Experiment
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TEACHER INFORMATION

Ventilation and Heart Rate

1. Editable Microsoft Word versions of the student pages and pre-configured TI-Nspire files can be found on the CD that accompanies this book. See *Appendix A* for more information.

2. This experiment works equally well with either a Hand-Grip Heart Rate Monitor or an Exercise Heart Rate Monitor.

3. It is important to have good contact between the transmitter belt and the test subject when using the Exercise Heart Rate Monitor. It is very important that the belt fit snugly, but not too tight. Both electrodes should be wet with either saline solution or contact lens solution. A 5% salt solution works well and can be prepared by adding 5 g of NaCl per 100 mL of solution. Typical symptoms of inadequate contact with the electrodes are a noisy signal with erroneous peaks, missing heart beat readings, or a flat-line display. If the students receive a flat reading with no heart rate detected, have them move the transmitter and the receiver closer together. The range of the transmitter in the chest belt is 80 cm.

4. Computer monitors can be a source of electrical interference. Keep the receiver module of the Exercise Heart Rate Monitor as far as possible from any computer monitors in the class.

5. The receiver module of either type of Heart Rate Monitors will receive signals from the closest transmitter source. To avoid confusion or erroneous readings, have the test subjects from different lab teams stay at least 2 m apart.

6. It is possible to alter your heart rate by simply decreasing your respiratory rate and relaxing. Encourage students to stay alert and breathe normally.

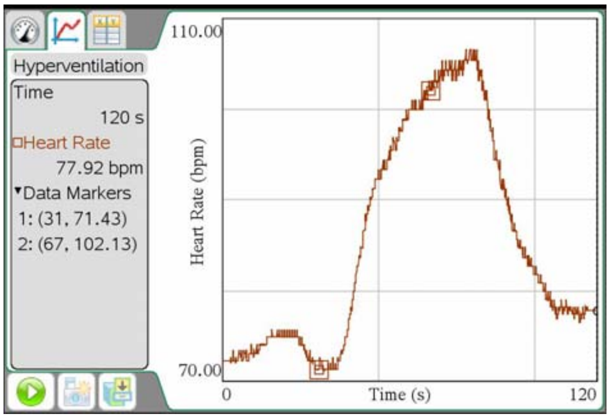
7. Anyone prone to dizziness, nausea, or headaches should not be selected as the test subject.

8. You can have your students create graphs of the data recorded in the data table by doing the following:

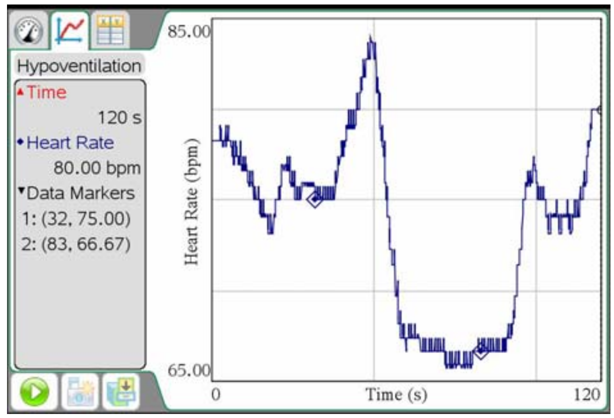
   a. Insert a new **problem** in your TI-Nspire document and launch the DataQuest App.
   b. Click on the Table View tab ( ) to view the table.
   c. Double-click on the x-column to open the column options.
   d. Change the Name to **Time** and enter **s** as the units.
   e. Select the Generate Values option. Enter **10** for the Start value, **120** as the end value, and **10** as the increment. Select OK to generate the values.
   f. Double-click on the y-column.
   g. Change the Name to **Heart Rate** and enter **BPM** as the units. Select OK.
   h. Double-click the run name and enter **HyperVent** as the Data Set name. Select OK.
   i. Enter the data in the table.
   j. Select New Data Set from the Data menu.
   k. Repeat Steps c – i. Be sure to use **HypoVent** as the data set name.
   l. Click on the Graph View tab ( ) to view the graph.

SAMPLE RESULTS

Table 1												
Time (s)	10	20	30	40	50	60	70	80	90	100	110	120
Hyperventilation	77	75	71	77	80	82	86	88	89	88	80	73
Hypoventilation	72	73	76	78	74	64	63	66	69	76	77	82



Typical graph for hyperventilation



Typical graph for hypoventilation

ANSWERS TO QUESTIONS

1. Heart rate will increase during hyperventilation.
2. This would be the time between the marked start of hyperventilation and the time the heart rate begins to rise. For the sample data, this was approximately 2–5 seconds.
3. Heart rate will decrease during hypoventilation.
4. This would be the time between the marked start of holding your breath and the time the heart rate begins to decrease. For the sample data, this was approximately 18 seconds.
5. Answers will vary. Factors that may be listed are blood carbon dioxide concentrations, blood oxygen concentrations, blood pressure, body temperature, and hormones.
6. Hyperventilation results in an increase of oxygen levels in the alveoli of the lungs and a decrease in carbon dioxide levels. The opposite results during hypoventilation.
7. When heart rate decreases, so does the rate at which carbon dioxide levels increase in the lungs. By slowing the increase of carbon dioxide in the lungs, an organism could hold its breath for a longer period of time. Aquatic mammals are a good example of organisms that use such an adaptation. This allows whales to stay under water for as long as one hour. A seal’s heart rate can change from 150 beats per minute to 10 beats per minute when it dives underneath the water to search for food.