**Reading Assignment**: Read Chapter 4, Physiology of Respiration (p. 125-149). Supplemental reading: Chapter 2 of Dr. Hill's Lecture Notes. I recommend reading the lecture notes online rather than printing. Use the search tool (binoculars) in Adobe Acrobat Reader to reference specific terms.

E. Physics of Breathing

1) Lung Volumes –

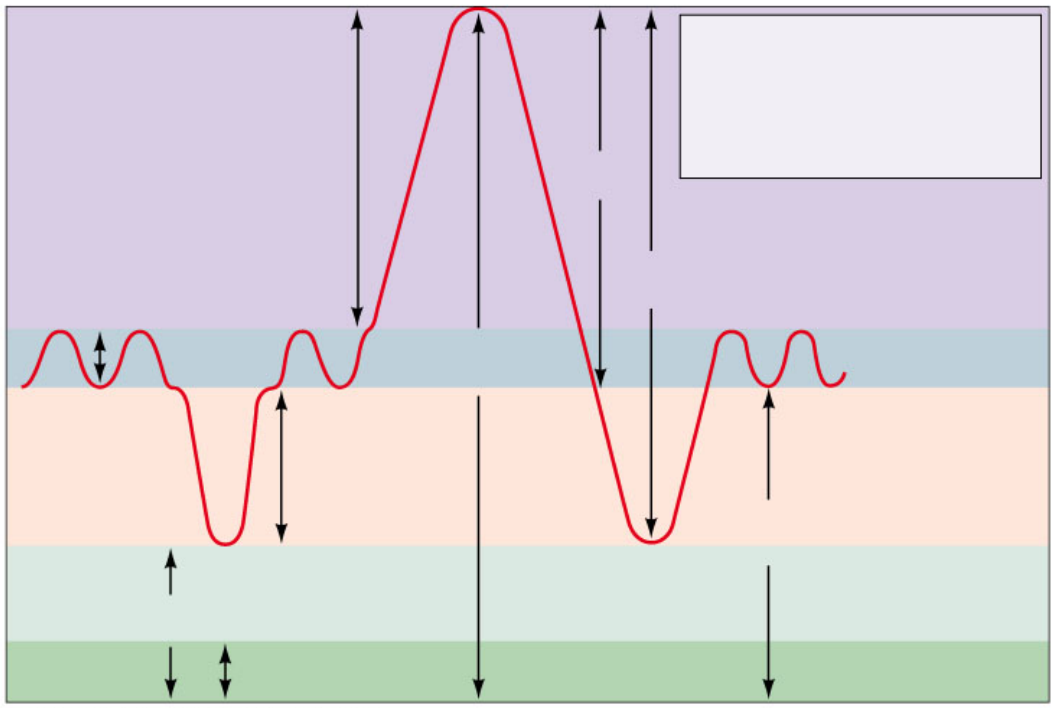
Spirometer –

Recording spirometer –

Propper spirometer –

Airflow transducer –

A SPIROGRAM—What are the lung volumes and capacities indicated by the arrows? Label the volumes indicated below the graph.





Tidal volume (TV) –

Expiratory reserve volume (ERV) –

Inspiratory reserve volume (IRV) –

Vital capacity (VC) –

Inspiratory capacity (IC) –

Residual Volume (RV) –

Functional Residual Capacity (FRC) –

Total lung capacity (TLC) –

Ventilation (breathing) rate –

Minute respiratory volume (MRV) –

**HOMEWORK ASSIGNMENT:** Read about major factors that influence the measurement of lung volumes and capacities. These are explained on pages 139-140 and illustrated in Table 4-4 and Figure 4-8. Describe the pattern of change in vital capacity that occurs with age, gender, and body size by answering the questions below.

Which gender generally possesses the larger VC?

Is the VC always greater in one gender than the other? Why or why not?

Does VC change with age in the same manner in both genders? Explain the pattern of increase, peak, and decline in VC. At about what age is a person's VC greatest?

How does muscle weakness affect respiratory function?

Know the normal values for males and females in Table 4-4 on p. 135.

Use the formulas below to calculate the predicted VC for two patients visiting a clinic. (1 in. = 2.54 cm)

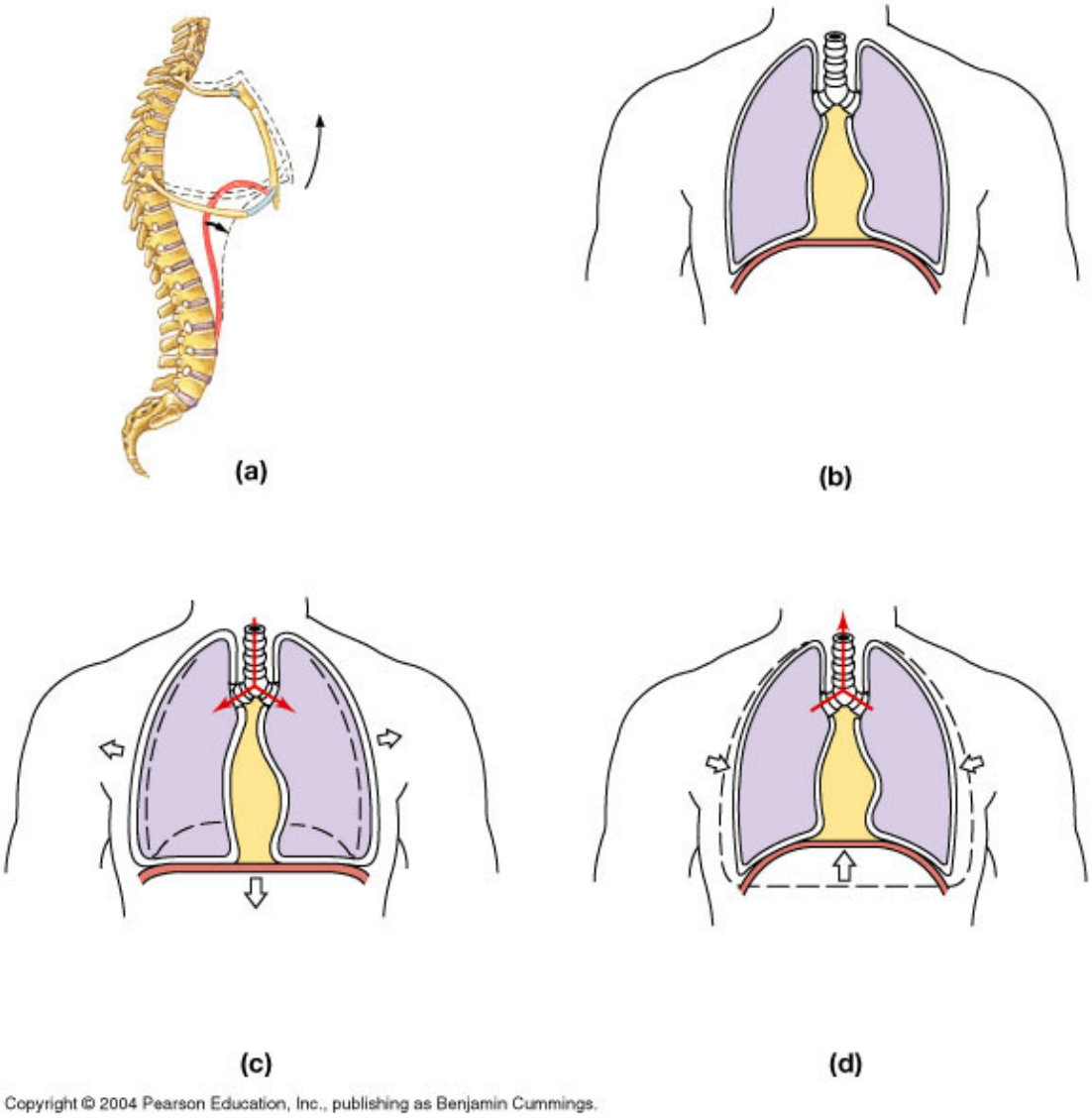
Males: predicted VC in mL = [27.63 – (0.112*age in yrs)]*ht in cm.
Females: predicted VC in mL = [21.78-(0.101*age in yrs)]*ht in cm.

| Emma Elwell: 55 yr-old female, 5 ft 6 in | Walter Waller: 32 yr-old male, 6 ft 2 in |
|---|---|
| | |

2) Inhalation (inspiration) and exhalation (expiration) –

a) Boyle's law: PV=nrT

b) Closed vs Open systems



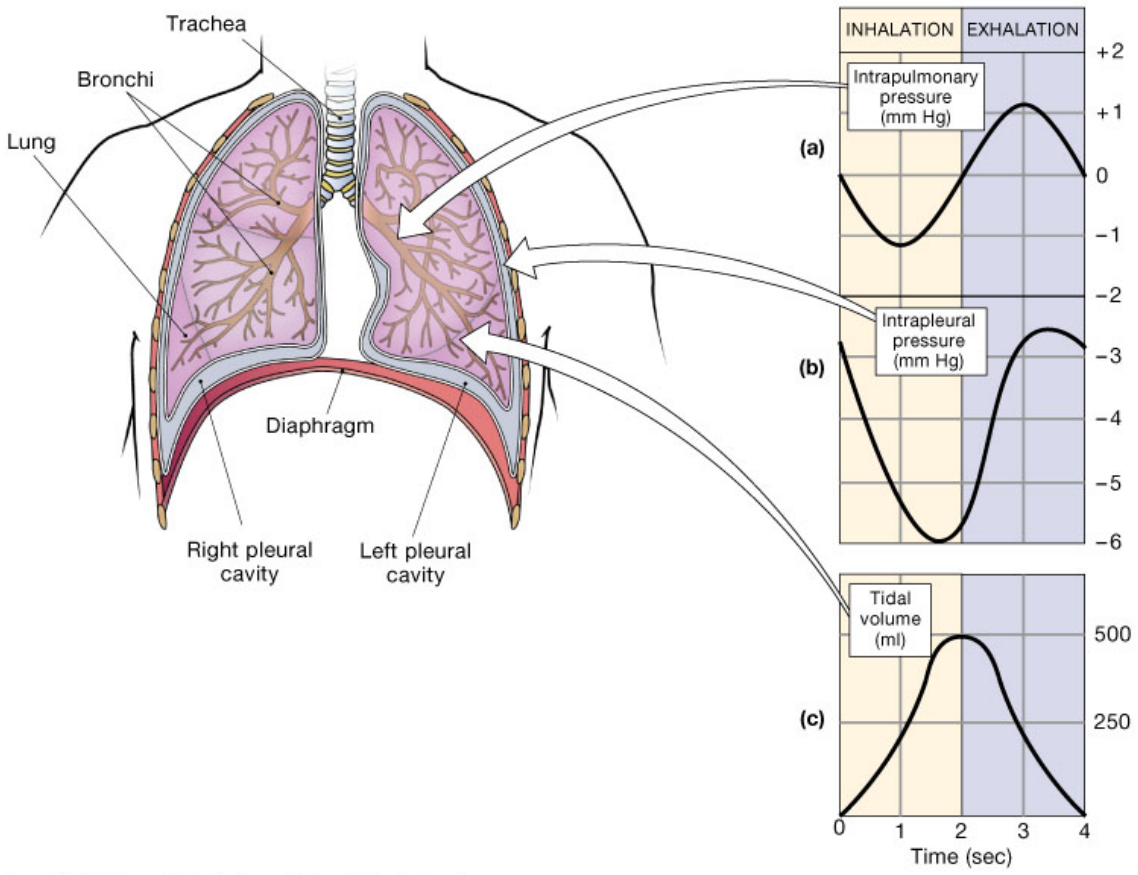
F. Air movement in breathing –

1) Manometer –

2) Graph of Pressure and Volume Changes during breathing:
a) X-axis

b) y-axis

c) Atmospheric pressure ($P_{ENV}$)



d) Intrapulmonary pressure ($P_{IP}$)

e) Intrathoracic (pleural) pressure ($P_{IT}$)

G. Forces & Mechanical Limits of Respiration

1) Relaxation pressure (RP)

2) Inspiratory pressure (IP)

3) Expiratory pressure (EP)

H. Muscles used in SPEECH—Draper's study (Draper et al., 1959)

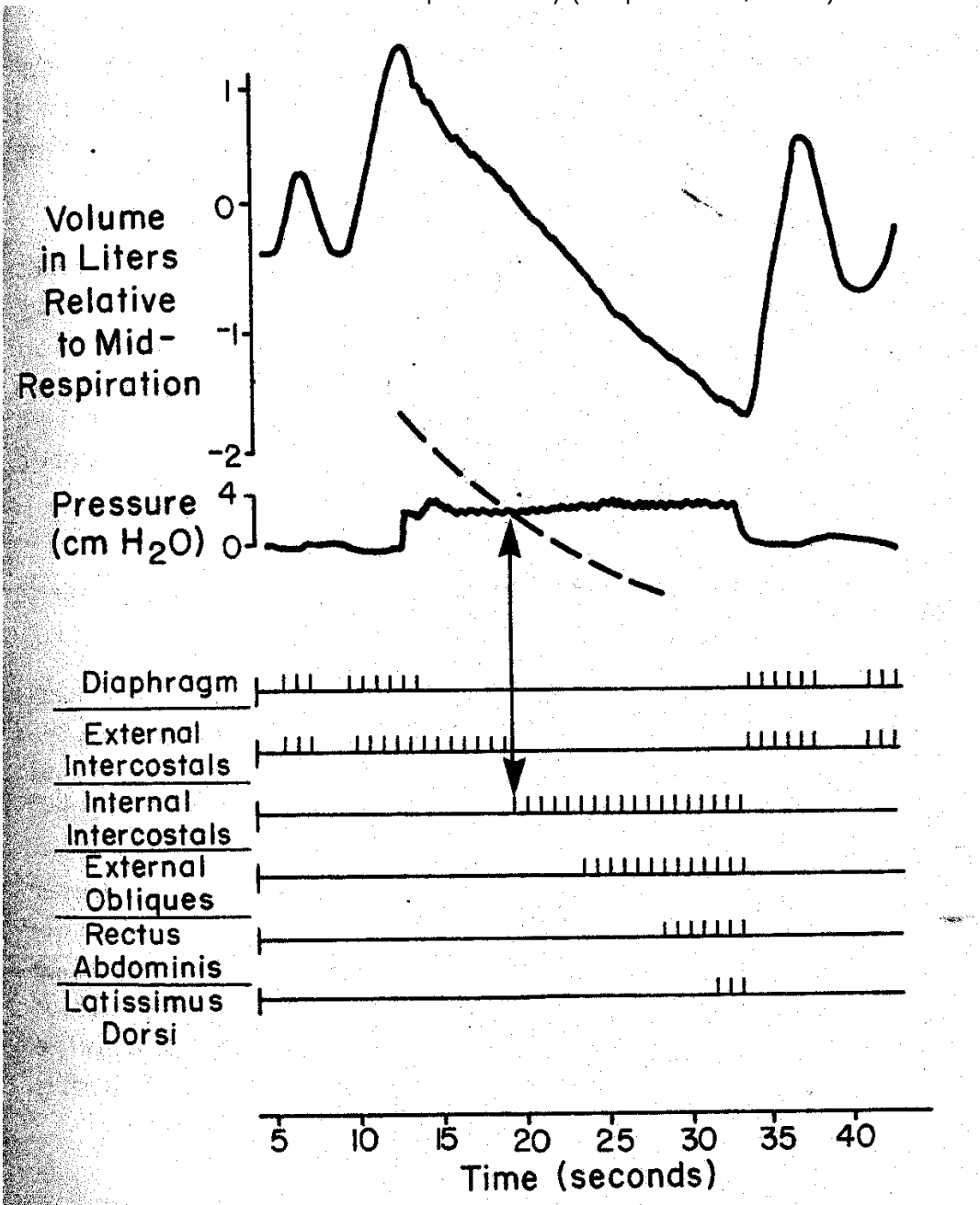


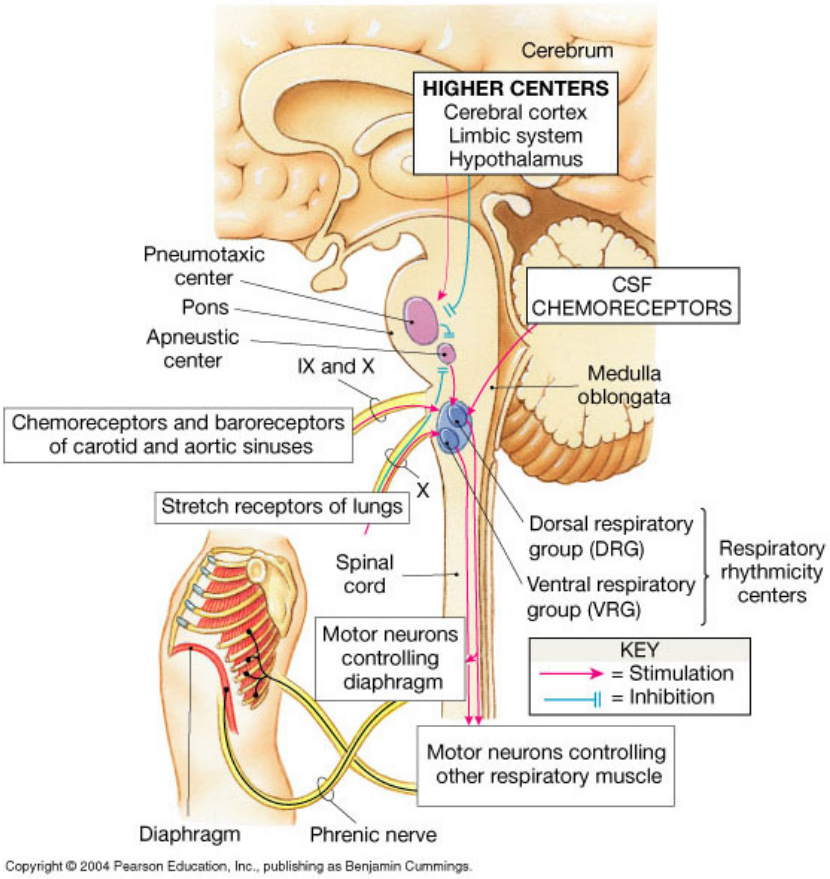

**FIGURE 4–15.** Muscular activity as it relates to alveolar pressure and lung volume. (Redrawn from data from Respiratory Muscles in Speech by M. Draper, P. Ladefoged, & D. Whitteridge, 1959, p. 20. *Journal of Speech and Hearing Research, 2.*)

I. ANATOMICAL COMPONENTS INVOLVED IN THE REGULATION OF BREATHING

Receptors -

$CO_2$ (pH) receptors –

$O_2$ receptors –




Stretch receptors –

Involuntary control centers of the CNS:

Medulla oblongata

| Dorsal regulatory group (DRG) | Ventral regulatory group (VRG) |
|---|---|
| | |

Pons varoli

| Pneumotaxic center | Apneustic center |
|---|---|
| | |

## J. REFLEXES THAT REGULATE BREATHING

Baroreceptor reflex –

Herring-Breuer Reflexes:

inflation reflex –

deflation reflex –

Protective reflexes:

sneezing –

coughing –

Voluntary control of breathing:

## RESPIRATORY PHYSIOLOGY REVIEW MATERIALS

### Lecture Guide Questions

1. What does Draper's study reveal about the relative contributions of the primary and accessory respiratory muscles during speech? Specifically: during speech is only the expiratory muscles that contract? Why or why not? Which muscles contract above the relaxation volume? Below the relaxation volume?
2. Name three instruments used to record/measure lung volumes.
3. Be able to identify the lung volumes on a graph. Define: TV, IRV, ERV, VC, IC, RV, TLC. Know normal values for each and how age, gender, and height influence VC. Be able to apply the formulas for VC in men and women (will be provided on an exam).
4. Which parts of the respiratory system make up a closed pressure system? An open pressure system? Define: environmental (atmospheric pressure), intrapulmonary pressure, and intrathoracic pressure.
5. Define: relaxation pressure, expiratory pressure, and inspiratory pressure?
6. Know the components of the regulatory mechanism for ventilation: receptors, integrators/regulatory centers, and effectors. Describe how these parts interact to regulate breathing.
7. What is the baroreceptor reflex? Why is this chemical regulation of breathing? Under normal conditions, is it $O_2$ or $CO_2$ in blood and body fluids that regulates your breathing rate? Why?
8. Why is overfilling of the lungs inhibited? Why is expiration inhibited as air leaves the lungs? What are the names of these reflexes?
9. Describe the protective reflexes of coughing and sneezing. What stimulates each reflex? Does a period of apnea precede each one? What is the function of each reflex?
10. Why do we have voluntary control over breathing? What is the functional significance? Little Nellie, daughter of Emma Elwell, goes into a temper tantrum in a store because she can't get a toy. Nellie threatens to hold her breath until she dies. Why shouldn't Emma be concerned?

### End of the Chapter 4 Questions (p. 156)

Lecture topics: 1-9, 11, 12
Laboratory: same as above.

### CD-ROM Review

Lecture topics: Lessons 04-01 through 04-04
Laboratory topics: 04-01 and 04-02