Human Cardiovascular Physiology:  
Electrocardiogram, Blood Pressure and Pulse  
Bio 2402 Lab

Read introductory material in the lab manual, Exercises 31 & 33a. You will be combining activities from these two exercises. Decide beforehand who will do each of the experimental treatments that way after their baseline values of ECG and pulse are measured they can proceed to the experimental section while they are still hooked up to the iWorx machine.

**Activity: Auscultating Heart Sounds**  
Skip or Optional

**Activity: Palpating Superficial Pulse Points** (group)  
1. Follow the procedure as described in your lab manual to palpate four of the pulse points mentioned in the lab manual.  
2. List the pulse points that you palpated in the table on your data sheet and indicate which seemed to have the greatest amplitude and which the least amplitude (1=greatest; 4=least).  
3. As you sit quietly have your partner take your pulse for 1 minute; do this three times then report the data and the average on your data sheet.

**Activity: Using a Sphygmomanometer to Measure Blood Pressure Indirectly** (individually)  
1. Follow the instructions in your lab manual to record each others blood pressure  
2. Make two trials being sure to wait about 2 or 3 minutes in between each trial

***The cuff should not be kept inflated for more than one minute***

3. Report your blood pressure, the pulse pressure for each trial and the average in the table on your data sheet  
4. Compute Pulse Pressure and the Mean Arterial Pressure (MAP) by following the instructions in your lab manual and record your information on the data sheet

**Activity: Estimating Venous Pressure**  
Skip

The rest of the activities in this exercise will be performed with the iWorx software, ECG electrodes and the plethysmograpgh.

**Activity: ECG and Finger Pulse: Baseline Recordings** (individually)  
You will be using the iWorx station to record individual ECG’s and finger pulses. Each student should make a baseline recording of their own ECG and finger pulse; members of the group should also be preselected to get one recording from each of the experiments below. Then, after each records their baseline values they can perform the experimental activity and immediately make the appropriate experimental recordings.

*each student should only use ONE set of electrodes for ECG, do not remove them until you are completely finished with this exercise*

1. The equipment should be set up and preprogrammed for you. iWorx settings: HK204; Heart #2; drag away the integral channel window  
2. Prepare the subject for recording by having them remove all jewelry from wrists and ankles. Then swab the volar surface of each wrist and an area on the left leg just above the ankle with an alcohol swab. You will only be using three of the leads.  
3. Place the plethysmograph on the volar surface (area of fingerprint) of the distal segment of the middle finger and wrap the Velcro to attach the unit firmly to the end of the finger  
4. Convince the subject to sit quietly with hands in their lap  
5. click <Start> and, if needed, <AutoScale> in the channel two title area
6. You should see a rhythmic ECG tracing and pulse appear on the screen
   if the trace is upsidedown, click <Stop> and switch the positive and negative electrode leads and
   restart the tracing
   if a larger signal is required, the electrodes should be moved from the wrists to the skin
   immediately below each clavicle
7. When you are getting a suitable trace, type the “subject’s name” and “resting” and press
   Enter on the keyboard.
8. Click <stop> to halt recording
9. Proceed to the data analysis section of the exercise
10. Each student should print a copy of their resting ECG and finger pulse, label the major waves on their
    ECG and attach it to their data sheet

Activity: Observing the effect of various factors on Blood pressure and heart rate (group)
Group members should have been preselected to perform at least one of the experimental treatments
below:
   - exercise
   - holding breath
   - laying down
   - smoking
   - etc

It is preferable that a single subject not perform more than one of the above experiments.
Immediately after the baseline tracings have been made, have the volunteer perform one of these
activities and record an ECG and pulse tracing in the same way they made the baseline recording above.
In your analysis of the effects of exercise, breath-holding, etc., always use the baseline of the person
performing the activity as the control

Effects of exercise on ECG and pulse
1. After a preselected subject has made a baseline recording, have the subject exercise for at least three
   minutes by running in place or using the exercise bike for at least three minutes, or unplug the
   electrodes from the pads and remove the plethysmograph and run up and down the stairwell
2. Immediately, have the subject sit down and record their ECG and pulse as above
3. Proceed to the data analysis section of the report

Effects of breath-holding on ECG and pulse
1. After a different preselected subject has made a baseline recording, have them hold their breath for
   at least one minute, longer if possible.
2. Immediately, record the subject’s ECG and pulse as above
3. Proceed to the data analysis section of the report

Food Additives:
1. With the plethysmograph on and after the baseline recording, have the subject drink 12 ounces of one
   of the following:
      - soft drink with caffeine
      - sugar free soda with caffeine
      - decaffeinated regular soda
      - decaffeinated, sugar free soda
      - candy bar
2. Follow the procedure above but type the treatment you are doing at the time

Other Tests
(creative, you can perform the same experiment with nicotine (have the subject go outside and smoke a
   cigarette after they have made their baseline recording); OTC medications, sports drinks, things with MSG
   in them, etc)
Data Analysis
1. You now have a set of baseline ECG’s and finger pulse data for each member of your group and at least one tracing of several of the experimental treatments
2. After each subject has completed his/her measurements scroll to the appropriate area of the record to analyze their control and experimental results
3. Click <autoscale> and or <half display time> if necessary
4. Click the <2Cursor> icon(Fig. 2-5) so that two vertical lines appear over the recording window
5. Drag the cursors left and right so that four complete heartbeat cycles are located between the two blue lines
6. Use the mouse to click and drag the cursors around the window to measure:
   a. the amplitude (max-min) of at least three QRS waves (Fig 2-3)
   b. the amplitude of at least three P waves
   c. the amplitude of at least three T waves
   d. the time interval between at least three different pairs of adjacent QRS waves (Fig. 2-9)
7. Calculate the average for each of these values, round to the 2nd decimal place, and enter them in the tables on your data sheet
8. Calculate the heart rate as

   \[
   \text{Heart Rate} = \frac{60}{\text{mean time interval}}
   \]

   round to the nearest whole number, and enter in the table on your data sheet
9. Also, use the two cursors to measure amplitudes of at least three pulse peaks and the time intervals between at least three adjacent peaks
10. Convert the time interval to pulse rate per minute
11. Calculate an average value for each and record in the table below.
12. Also calculate the difference between baseline and the experimental values for the subject (be sure to use the baseline tracing for the same subject who did that particular experiment)
13. Enter your data in the table on your data sheet
14. Make bar graphs comparing the following values for each of the conditions that your group tested to the control value:
   a. The heart rate
   b. The amplitude of the QRS waves
   c. The amplitude of the finger pulse
15. Finally, calculate the time difference between the generation of a heart beat and the actual pulse recorded in the finger for any member of your group
   a. press the 2-cursor icon and place one cursor on the peak of the QRS wave in window #2
   b. place the other cursor in the peak of the finger pulse in window #3
   c. read the time difference in the T2-T1 window; this is a rough estimate of the time it took for the pulse generated by the heart to reach the artery in your finger
   d. record this value on your data sheet

Disposal and Cleanup:

Replace all materials to trays
Turn off iWorx station
Activity: Palpating Superficial Pulse Points

<table>
<thead>
<tr>
<th>Pulse Points Tested</th>
<th>strongest to weakest</th>
<th>Explain why pulse was stronger or weaker</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Pulse Rate:
Count 1:_________ Count 2:_________ Count 3:_________ Average:_________

Activity: Using a Sphygmomanometer to Measure Arterial Blood Pressure Indirectly:

<table>
<thead>
<tr>
<th>Trial</th>
<th>Arterial Pressure</th>
<th>Pulse Pressure</th>
<th>MAP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Systolic</td>
<td>Diastolic</td>
<td></td>
</tr>
<tr>
<td>#1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>#2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Baseline Finger Pulse

<table>
<thead>
<tr>
<th>Your Baseline Finger Pulse</th>
<th>Amplitude</th>
<th>Time Interval (sec)</th>
<th>Pulse Rate (b/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#2</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>#3</td>
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<td></td>
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</tr>
<tr>
<td>Average</td>
<td></td>
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</tr>
</tbody>
</table>
### Baseline Electrocardiogram

<table>
<thead>
<tr>
<th>Your Baseline ECG</th>
<th>Amplitude of Waves</th>
<th>Time Interval</th>
<th>Heart Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P wave</td>
<td>QRS wave</td>
<td>T wave</td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
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<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Average</td>
<td></td>
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</tr>
</tbody>
</table>

### Activity: Observing the effect of various factors on Blood pressure and heart rate:

<table>
<thead>
<tr>
<th>Finger Pulse</th>
<th>Average amplitude</th>
<th>Time Interval</th>
<th>Pulse Rate</th>
<th>Amplitude Change from Control</th>
<th>Pulse Rate Change from Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Breath-Holding</td>
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</tr>
<tr>
<td>control*</td>
<td></td>
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</table>

### ECG

<table>
<thead>
<tr>
<th>ECG</th>
<th>Amplitude of Waves</th>
<th></th>
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</thead>
<tbody>
<tr>
<td></td>
<td>P wave</td>
<td>QRS wave</td>
</tr>
<tr>
<td></td>
<td>Amplitude</td>
<td>Change from Control</td>
</tr>
<tr>
<td>Exercise</td>
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<tr>
<td>control*</td>
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</tbody>
</table>

* control copy the baseline values for person performing the activity

Difference in time between the heart beat and the finger pulse being felt.

:___________
Review Questions:

1. Is the “heart rate” the same as the “pulse rate”? Why or Why not

2. How does your Blood Pressure, Pulse Pressure, and Mean Arterial Pressure compare to average values? Explain any differences.

3. Within your group, how much variation was there in baseline ECG’s and finger pulses. Which of the two factors seemed to vary the most? Was any particular part of the ECG tracing more variable than any other? Explain.

4. Summarize the results of your group’s experiments on the effects of various factors on ECG and pulse amplitude and rate. Did they vary from control? How did they change? Why do you think they changed or didn’t change? Be specific.

   a. Effects of Exercise:

   b. Effects of Breath Holding:

   c.

   d.
5. Explain the time difference between the heart beat and the finger pulse.