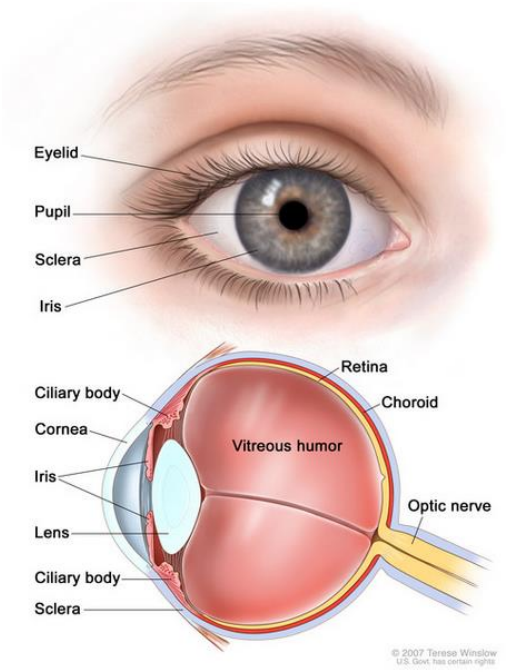
G10 Science: Class 7 Homework

Read the following excerpt and answer the questions below. Adapted from Science Perspectives 10 Section 13.6 and http://www.glencoe.com/sec/science/cgi-bin/splitwindow.cgi?top=http://www.glencoe.com/sec/science/top2.html&link=http://www.allaboutvision.com/visionsurgery/

THE HUMAN EYE



The eye is a fluid-filled orb with an opening in the front (pupil), a sheet of about 125 million light-sensitive nerve cells (retina) at the back and a lens in-between. The pupil is surrounded by pigmented fibers (iris) and covered by a sheet of clear tissue (cornea) that merges with the tough outer surface of the "white" of the eye (sclera). The optic nerve passes through a hole in the back of the eye to link to the brain.

The eye detects images, which are focused on the **retina** by the **cornea** and **lens**. There are many key terms related to the eye.

The **iris** opens and closes to control the amount of light entering the eye and striking the retina. Within the iris is the **pupil,** which dilates in the dark and constricts in the light.

The **cornea** is the transparent bulge covering the pupil. It is responsible for the refraction of light entering the pupil.

The **lens** is a transparent, flexible structure behind the pupil that helps refract the light entering the pupil. Ciliary muscles squeeze it to change its shape, changing the focal length of the lens. "Accommodation" is the ability of the eye to focus on both near and far away objects.

The **retina** is a layer of light sensitive cells called rods and cones at the back of the eyeball. Light striking these cells is converted into electrical impulses that are sent along the optic nerve to the brain. The area at which the optic nerve connects to the retina, no cells are present and there is a "blind spot". The image on the retina is smaller, real and inverted. The brain flips the image so we see it upright.

How does your brain see?

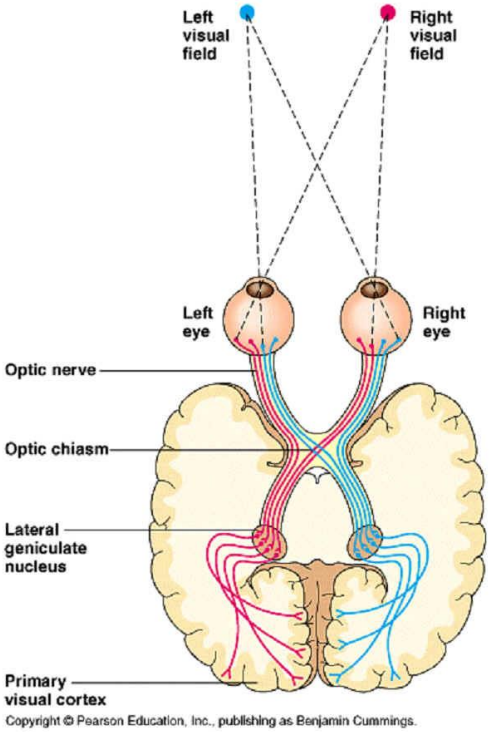
Sequence of vision in your eye

- Light passes through the cornea
- Light enters the eye through the pupil. The iris controls how much light enters by changing

shape (i.e., the pupil is smaller in bright lights and bigger in low light conditions).

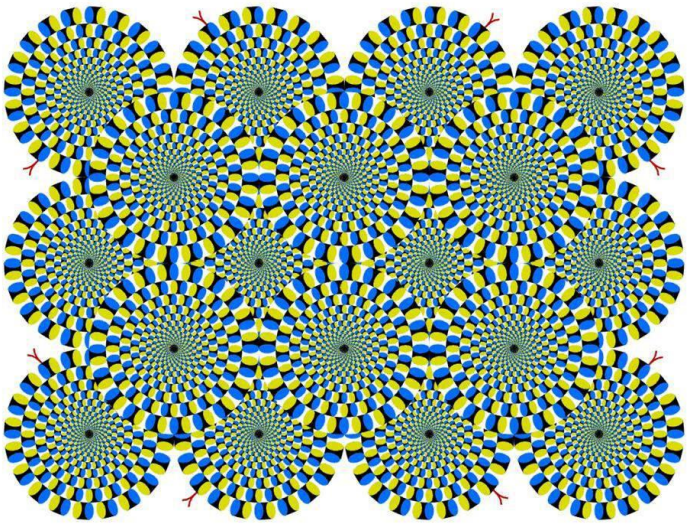
- Light rays pass through the lens that refracts the light so it converges on the retina. If focusing on a near object, the lens thickens to increase refraction. If the object is distant, the lens flattens to reduce refraction
- The light hits the photoreceptors (rods and cones) in the retina. If activated by the light, the photoreceptor will fire and send an electrical signal to the brain via the optic nerve.

The "seeing area" of the brain is at the back of the brain – the Visual Cortex. Information from the eyes has to travel the full depth of the skull before it begins to be processed into sight. On route, the information must pass through two major junctions: (1) optic chiasm and (2) lateral geniculate nucleus. At the optic chiasm, signals from each eye converge. Information from the left visual field (in both right and left eye) join and continues down the left optic tract, while information from the right visual field joins and moves down the right optic tract. The optic nerve ends at the lateral geniculate nucleus, but the signals move to the visual cortex along nerve fibers called the optic radiation.



The crossover along the optic nerves means the object viewed by the eyes becomes a mirror image in the visual cortex (i.e., signals from the left visual field register in the right hemisphere of the visual cortex and vice versa).

We see depth and dimension because (1) each eye sees the object slightly different (called spatial binocular disparity) and (2) the process by which the brain perceives movement. Our spatial binocular disparity is used to trick the brain into seeing a three-dimensional image when, in reality, it is two-dimensional.



Likewise, an optical illusion of motion is created by tricking the parts of the brain processing movement. If an image can "excite" the motion-detecting neurons, it can create the effect of movement.

LASER EYE SURGERY: **The LASIK Procedure**

LASIK, or "laser-assisted in situ keratomileusis," is the most commonly performed laser eye surgery to treat myopia (nearsightedness), hyperopia (farsightedness) and astigmatism. Like other types of refractive surgery, the LASIK procedure reshapes the cornea to enable light entering the eye to be properly focused onto the retina for clearer vision.

In most cases, laser eye surgery is pain-free and completed within 15 minutes for both eyes. The results — improved vision without eyeglasses or contact lenses — can usually be seen in as little as 24 hours. First, your eye surgeon uses either a mechanical surgical tool called a microkeratome or afemtosecond laser to create a thin, circular "flap" in your cornea. The surgeon then folds back the hinged flap to access the underlying cornea (called the stroma) and removes some corneal tissue using an excimer laser. This highly specialized laser uses a cool ultraviolet light beam to remove ("ablate") microscopic amounts of tissue from the cornea to reshape it so it more accurately focuses light on the retina for improved vision. For nearsighted people, the goal is to flatten the cornea; with farsighted people, a steeper cornea is desired.

Excimer lasers also can correct astigmatism by smoothing an irregular cornea into a more normal shape. It is a misconception that LASIK cannot treat astigmatism. After the laser reshapes the cornea, the flap is then laid back in place, covering the area where the corneal tissue was removed. Then the cornea is allowed to heal naturally.

Laser eye surgery requires only topical anesthetic drops, and no bandages or stitches are required. Before your surgery begins, numbing eye drops are applied to your eye to prevent any discomfort during the procedure. Your doctor may also give you some medication to help you relax.
Your eye will be positioned under the laser, and an instrument called a lid speculum is used to keep your eyelids open. The surgeon uses an ink marker to mark the cornea before creating the flap. A suction ring is applied to the front of your eye to prevent eye movements or loss of contact that could affect flap quality.

After the corneal flap is created, the surgeon then uses a computer to adjust the excimer laser for your particular prescription. You will be asked to look at a target light for a short time while he or she watches your eye through a microscope as the laser sends pulses of light to your cornea.
The laser light pulses painlessly reshape the cornea, although you may feel some pressure on your eye. You'll also hear a steady clicking sound while the laser is operating. LASIK is performed on each eye separately, with each procedure taking only about five minutes.

While the procedure has an excellent safety profile, LASIK complications can occur and may include infection or night glare (starbursts or halos that are most noticeable when you're viewing lights at night, such as while you're driving). A small percentage of people will need a LASIK enhancement, or "touch up" procedure, a few months after the primary LASIK surgery to achieve acceptable visual acuity. You also may still need reading glasses once you reach your 40s, due to a normal age-related loss of near vision called presbyopia.

QUESTIONS

1. List the advantages and disadvantages of LASIK eye surgery. **[6 marks]**

Advantages	Disadvantages

2. Distinguish between myopia, hyperopia, and presbyopia. **[3 marks]**

3. Why does the pupil enlarge in the dark and constrict in bright situations? **[2 marks]**

4. Explain what happens to the eyeball when a student stares at their phone for too long and what vision complications could occur. **[3 marks]**

5. What muscle is responsible for changing the shape of the lens? **[1 mark]**

6. What is the desired shape of the cornea for a nearsighted patient? What about farsighted patients? **[2 marks]**

7. Optometrists often only recommend laser eye surgery for patients who are 25 years older. Explain why. **[2 marks]**

8. Describe three similarities between a camera and a human eye. **[3 marks]**

9. Do you see with your eyes or your brain? Explain. **[2 marks]**

10. Acquired Monocular Vision is the condition in which there is loss of one eye. Patients with this condition often report the loss of stereoscopic binocular vision, which is the perception of depth and 3D structure. Explain why. **[2 marks]**