18-1 Reflection

- Light striking an object can be reflected, absorbed, or transmitted.
  - most objects are opaque and absorb or reflect all the light that strikes them; you can't see through because light can't pass through; ex. wood, metal, cotton fabric, wool fabric
  - transparent materials transmit light; you can see what is on the other side; ex. clear glass, water, air
  - translucent materials allow some light to pass through because they scatter light; you can't see details clearly; ex. frosted glass, wax paper
- You can see most objects because light reflects (bounces) off them. See pg. 571, fig.2.
  - regular reflection occurs when parallel rays of light hit a smooth surface such as a sheet of shiny metal and all the rays are reflected at the same angle following the law of reflection
  - diffuse reflection occurs when parallel rays of light hit an uneven surface (most objects) each at a different angle and the rays are reflected at different angles; each ray obeys the law of reflection individually; this allows you to see from any position.
- A mirror is a sheet of glass that has a smooth, silver-colored coating on one side. This coating reflects light allowing you to see an image. An image is a copy of an object formed by the reflected rays of light. An image can be real (reflected rays meet at a focal point and image is inverted) or virtual (reflected rays don't meet and image is right-side up).

  <u>Plane Mirror:</u> see pg. 572, fig. 3
  - flat
  - image is virtual, same size as object being reflected
  - ex. house mirrors

  <u>Concave Mirror:</u> see pg. 573, fig. 4 and 5
  - curved inward
  - image is real when the object is farther away from the mirror than the focal point and is larger or smaller depending on the position; image is virtual when the object is between the mirror and the focal point and is enlarged
  - ex. car headlight, make-up mirror

  <u>Convex Mirror:</u> see pg. 574, fig. 6
  - curved outward
  - image is virtual because the rays are spread out and is smaller
  - ex. car rearview mirror, car passenger-side mirror

18-2 Refraction

- When light waves enter a medium at an angle, the change in speed causes them to bend or change direction. This is called refraction.

- Index of refraction: measure of how much a light ray bends when it enters another medium. The higher the index, the more the medium bends the light ray. Light travels faster in air, a little slower in water, slowest in glass.

- Refraction may cause you to see something that may not actually be there. A mirage is an image of a distant object. The air higher up is cooler. Light travels faster when it reaches warmer air. The rays bend as they go down and become parallel to the ground until they travel upward and bend in the other direction. The brain assumes the rays have traveled in a straight line as if reflected off a smooth surface.

- Refraction also is the cause of rainbows. Raindrops act as tiny prisms, which refract and reflect white light passing through separating the colors. Red with the longest wavelength is refracted the least, violet with the shortest wavelength is refracted the most.

- Lens: curved piece of glass/transparent material that refracts light and forms an image. See pg. 578 and 579 all figures.
    - concave lens is thinner in the center than the edges and forms a virtual image
    - convex lens is thicker in the center than the edges. The rays meet and continue. The image depends on the position of the object in relation to the focal point. It is virtual, on the same side of the lens, and enlarged if the object is between the lens and the focal point. It is real, on the other side of the lens, and reduced/enlarged if the object is farther away from the focal point.

18-3 Color

Light

- Color of an object is the color it reflects; the other colors are absorbed.
- Under white light: a white objects reflects all colors; a black object absorbs all colors
- Under colored light: a red binder appears black under green light since there is no red to be reflected by the binder; green is absorbed.
- Color filters are transparent materials that allow only certain colors to pass through; other colors are reflected or absorbed. Ex. spotlights on theater stages, photographic slides.
- Primary colors of light are red, green, blue. They are used to make any other color. When combined in equal amounts they produce white. A TV screen picture is made up of the primary colors of light.
- Secondary colors of light are formed when any 2 primary colors are combined in equal amounts. Ex. red and green make yellow, green and blue make cyan, red and blue make magenta.
- Any primary and secondary colors combined will make white and they are referred to as complementary colors.

Pigment

- opaque substance used to color other materials as they reflect colors
- primary colors are cyan, yellow, magenta; all together in equal amounts will make black
- secondary colors are any 2 primary colors combined in equal amounts. Ex. magenta and yellow make red, cyan and yellow make green, magenta and cyan make blue
- pictures in a book are made up of tiny dots of different colors of ink (cyan, yellow, magenta, and black to make them darker). Because of this the process is called 4-color printing.

18-4 Eye

- Cornea: the place where light enters
- Iris: a muscle that contracts and expands to change the amount of light that enters the eye; gives the eye color
- Pupil: a hole into the dark inside the eye (looks black); its size depends on whether it is contracted in bright light thus reducing the amount of light entering or expanded in dim light thus allowing more light to pass
- Lens: is convex and refracts the light forming an image
  Focusing on a distant object will make the lens muscles relax and the lens longer and thinner.
  Focusing on a nearby object will make the lens muscles contract and the lens shorter and fatter.
- Retina: the layer of tiny cells lining the inside of the eye; the place where an inverted image forms
  Rods are the cells that have pigments to react to light and disinguish between black, white, and gray; they allow you to see in dim light (night vision).
  Cones are the cells that respond to colors red, green, and blue; they function in bright light.
  The blind spot is on the retina where the optic nerve begins and has no cones/rods. You can't see light that falls on it but the blind spot of one eye can be seen with the other eye.
- Optic Nerve: signals travel through the optic nerve to the brain, which turns the image right side-up and combines images from both eyes.
- <u>Vision Correction</u>

Nearsightedness:

- can see nearby objects
- eyeball a little too long
- image is in front of retina
- need a concave lens to spread out the rays so image is farther back on retina

Farsightedness

- can see distant objects
- eyeball is a little too short
- image is behind the retina
- need a convex lens so image is on retina

18-5 Using Light

- Telescope: forms enlarged images of distant objects using lenses/mirrors to collect and focus light
- Microscope: forms enlarged images of tiny objects using lenses and a mirror or a light source to illuminate the slide
- Camera: uses lenses to focus light and record the image; similar to the eye
  Photographic film is a material that undergoes a chemical change when exposed to light. The film is developed into negatives by treating with chemicals. The negatives are used to print the image. The result is a photograph.
- Laser beam: consists of waves that have the same wavelength or color (waves are coherent or in step)
  LASER stands for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation.
  Uses:
    - by surveyors and engineers to make sure surfaces are level, bridges/tunnels are aligned; also to cut through steel
    - in supermarkets to scan bar codes
    - in compact discs to store and read information
    - in surgery to make incisions, repair detached retina, remove skin blemishes/cancerous growths; correct eye vision
    - in holography (3-dimentional photograph on videos/magazines) for security purposes
    - in pointers for lectures/presentations
    - in optical fibers (long strands of glass/plastic that carry light long distances without allowing light to fade out) for
      a. communication because they are thinner and use less space, faster, clearer, and carry many phone conversations at the same time
      b. medicine to check out internal organs
      c. lamps