How do we determine our heart rate by monitoring EKG?

INTRODUCTION:

An electrocardiogram, also known as an EKG, is a graphical representation of the electrical activity that occurs within your heart. The graph produced by an EKG consists of five basic deflection points; P, Q, R, S and T. By noting the time interval between these points, you can determine your heart rate. An EKG also is valuable in diagnosing diseases or ailments that damage the conductive abilities of the heart muscle. When cardiac muscle cells are damaged or destroyed, they are no longer able to conduct the electrical impulses that flow through them. In this activity, you will use the EKG sensor to make a five-second graphical recording of your heart's electrical events. From this recording, you will be able to calculate your heart rate.

OBJECTIVE:

- Use the EKG sensor to graph your heart's electrical activity.
- Calculate heart rate based on your EKG recording.
- Design an experiment using the EKG sensor that examines the effect of an outside factor on heart rate.

HYPOTHESIS:

1. What would you expect to happen to your EKG recording after doing about 15 jumping jacks?

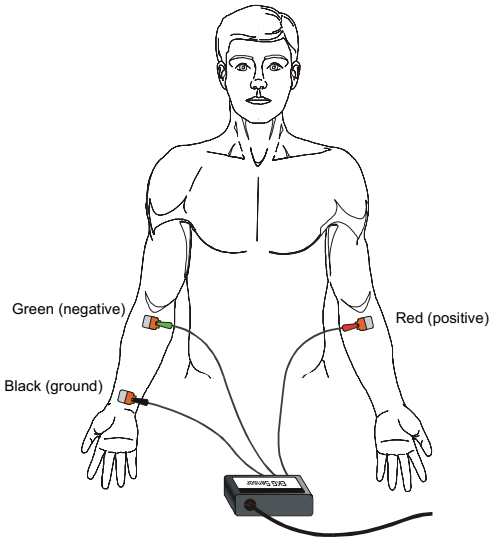
2. How would that affect your heart rate?

MATERIALS:

Computer
Vernier computer interface
Logger*Pro* (and software)
Vernier EKG sensor
Disposable electrode tabs

PROCEDURE:

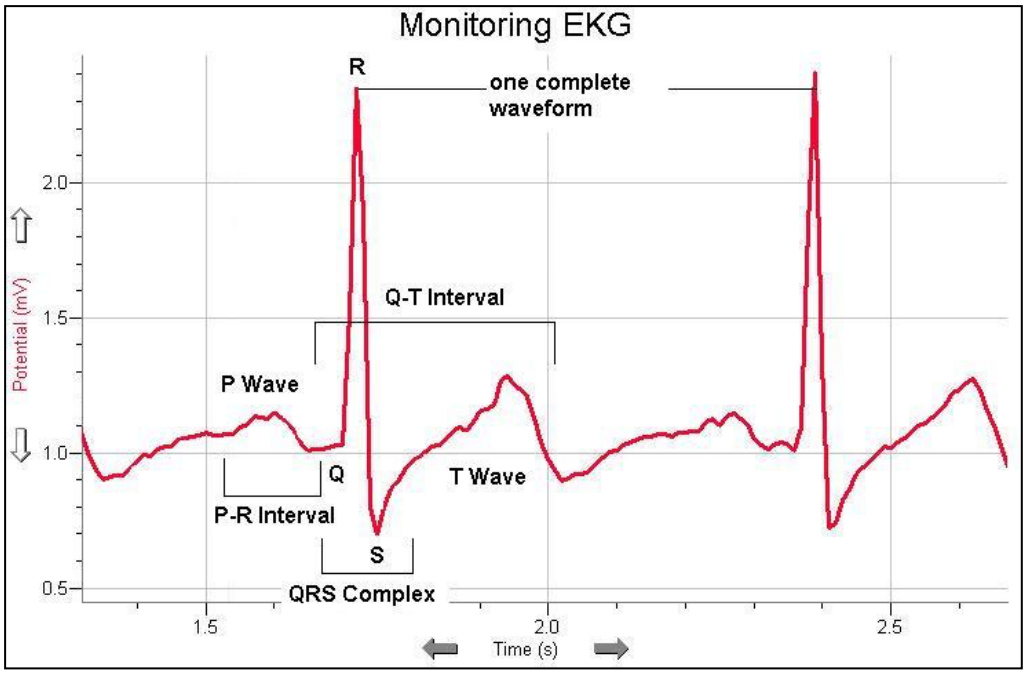
1. Attach the three electrode tabs to your arms, as shown below. A single patch should be placed on the inside of the right wrist, on the inside of the right upper forearm (below elbow), and on the inside of the left upper forearm (below elbow).



2. Connect the EKG clips to the electrode tabs as shown in the picture above.
3. Sit in a reclined position in a chair or lay flat on top of a lab table. The arms should be hanging at the side unsupported. When everything is positioned properly, click Collect to begin data collection. If your graph has a stable baseline as shown below, continue to the next step. If your graph has an unstable baseline, collect a new set of data by clicking Collect. Repeat data collection until your graph has a stable baseline.
4. Click the Examine button, to analyze the data. As you move the mouse pointer across the screen, the x and y values are displayed in the Examine window that appears.

5. Calculate the heart rate in beats/min using the EKG data. Remember to include the time between the two consecutive R peaks. (See diagram below). Use the total number of seconds for one full heart cycle in the equation. Record heart rate in Table 1.

$$\frac{\#\,\text{beats}}{\text{minute}} = \frac{1\,\text{beat}}{\_\_\,\text{seconds}} \times \frac{60\,\text{seconds}}{1\,\text{minute}}$$



6. Do 15 jumping jacks with the electrode tabs in place.
7. Repeat Steps 3-5.

DATA: Table 1:

	Time (T-P) interval (s)	Heart Rate (#of beats/minute)
Without Jumping Jacks		
With Jumping Jacks		

QUESTIONS/CONCLUSION:

1. Based on your findings, was your hypothesis correct? Why or why not?

2. How is an EKG recording so useful in diagnosing heart problems?

3. Can an EKG recording detect all different kinds of heart problems? Why or why not?

4. To calculate an individual's maximum heart rate the following formula is used:

   220 bpm – Individual's Age = Max Heart Rate

   a) According to your data collected for the jumping jacks, does the formula hold true or not?

   b) What are some possible factors that could affect heart rate that were not taken into account in this experiment?

EXTENSION:

Using one of the factors mentioned above, design an experiment using the EKG sensor that tests the effect of your factor on heart rate. Be sure to include your problem, hypothesis, materials, experimental procedure, and how you will collect your data.