Physiology Labs Protocols

Labs aim: Explore biology in context through brain and hands

Vision Lab

AIM of that lab:

- Understand common refractive disorders, principles of evaluation and correction
- Understand principles and use of ophthalmoscopy
- Understand some other tests for vision

REQUIRED KNOWLEDGE:

- Snell's law, optical rays refraction (converging lens, concave lens, cylindrical lens, toroidal lens, progressive (multifocal) lens, contact lens)
- Principles of ophthalmoscopy. Direct and indirect.
- Purkinje images
- Eye Anatomy. Eyeball, muscles, visual pathway, retina, aqueus humor
- Accomodation – principles, significance, presbyopia
- Weber-Fechner psychophysical law, optical transduction

TASKS, EVALUATIONS AND DESCRIPTIONS

1. **Visual acuity, clarity of vision (Visus)**

   Visus checks the resolution of visual system (i.e. optical system, transduction, pathway and image processing). It is very sensitive but not very specific test (*be familiar with terms **sensitivity** and **specificity** of diagnostic tests*).

- think about formulation of principles describing the estimation of visual acuity (visus) by means of Snellen optotypes. (if necessary see the corresponding chapters of biophysics)
- try to formulate how you would explain the clinical significance of visual acuity test
- think about its significance in terms of „*objective*" and „*subjective*" measurement (evaluation)

Typical Snellen Optotype
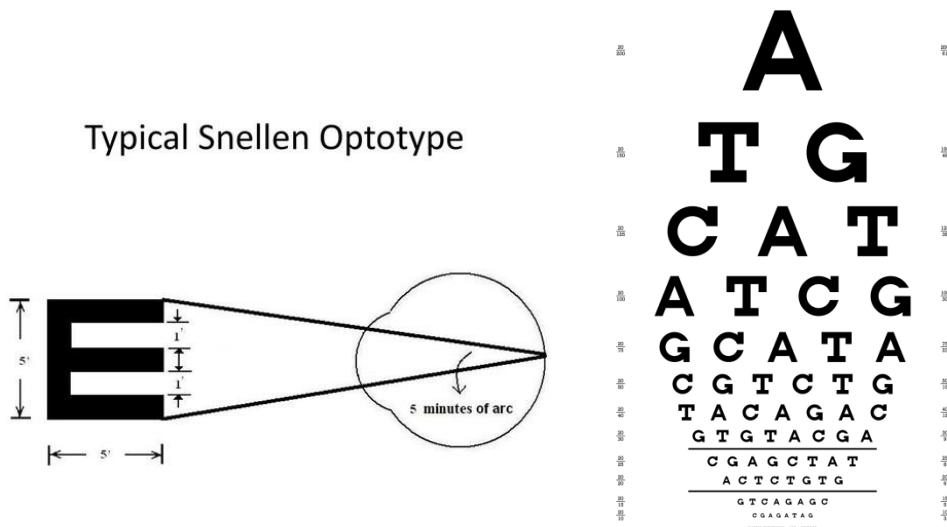
a. Visus

RIGHT	LEFT

Inerpretation:

2. Estimation of Near point (NP) and Far point (FP)

- think about principles allowing the estimation NP and FP by means of Snellen's optotypes
- try to formulate the explanation of **optometry** principles, focus on optical explanation (think why an additional lens is permitting the estimation of far point)
- formulate reasonable explanation of myopia, hyperopia in terms of optical point of view and also in terms of clinical point of view
- what does accommodation range reflect?
- which parameter best reflects myopia/hyperopia? FP, NP, accommodation range, Visus?

PRINCIPLE OF SCHEINER'S DISC
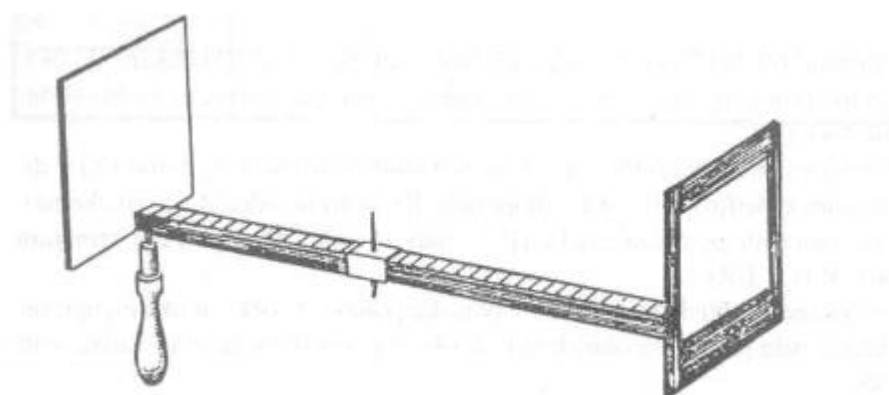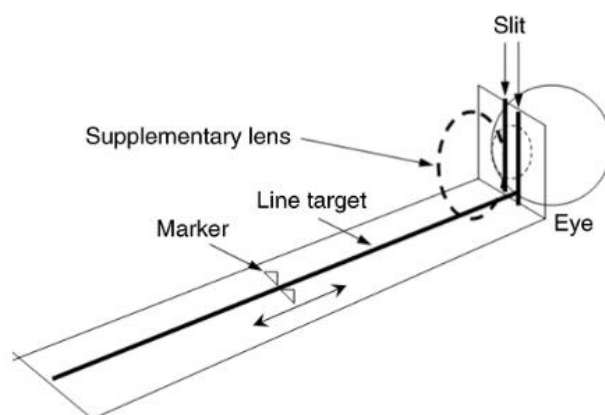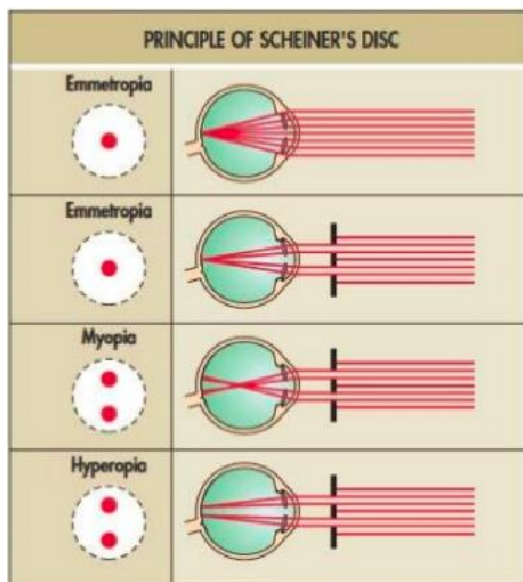
	RIGHT		LEFT	
PF	NP	FP	NP

Interpretation:

3. Astigmatism

Astigmatism is the condition that is decreasing the visual acuity. Commonly this is caused by the irregular curvature of the cornea and/or lens. It is estimated objectively by means of **ceratoscope** (approximate, rough, indicative method) or by **ophthalmometer** (an exact method). It can also be evaluated subjectively by **optometer**.

- try to think about optical principles used to measure or to assess the astigmatism (Purkinje pictures, convex/concave mirror, dot-to-dot vs. dot-to-bar optical projections)
- understand differences between astigmatism of cornea, lens and total astigmatism
- try to formulate what is the difference between regular and irregular astigmatism
- explain principles how **Optometer** helps evaluating the total astigmatism
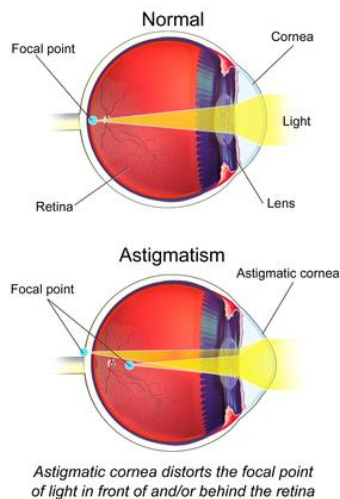
Astigmatism

|	RIGHT		LEFT	
	Horizontal	Vertical	Horizontal	vertical
Cornea (D) (Ophthalmometer)				
FP (D) (optometer)				

Inerpretation:

4. Ophthalmoscopy

Ophthalmoscopy is observation of the inside of the eye, mainly the posterior portion of it – the retina and structures located on retina. It is common eye examination method; however it is also performed frequently as part of general routine physical examination (e.g. internal medicine, test done ahead of cerebrospinal fluid removal procedure, etc.)

- try to understand the schemes attached, explaining the principle of direct ophthalmoscopy, formulate the principles behind the operation of a direct ohthalmoscope
- which simple pathologies can be identified by ophthalmoscopy, try to mention some?

- is this method subjective or objective ?, try to reason why !
- why is it vital to perform ophthalmoscopy prior to lumbar puncture?
- try to think about measures (arrangements, maneuvers) to test (evaluate) myopic or hyperopic patients (doctors – observers)
- introduce several indications for performing ophthalmoscopy


Traditional Direct Ophthalmoscope
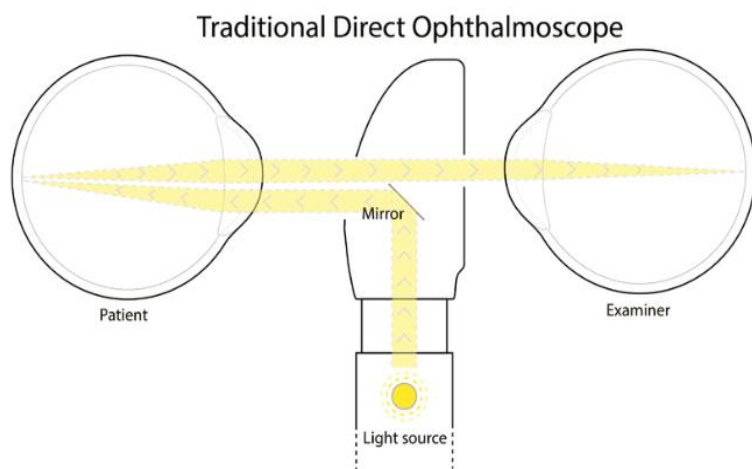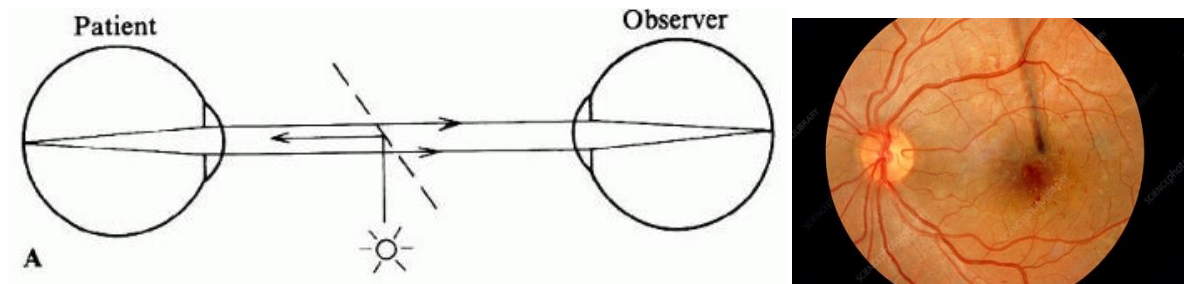
Structure	Observation	Implication
Papilla		
Retina		
Retinal artery		
...		

5. Perimetry

Perimetry tests the area (or scope) of peripheral vision by means of systematic evaluation of visual field and its functionality. Drops (failures) in peripheral (even central) vision are called **scotomas** and reflect ongoing pathology of the eye or visual pathway.

- think how to explain principles allowing estimation (collection) of map of whole scope visual field functionality or visual field border-lines
- try to explain why the visual field scope (its extend) differs when different colors and light source intensities are observed
- think and try to interpret the last picture showing various affections to the visual field (e.g. physiological scotoma, bitemporal hemianopisa, etc.)
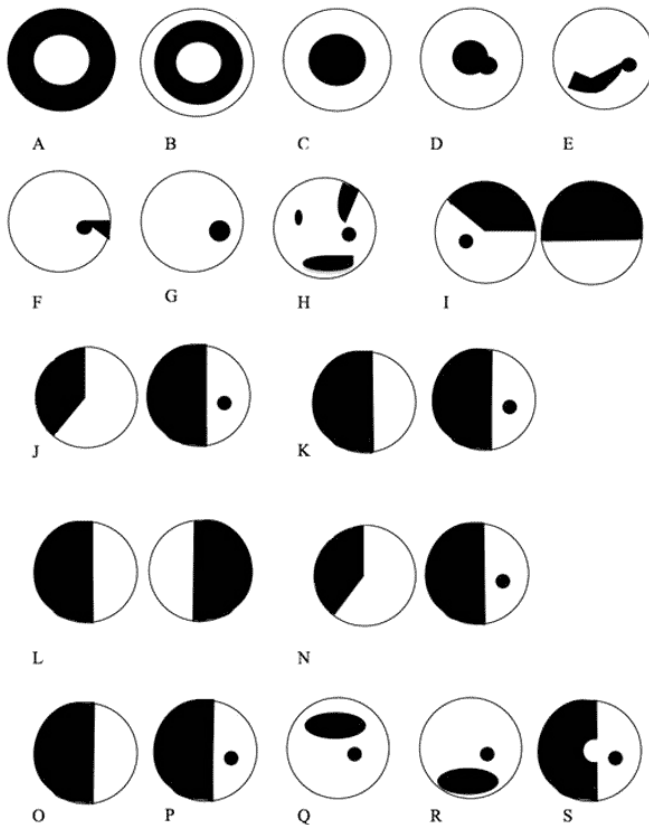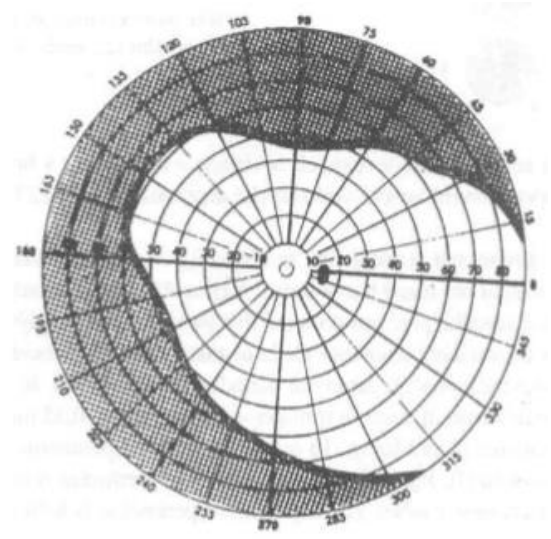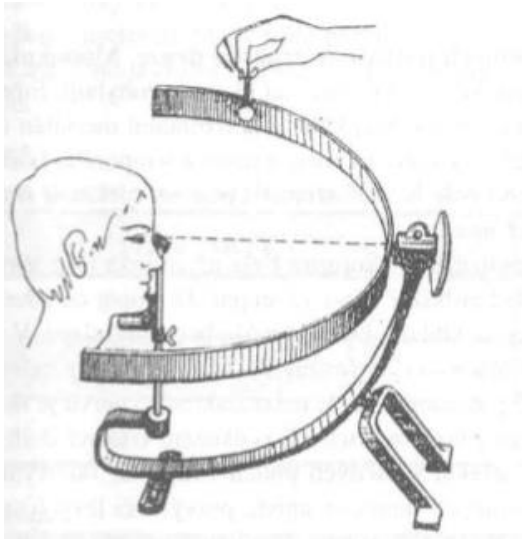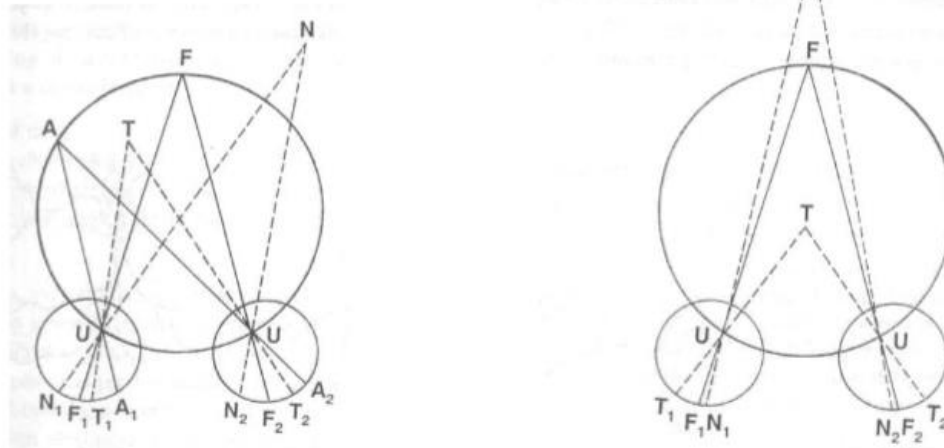

6. Binocular vision

The ability to perceive depth in the visual scene observed, interpreted as 3D vision or stereoscopic vision. Depth perception comes from a variety of depth cues. In case they come from both eyes, we speak about binocular stereoscopic vision. This is based on sensory principles of **disparity** and optical phenomena referred to as **parallax** (review these principles).
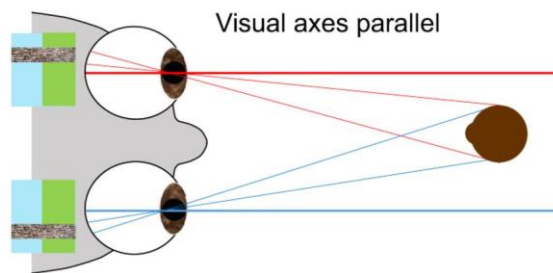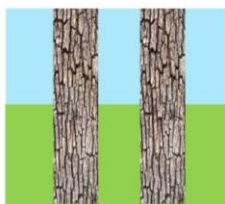
- look at the pictures beneath and try to explain **horopter** and try to distinguish it from the term of **diplopia** in the context of stereoscopic vision.
- can we perceive depth with monocular vision?
- it the distance (distance to the scenes observed stereoscopically) of stereoscopic vision limited ?
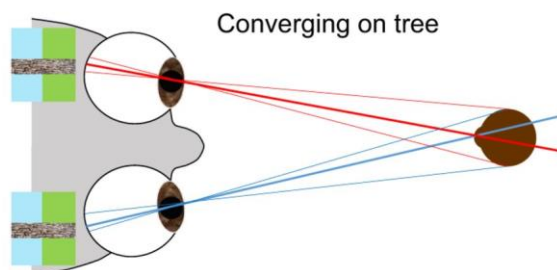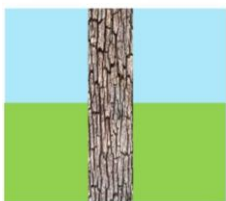

Horopter (left) and Diplopia (right)

A Double vision — Visual axes parallel

B Binocular fusion — Converging on tree

7. Color Vision

It is the ability to see light not only in terms of light intensity, but also to perceive wavelengths of that light. It is based on functionality of different types of photoreceptors in our retina (humans = **trichromacy** principle)

- read the principles behind the testing of color vision (see **Ishihara Color Vision Tests** and physiological description and commentaries of these tests)
- try to understand basic principles deployed in color vision tests

- think about **simulation** and **dissimulation** activities of tested individuals and put them in the context of subjective and objective measurement
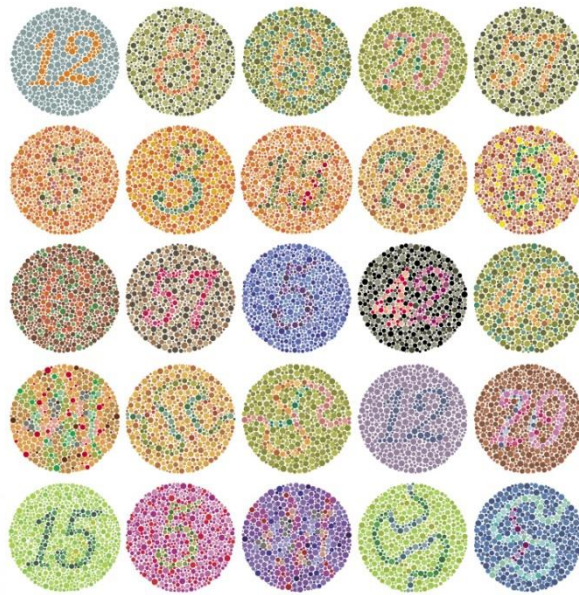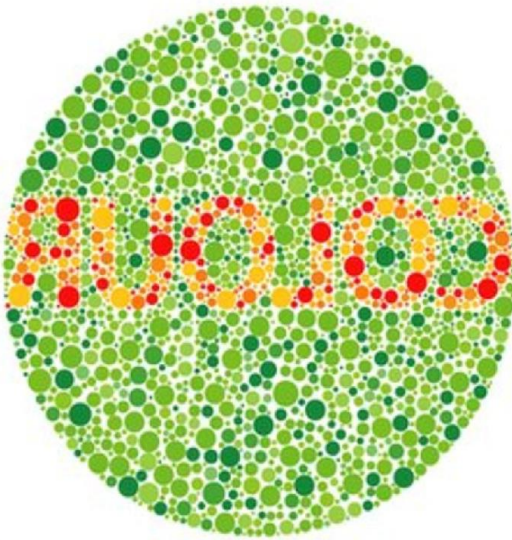
QUESTIONS:

Which refractive disorder/s cannot be corrected by regular lenses? Please explain.

Which refractive disorders you know?

Which parameter best reflects myopia/hyperopia? FP, NP, accommodation range, Visus?

What does Accommodation range reflect?

Introduce several indications for performing ophthalmoscopy

What are the advantages of direct/indirect ophthalmoscopy?

Why is it vital to perform ophthalmoscopy prior to lumbar puncture?