Filters

- CPF 450
- CPF 511
- CPF 527
- CPF 550
- CPF 550 XD

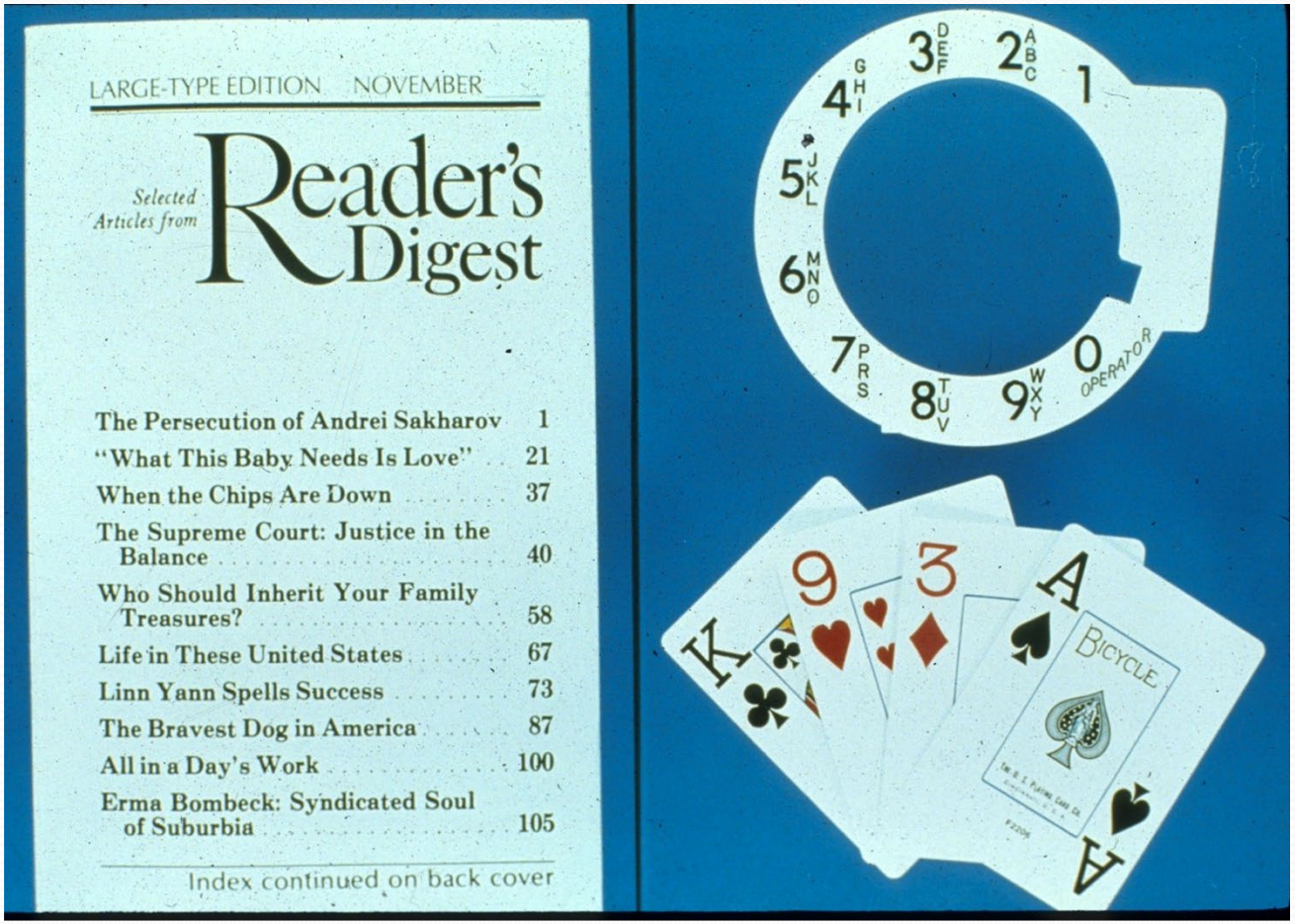
Effects of GlareControl Lenses

- Corning glarecontrol lenses attenuate 100% of UVB wavelengths.
- Corning glarecontrol lenses block 99% of uva wavelengths.

- The blue light portion of the visible spectrum is most likely to scatter in the eye, causing discomfort and hazy illusion.

- Corning glarecontrol lenses attenuate 98% of high-energy blue light, with exception of cpf 450, which is 96% of high-energy blue light.

Non-Optical Aids to Vision



Conclusion/Questions/Answers
Thank You