

## ECG, heart sounds, and effects of exercise report

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Set up tables like these in your notebook to help guide the collection of data.

### Data

For each member of the group, fill in results of ECG analyses in the spaces below.

Name: \_\_\_\_\_

Component	Mean Amplitude (millivolts)	Mean Duration (seconds)
P wave		
QRS complex		
T wave		
Heart Rate		

Name: \_\_\_\_\_

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P wave		
QRS complex		
T wave		
Heart Rate		

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Name: \_\_\_\_\_

Component	Mean Amplitude (millivolts)	Mean Duration (seconds)
P wave		
QRS complex		
T wave		
Heart Rate		

**ECG during rest and after exercise**

In the tables below, fill in the values for each individual in your group.

Name: \_\_\_\_\_

Measurement	ECG while resting	ECG after exercise		
		30 seconds	60 seconds	Fully recovered
P-R interval (sec)				
QRS duration (sec)				
S-T interval (sec)				
T-P interval (sec)				
R-R interval (sec)				
Heart Rate (BPM)				

Name: \_\_\_\_\_

Measurement	ECG while resting	ECG after exercise		
		30 seconds	60 seconds	Fully recovered
P-R interval (sec)				
QRS duration (sec)				
S-T interval (sec)				
T-P interval (sec)				
R-R interval (sec)				
Heart Rate (BPM)				

Name: \_\_\_\_\_

Measurement	ECG while resting	ECG after exercise		
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QRS duration (sec)				
S-T interval (sec)				
T-P interval (sec)				
R-R interval (sec)				
Heart Rate (BPM)				

Name: \_\_\_\_\_

Measurement	ECG while resting	ECG after exercise		
		30 seconds	60 seconds	Fully recovered
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QRS duration (sec)				
S-T interval (sec)				
T-P interval (sec)				
R-R interval (sec)				
Heart Rate (BPM)				

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Use these questions and prompts to help guide the collection of data, and writing of your lab report.

## Introduction

What ideas do you need to explain to understand this experiment?

Write a paragraph defining the components of an electrocardiogram, and how it relates to heart sounds. Describe what happens during the cardiac cycle.

Write a paragraph explaining how exercise may affect heart rate and the ECG. How might these changes result in greater blood delivery? (Make sure you've covered why this is important).

End the introduction with a hypothesis regarding the physiological mechanisms involved.

## Materials and Methods

Briefly describe the techniques you used to measure heart sounds and the ECG. Be sure to include the species of subjects, the number of subjects, the instruments used, and the parameters measured. Include a description of the experimental design (the controls and treatments) and the method of analysis. Write in the style of a scientific paper — so that someone reasonably familiar with physiology could repeat the experiment. Don't include any step-by-step in your paper, simply cite the relevant lab manual chapter or lab protocol.

## Results

### ECG in a resting volunteer heart sounds

Include a copy of the Zoom window of a representative resting ECG to demonstrate that you

collected good data. Indicate on the figure the P-wave, QRS complex, and the T-wave. Indicate on your figure where you heard the “lub” and “dup” sounds.

### Changes in ECG with exercise

What changed with exercise? Include figure that shows the most interesting things that changed between rest and exercise.

### ECG for a range of volunteers

We measured parameters for a range of individuals at rest and during exercise. As a class, discuss:

What is the best way to demonstrate the effect of exercise? For example, for heart rate, should we: (1) plot the mean HR for the entire class at rest, and the mean HR during exercise? or (2) take the individual variation between exercise and rest and plot the mean change? What is the control or the comparison?

If (2), should we (a) take the difference for each individual  $HR_{\text{exercise}} - HR_{\text{rest}}$ ? or (b) take the ratio for each individual  $HR_{\text{exercise}}/HR_{\text{rest}}$ ?

What type of graph should it be? How should the data be arranged?

Make your graphs to show average changes in: HR; **amplitudes** of the P wave, QRS complex, and T wave; and **duration** of the P wave, QRS complex, and T wave. Put error bars on the graph representing (+/-) 1 standard error from the mean value.

## Discussion

Write your discussion in paragraph form. Make sure each paragraph starts with a strong topic sentence, and organize your paragraphs to address the hypotheses most effectively (and these should follow the organization of your results). Here are some questions/ideas to guide your discussion.

- 1) Describe the events that are occurring in the heart during the following times: (a) P wave (b) QRS complex (c) T wave.
- 2) Explain why the QRS complex appears *before* the “lub” sound, and why the “dup” sound occurs *after* the T wave.
- 3) Which elements of the cardiac cycle change during exercise? Why?
- 4) What was the biggest change? How much did **amplitudes** of the ECG waves vary among individuals in your group? How much did **durations** of the ECG wave vary among individuals in your group? How much did **heart rate** vary among members of your group? How might they be involved in a physiological response?
- 5) What happens to the amplitude and duration of the volume pulse immediately following exercise (during recovery)? What does this mean for the actual delivery of volumes of blood? What physiological mechanism could explain this (maybe vasoconstriction), how is it useful?
- 6) Connect all of your ideas to physiological mechanisms and functions.