The minimum **requirements** for lab reports in case of each biophysics lab.

Color code:

- Measurements (to be executed during the practice): red
- Evaluations, calculations (to be prepared at home then submitted for evaluation in the next class): blue
- Charts (to be prepared at home): green.

I/1. Introduction (no lab report required)

I/2. Microscopy (number of graphs: 1, curves: 2)
Aims: To impart knowledge about the geometrical optics of a simple microscope; to measure the size of objects examined with a microscope and statistical analysis of the acquired data.
Tasks:

1. Calibrate the eyepiece scale of the microscope using a known scale in the case of the highest magnification.
2. Determine the unit of the eyepiece scale in SI unit.
3. Measure the length of frog red blood cells using the eyepiece scale and calculate the length in SI unit based on the calibration.
4. Characterize your smaller dataset and your group's larger dataset by main descriptive statistics elements.
5. Plot the relative frequency distribution of the cell length both for the smaller and larger dataset.

I/3. Measurement techniques (number of graphs: 0)
Aims: To provide knowledge in the basic concept of measurements, to impart practical knowledge about the handling and basic properties of measuring devices by carrying out simple electronic measurements. To study the application of an oscilloscope for visualizing time-dependent signals.
Tasks:

1. Measurement of voltage, current and resistance with digital multimeter.
2. Measure the equivalent resistance in case of serial and parallel connection of resistors and verify Ohm's law.
3. Measure the parameters of a pure and a noisy sine function.

I/4. Refractometry (number of graphs: 1, curves: 1, additional fitted lines: 1)
Aims: To study the basis of refraction and its special conditions, to determine concentration based on the measurement of refractive index.
Tasks:

1. Calibrate the refractometer with distilled water.
2. Measure the refractive index of glycerol solutions with known concentration and plot the calibration curve. Determine the parameters of the fitted line.
3. Measure the refractive index of the blood plasma and glycerol solutions with known concentration.
4. Determine the serum protein concentration and the unknown glycerol concentrations based on the appropriate calibration curve.

I/5. Light emission (number of graphs: 0)
Aims: To get familiar with various types of light sources, emission spectroscopy and to impart knowledge about different spectroscopic tools.
Tasks:

1. Set the manual spectroscope and calibrate its scale.
2. Measure the wavelength of the lines seen in the emission spectra of various (known and unknown) metal ion solutions.
3. Determine the composition of mixtures containing two metal ions based on their emission spectra (qualitative analysis).

I/6. Resonance (number of graphs: 2, curves: 1-1, additional fitted lines: 1)
Aims: To verify Hook's law; to demonstrate resonance phenomenon, to determine the resonant frequency of an oscillating system and to demonstrate the dependence of the resonant frequency on the mass of the system.
Tasks:

1. Determine the spring constant of a cantilever by measuring the force and displacement and using the parameters of the fitted line of the plotted data (graph1).

2. Measure the the displacement of the cantilever with the highest mass (120 g) by using different frequencies of a driven oscillation. Plot the resonance curve of the oscillatory system (graph2). Determine the measured resonance frequency.
3. Calculate the eigenfrequency based on the parameters of the oscillatory system. Compare the measured and the calculated values of the resonant frequency.

I/7. Microscopy II (Special Microscopes) (number of graphs: 0)
Aims: To impart knowledge about the resolution limit of microscopes, to verify experimentally Abbe's principle and to familiarize with the working principle of some special microscopes.
Tasks:

1. Measure the distance of the first order maximas by using a coherent source of light in case of a known and an unknown wavelength. Measure the distance between the optical grating and the screen.
2. Determine the grating period of an optical grating according the data of the light with known wavelength.
3. Based on the calculated grating period determine the wavelength of the light source with unknown wavelength.

I/8. Light absorption (number of graphs: 2, curves: 1-1, additional fitted lines: 2)
Aims: To impart hands on experience in absorption spectrophotometry, to reveal the method of spectrophotometric titration and concentration determination.
Tasks:

1. Measure the absorbance of the copper-complex solution at different wavelengths, plot the absorption spectrum (graph1) and determine the excitation energy at the wavelength of maximal absorption (in eV units).
2. Measure the absorbance of the given complex solutions at the wavelength of maximal absorption and plot the results as a function of ligand concentration (graph2, 2 fitted linears).
3. Determine the copper concentration by using the parameters of the two fitted lines.

I/9. Optics of the eye (number of graphs: 0)
Aims: To describe the image formation of human eye and its common refractive errors based on optical geometry. To determine some important and interesting parameters of the eye.
Tasks:

1. Measure your near point of vision and estimate your far point of vision. Determine the personal power of accommodation.
2. Determine your visual acuity (visus) by measuring the distance from the eye chart.
3. Determine your blind spot size and its distance from the yellow spot by using the 'dot-cross' chart.

I/10. Nuclear medicine (number of graphs: 2, curves: 2-1)
Aims: To impart knowledge about the parts and operation of the scintillation counter; to clarify the terms: signal and noise, to determine the optimum setting of the instrument.
Tasks:

1. Check the preset parameters of the scintillation counter, adjust if necessary.
2. Measure and plot the pulse number as a function of integral discriminator level with and without the sample isotope (graph1, 2 curves).
3. Calculate and plot the signal-to-noise ratio vs. the integral discriminator voltage and determine the value of optimal integral discriminator level (graph2).
4. Determine the optimal discrimination level.

I/11. Polarimetry (number of graphs: 0)
Aims: Introduction to different kinds of polarized light and to optically active materials; to investigate optical rotation and to carry out qualitative and quantitative examinations by measuring the angle of optical rotation.
Tasks:

1. Measure the angle of rotation of unknown sugar solutions (*A* and *B*) with known concentration.
2. Determine the specific rotation of unknown sugar solutions then identify them.
3. Measure the angle of rotation of solutions *A* and *B* with unknown concentration.
4. Determine the concentration of solution *A* and *B* with unknown concentration.

I/12. Skin impedance (number of graphs: 1)
Aims: To reveal the importance of impedance in relation with the hazards of electric current and contact protection; to familiarize with medical diagnostic methods based on impedance measurement.

Tasks:

1. Measure voltage and current at various AC frequencies (also DC), in a circuit that is wired through your skin.
2. Calculate and plot the impedance as a function of frequency.
3. Determine the specific resistance and specific capacitance of skin.

I/13. Gamma absorption (number of graphs: 1, curves: 4, additional fitted lines: 4)

Aims: To investigate the gamma radiation absorbing capacity of various materials, in regards with radiation protection.

Tasks:

1. Check the preset parameters of the scintillation counter, adjust if necessary.
2. Measure the background pulse number.
3. Measure the pulse number in case of various absorbers.
4. Create a comparative plot of the pulse number values measured for different materials (after background correction) as a function of the absorber thickness (attenuation law). Fit the curves.
5. Based on the parameters of the fitted lines determine the half-value thicknesses, attenuation coefficients and mass attenuation coefficients for each absorber material.
6. Compare attenuation and mass attenuation coefficients.
7. By using the appropriate graph determine the energy of the γ photon emitted by the isotope and the partial mass attenuation coefficient for photo- and Compton effects respectively.

Repetition (no lab report required)