

Midterm Exam 1

The exam is not cumulative: therefore, you only need to cover the lab basics, skeletal muscle and peripheral nerve material. I am always available for quick questions via e-mail.

Possibly useful websites:

Leif - <http://stripe.colorado.edu/~saul/physiology/>
Mike - <http://ucsu.colorado.edu/~pascoe/physiology/index.html>
IPHY - <http://www.colorado.edu/intphys/iphy3435/index.html>

Prioritize in this order:

1. Read the manual and notes: understand all the expected outcomes from the experiments and re-read closely to pick up some of the obscure information for tricky questions.
2. Be prepared to use Chart and Scope to replicate parts of the lab sessions.
3. Cover all the questions we had on the quizzes and homeworks.
4. Ask questions if you don't understand something.

Lab Basics

- Know how to log on to the physiology server.
- Understand the basic purpose of the PowerLab and transducers. A transducer changes the physical phenomenon we are measuring into an analog signal that Powerlab can read. Powerlab converts the electrical signal from the transducer into a digital signal that the computer can read.
- Scope and Chart are software programs that we use to display and record experimental data. Know how to read a Chart/Scope recording and obtain data. Also, know how the two programs differ from one another and when would it be more appropriate to use one vs. the other.
- Know how to calibrate a force transducer (2-point calibration).
- Understand the difference between the independent variable (which goes on the x-axis) and the dependent variable (which goes on the y-axis).
- Given a description of an experiment, be able to state whether a paired or unpaired t-test is more appropriate.
- Know how to perform a paired or unpaired t-test in SPSS.
- Be able to interpret p-values.
- Know what kind of graph (e.g. bar, scatter w\ regression line) is appropriate for a given set of data.

Muscle

Big picture: Muscle contractions occur in groups called motor units. Muscles will exhibit a minimal and maximal tension with increasing stimulus due to motor unit recruitment. There is an optimal muscle (and sarcomere) length for maximal tension production. This length-tension relation of muscle is explained by the sliding filament theory. In vivo, muscle contractions are generally tetanic in nature, achieved through summation of graded twitch responses. Twitch contraction is a 'laboratory phenomenon.'

- Understand that we used an isolated muscle, so nerve activity/input was not an issue.
- Know muscle structure from whole muscle to the level of the sarcomere.
- Isometric (same length) and isotonic (same force) muscle contractions.
- Excitation-contraction coupling - know the processes involved.
- Sliding filament theory of contraction at the sarcomere level.
- Motor units act in all or none fashion but the entire muscle exhibits a graded response in tension due to motor unit recruitment.
- Twitch (single contraction) vs. tetanic (fused contractions). Type of stimuli (large; small; different frequency) that correspond to the different types of contraction. Why can a

- tetanic contraction occur if muscle fibers follow the all-or-none rule? (hint: action potentials are shorter than contractions, Ca^{2+} remains in cytosol)
- Muscle length vs. tension and the relation to filament overlap (see diagram in manual).
 - Muscle fatigue: major theories discussed in manual
 - Use of Chart for interpreting any of the data we recorded in class.
 - o Determination of max and min stimulus for twitch tension
 - o Determination of max tetanic tension
 - o Muscle length-tension relation
 - o Work calculation (see below).
 - Work calculation
 - o Work = force X distance
 - o Force = mass X gravity
 - o Force = mass (kg) X (9.8 m/s^2) = Newton or N
 - o Work = force X distance = Newton X meters = Nm = Joule
 - o 1J = 1000mJ

Peripheral Nerve:

Big picture: The main thing to understand here is how a nerve differs in relation to a single neuron. Nerves are composed of many neurons. Each neuron's wave of action potentials occurs in an all-or-none manner. The characteristics of threshold, refractory period and conduction velocity of a *nerve* depend on the size and number of neurons within that nerve.

- Neuron vs. nerve.
- Action potential (AP) vs. compound action potential (CAP).
- How does the all-or-none law apply to AP/CAP?
- What is a threshold stimulus in the nerve/neuron?
- What happens to CAP amplitude when you increase the voltage stimulus? Increases with increasing neuron recruitment. Individual neurons will not demonstrate an increase with increasing stimulus magnitude.
- What is seen when you shorten the interval between two max CAP stimuli? Why? Hint: refractory period.
- If you give 2 sub-threshold stimuli at large/small intervals, what happens to the CAP amplitude? Hint: temporal summation.
- Be able to recognise a stimulus artefact.
- Know basic physiology of AP propagation (K^+ , Na^+ etc.).
- Refractory period (absolute/relative).
- Conduction velocity. What happens to conduction if we reduce the stimulus magnitude (but keep it above minimum threshold)? Hint: differences between large and small neurons.
- Be able to use Scope sample data to calculate
 - a. Conduction velocity
 - b. Refractory period
 - c. Min threshold + max stimulus for CAP
 - d. Temporal summation