

4. RESPIRATORY PHYSIOLOGY

- References:** *Lab Manual, Exercise 32, p. 175-177, and study “Spirogram of Lung Capacities,” p. 175, and “Using Propper Spirometer”, p. 176.*
 Textbook, p. 770-772, and Fig. 19.26, p. 771, and Table 19.4, p. 772.
 Workbook, complete p. 232, #15 and #16.

USE OF THE DRY SPIROMETER

Work in groups of 2 or 3 students.

1. Wipe the stem of the spirometer with an alcohol swab.
2. Put the alcohol swab in the waste container.
3. Place a clean, disposable mouthpiece over the stem of the spirometer.
4. Note that the dry spirometer only measures exhalations.
5. Note that the metal ring around the face of the spirometer rotates so that the dial can be set to a specific number.
6. When performing experiments, close your nose with your fingers.
7. Your breath **MUST** be audible for the instruments to record it.
8. When you have finished the last test,
 PUT THE MOUTHPIECE IN THE WASTE CONTAINER!
9. Return the spirometer back to the beginning station for someone else to use.

Station 1: Respiratory Volumes

Tidal Volume (TV)

Follow the instructions in your Lab Manual, p. 176-177, under “Tidal Volume (TV),” and “Minute Respiratory Volume (MRV).”

- Q1A. What is the normal tidal volume in ml or cc?
Q1B. Record your average tidal volume in ml or cc from this experiment.
Q2A. Measure your resting breathing rate by counting your breaths per minute and record your rate on your lab report as X breaths/minute.
Q2B. Define Minute Respiratory Volume. Label TV on p. 232 of your workbook.

Expiratory Reserve Volume (ERV)

Follow the instructions in your Lab Manual, p. 177, under “Expiratory Reserve Volume (ERV).”

- Q3A. What is the normal ERV in ml or cc?
Q3B. Record your average ERV in ml or cc. Label ERV on p. 232 of your workbook.

Vital Capacity (VC)

Follow the instructions in your Lab Manual, p. 177, under “Vital Capacity (VC).”

- Q4A. What is the normal VC in ml or cc?
Q4B. Record your average VC in ml or cc. Label VC on p. 232 of your workbook.
Q5A. Look in your Lab Manual, Appendix C, p. 341-342 and record your predicted VC.
Q5B. What factors influence VC?

Inspiratory Capacity

Follow the instructions in your Lab Manual, p. 177, under “Inspiratory Capacity (IC).”

- Q6A. What is the normal IC in ml or cc? Label IC on p. 232 of your workbook.
- Q6B. Record your IC in ml or cc. Write the equation you used to determine it.

Inspiratory Reserve Volume (IRV)

Follow the instructions in your Lab Manual, p. 177, under “Inspiratory Reserve Volume (IRV).”

- Q7A. What is the normal IRV in ml or cc?
- Q7B. Record your average IRV in ml or cc. Label IRV on p. 232 in your workbook.

Residual Volume (RV)

Follow the instructions in your Lab Manual, p. 177, under “Residual Volume (RV).”

- Q8A. What is the normal RV in ml or cc? Label RV on p. 232 of your workbook.
- Q8B. Define the term, RESIDUAL VOLUME.

Station 2: Spirometry and FEV

References: *Read the Lab Manual Supplement on the lab table, and study Fig. 51.2, also on the lab table.*

- Q9A. What does FEV_1 measure?
 - Q9B. What does FEV_T measure?
 - Q10A. Following directions in the supplement on the lab table, calculate FEV_1 .
 - Q10B. Following directions in the supplement on the lab table, calculate FEV_T .
 - Q11A. Following directions in the supplement on the lab table, calculate $FEV_{\%}$. What does an abnormal $FEV_{\%}$ indicate?
 - Q11B. Is the $FEV_{\%}$ considered normal? Below what percentage is $FEV_{\%}$ considered abnormal?
- Practice calculating these values on other graphs at this station. You will be expected to perform these calculations on the lab quiz and practical.*

Station 3: Respiratory Physiology

Regulation of Respiration

References: *Lab Manual, “Control of Breathing,” p. 175. Lab Supplement on the lab table, “Regulation of Respiration”. Textbook, “Control of Breathing,” p. 774-777. Workbook, p. 234, #20.*

- Q12A. Where is the respiratory center located?
- Q12B. What is the location and function of the ventral respiratory group?
- Q13A. Why is carbon dioxide given along with oxygen to persons suffering from carbon monoxide poisoning?
- Q13B. An increase in blood CO_2 levels has what effect on respiratory rate?
- Q14A. What ion has the most effect on respiratory rate?
- Q14B. Where are the structures that monitor the concentration of blood gas located?
- Q15A. When the structures named in Q14B note a change in concentration, which brain center is notified?
- Q15B. What is the function of the Inflation (Hering-Breuer) reflex?

Normal Respiratory Rate (Work in pairs.)

- Q16A. Record your normal respiratory rate in breaths/minute.
- Q16B. How long can you hold your breath after normal breathing? (Record in seconds)

Hyperventilation

1. DO NOT ATTEMPT THIS EXPERIMENT IF YOU ARE PRONE TO SEIZURES!
 2. Sit down.
 3. Breathe deeply at a rate of 15 breaths per minute for 1 to 2 minutes. STOP if you feel dizzy.
 4. At the end of hyperventilation, hold your breath as long as you can. Record the amount of time you can hold your breath in seconds.
- Q17A. Record the amount of time you can hold your breath in seconds. Is this more or less than the time you recorded in Q16B?
- Q17B. As you hyperventilated, what happened to your blood O₂ levels?
- Q18A. As you hyperventilated, what happened to your blood concentration of hydrogen ions?

Rebreathing

1. Place a paper bag over your nose and mouth and breathe into it for three minutes.
 2. Hold your breath after breathing into the paper bag. Record the amount of time you can hold your breath in seconds.
 - 3.
- Q18B. Record the amount of time you can hold your breath in seconds. Is this more or less than your result in Q16B.
- Q19A. As you hypoventilated, how did your blood carbon dioxide levels change?
- Q19B. As you hypoventilated, what happened to the pH level of your blood?

Breathing Mechanisms: Pulmonary Ventilation

References: *Textbook, p. 764-770 and Fig. 19.23, p. 768.*
Workbook, complete p. 220, #10 and #11.

1. Move the rubber sheeting on the bell jar GENTLY.
 2. Observe the subtle changes in the position of the rubber sheeting cause the balloons to inflate and deflate.
- Q20A. What organ do the balloons represent?
- Q20B. What happens to the balloons when the rubber sheeting is GENTLY pushed downward?

Q21: Clinical Application Thought Question: (Answer at the bottom of your lab report.)

A person has a chronic obstructive pulmonary disease and has adapted to a high blood concentration of carbon dioxide. What chemical will stimulate the respiratory center?

Turn in p. 232 and 234 from your Workbook with your laboratory report