

## 18. EKG: FACTORS THAT AFFECT THE HEART

How does the heart respond to increased physical activity?

### Objectives

- Relate EKG periods to heart activity.
- Compare the time intervals of EKG periods before and after exercise.

### Materials and Equipment

- Data collection system
- PASCO interface such as a Wireless Airlink
- EKG sensor
- Electrode patches (3)
- Rubbing alcohol
- Paper towels

### Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- Do not perform this activity if vigorous exercise will cause discomfort. If you experience discomfort or pain, immediately stop exercise.
- The electrode patches are intended for use with a single student and cannot be re-used after completing this investigation.

### Procedure

1. Attach the EKG sensor to the interface.
2. To open the experiment file in SPARKvue, select Open PASCO Experiment > Quick Start Labs > EKG and Heart Rate > OK.
3. Use the Bluetooth icon to connect a wireless interface to your device.
4. Work in pairs. One student will collect data and keep track of time while the *subject* or person whose EKG is being measured will exercise such as jogging in place for 3 minutes. Select a subject who can conduct vigorous exercise without discomfort. Use alcohol and paper towels to clean the subject's inside elbows and inside right wrist. These areas are labeled as positions 1, 2, and 3 in Figure 1.
5. Peel the backing from 3 electrode patches and firmly place the patches in positions 1, 2, and 3. Position the non-adhesive, conductive tabs to the inside of the arms as shown.
6. Clip the black (reference) alligator clip to the conductive tab at position 1; clip the green (negative) alligator clip to the tab at position 2; clip the red (positive) alligator clip at position 3.
7. Have the subject sit quietly in a chair with their legs un-crossed and arms on a table, palms facing up as shown in Figure 1.

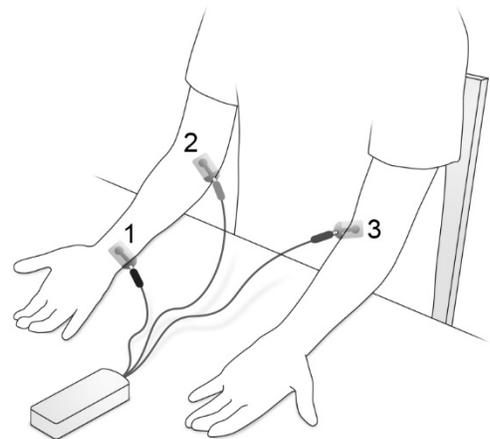


Figure 1: Subject is seated with electrodes placed in positions 1, 2, and 3

8. Remind the test subject to relax, remain still, and to not look at the data as it is recorded.
9. Select Start to begin collecting data. Stop collecting data after 20 seconds. Record the heart rate in Table 1.
10. Adjust the graph to find 5 seconds of data where heartbeats appear consistent.

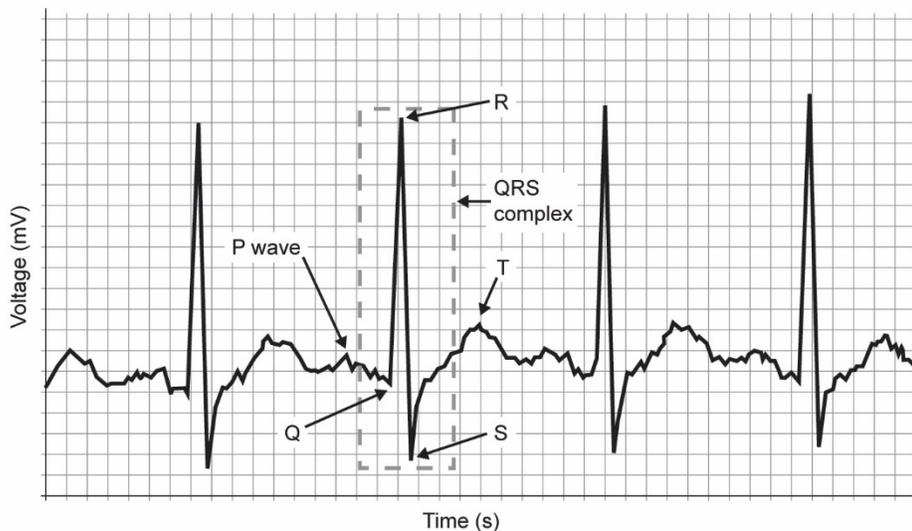


Figure 2: Electrocardiogram (EKG) reference diagram

11. Refer to Figure 2. Adjust the graph scale to view about 3 seconds of data that clearly shows a P wave, QRS complex, and T wave. Sketch your results in Graph 1. Include numbers, labels, and units on the x- and y-axes.

12. Remove the clips from the patches. Have the subject stand up and find a suitable area to jog in place for 3 minutes. After 3 minutes of jogging, repeat Steps 6-13, sketching results in Graph 2.

13. Have the subject report how they feel after exercising for 3 minutes. Examine the subject to identify post-exercise changes in their outer appearance. Record results in Table 1.

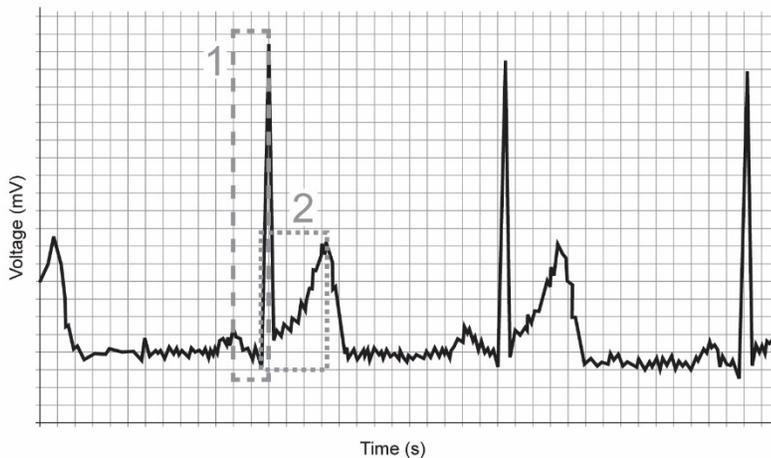


Figure 3: PR interval (box 1) and QT interval (box 2)

14. Refer to Figure 2. Label one set of P, Q, R, S, and T areas on both graphs.
15. Use Graphs 1 and 2 or SPARKvue tools to determine the QRS complex time duration (Figure 2, time across dotted box), the PR interval (Figure 3, time across box 1), and the QR interval (Figure 3, time across box 2) for both graphs. Record results in Table 1.

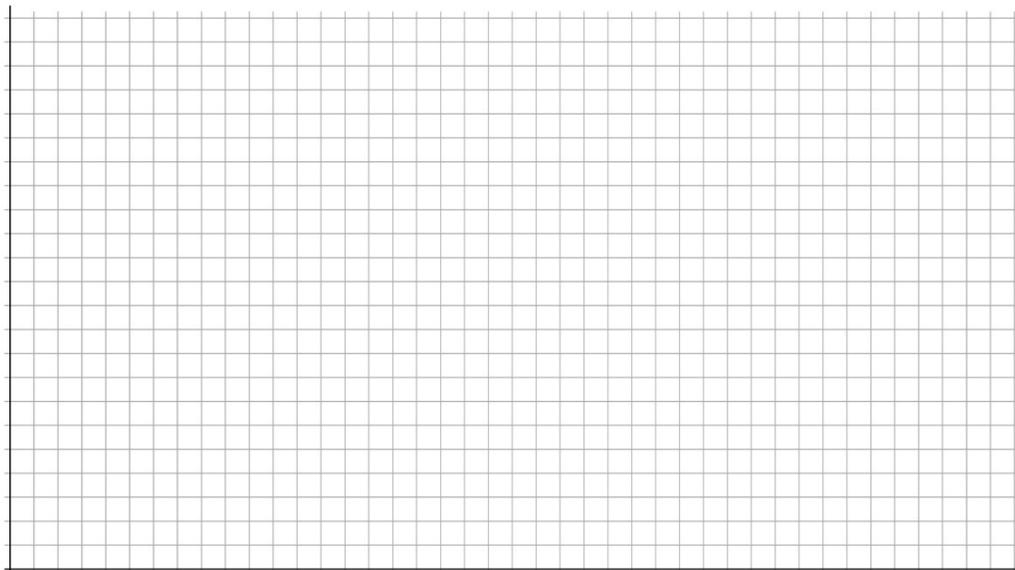
## Data Collection

Table 1: EKG parameters before and after exercise

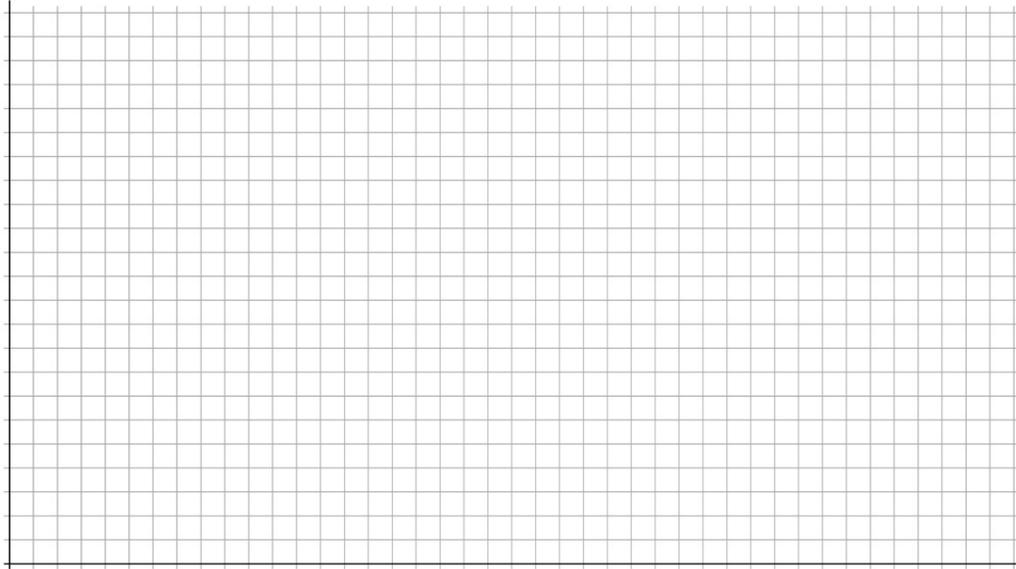
Activity Level	Heart Rate (beats/min)	QRS Complex (seconds)	PR Interval (seconds)	QT Interval (seconds)
Resting				
After Exercise				
Typical Range* (seconds)		Under 0.100	0.120 to 0.200	Under 0.380
Observations after exercise				

\*Table 1 includes a row with typical average ranges. Healthy hearts often have data outside these ranges. Do not be alarmed if an EKG in this activity falls outside these ranges. Also, reading an EKG effectively takes considerable training and skill, and the sensor in this activity is not intended for medical purposes.

Graph 1: Subject's resting EKG



Graph 2: Subject's EKG after 3 minutes of exercise



### Questions and Analysis

1. Compare the lengths of the PR interval, the QRS complex, and the QT interval. Does exercise affect the length of each of these intervals? Support your explanation with data.
  
2. How do the durations of the intervals for the EKG after exercise compare with the typical durations of intervals? What could this indicate about your physical condition?
  
3. Heart rate reports the number of P-wave to T-wave cycles per minute. Compare the heart rate before and after exercise.
  
4. What does the number of peaks (R waves) represent? Which graph (resting or exercising) shows more peaks (R waves) per amount of time?

