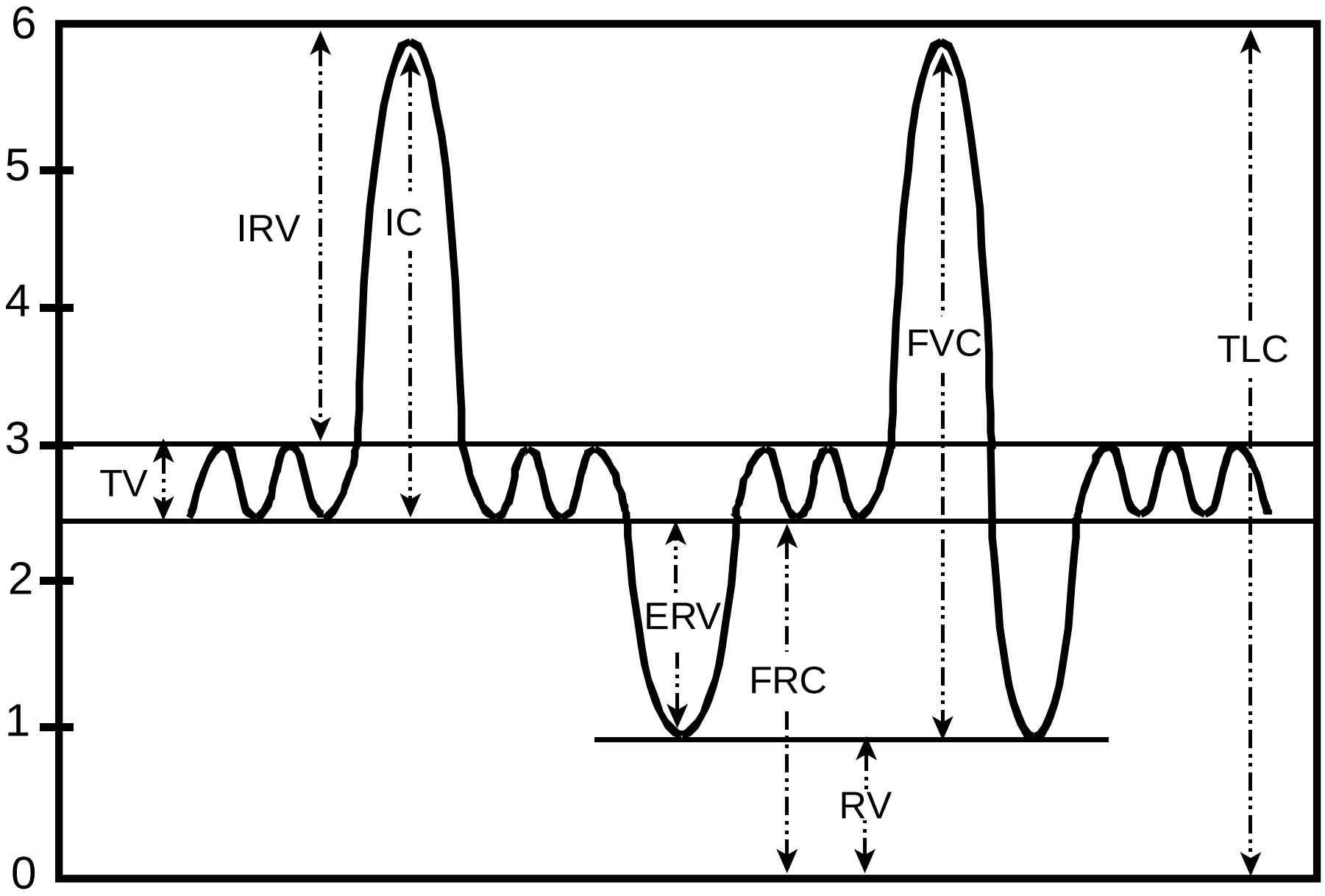
KINE 648 Lab #5

Clinical Assessment of Pulmonary Function

Equipment needed:

Automated Pneumotac Unit
Handouts
Web page notes

Dynamic Lung Volumes

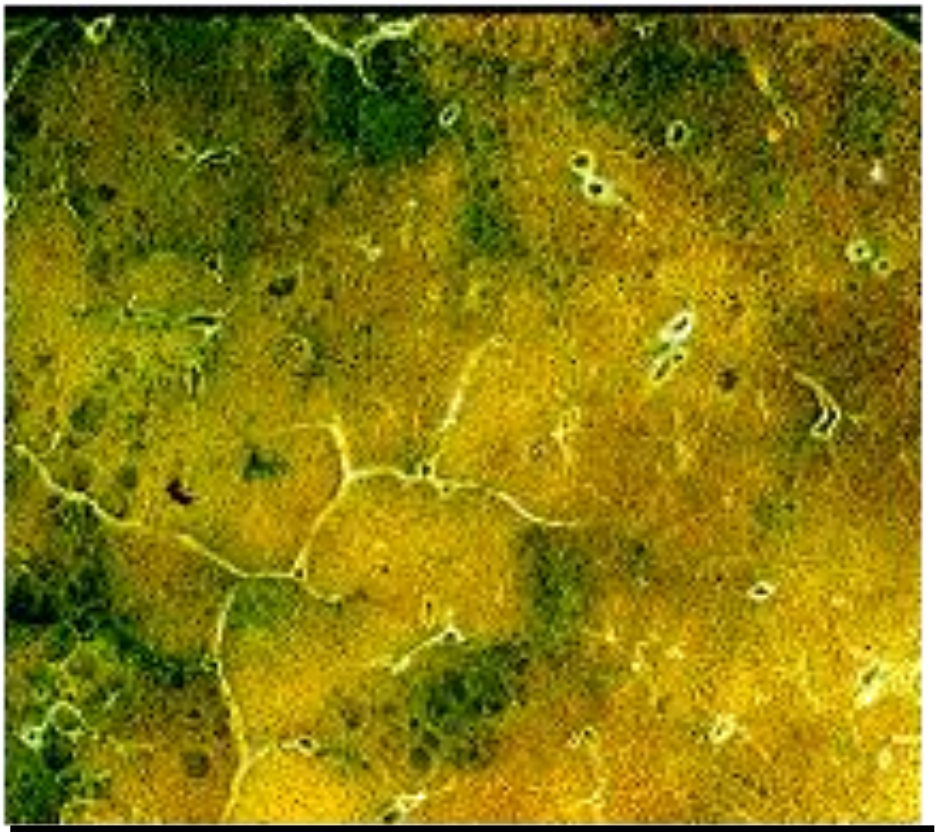


Chronic Obstructive Pulmonary Disease (COPD)

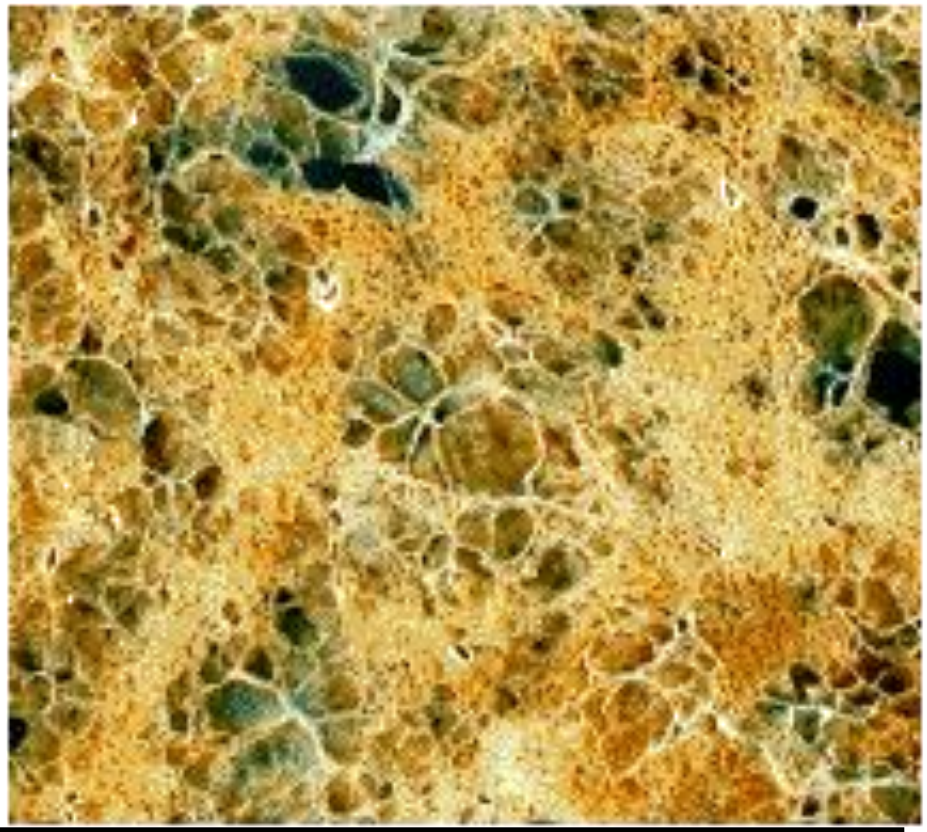
- **Three Main Conditions Comprise the Majority of COPDs**
  - **Asthma - reversible bronchospasm + airway inflammation**
    - may be related to: genetics, allergens, cold air, exercise, smoke, and smog
    - **SYMPTOMS:** wheezing, shortness of breath, coughing
  - **(Chronic) Bronchitis - inflammation & obstruction of small airways**
    - smoking is most common cause **(90% of COPD patients are smokers)**
    - other causes: respiratory infections, Industrial pollutants (smog)
    - characterized by chronic production of sputum & thickened bronchial walls
    - **INITIAL SYMPTOMS:** shortness of breath and productive coughing
      - usually not diagnosed until person has symptoms 3 months / year
  - **Emphysema - destruction and distension of alveoli**
    - again, smoking is most common cause
    - alveoli destruction results in the loss of elastic recoil
    - patients have usually lost 50% - 70% of tissue before symptoms appear
    - often difficult to distinguish from bronchitis - both may occur simultaneously
    - **INITIAL SYMPTOMS:** shortness of breath (exertional dyspnea)

Chronic Obstructive Pulmonary Disease (COPD)

Emphysema



Normal Lung Tissue



Lung Tissue with Emphysema

* Same magnification

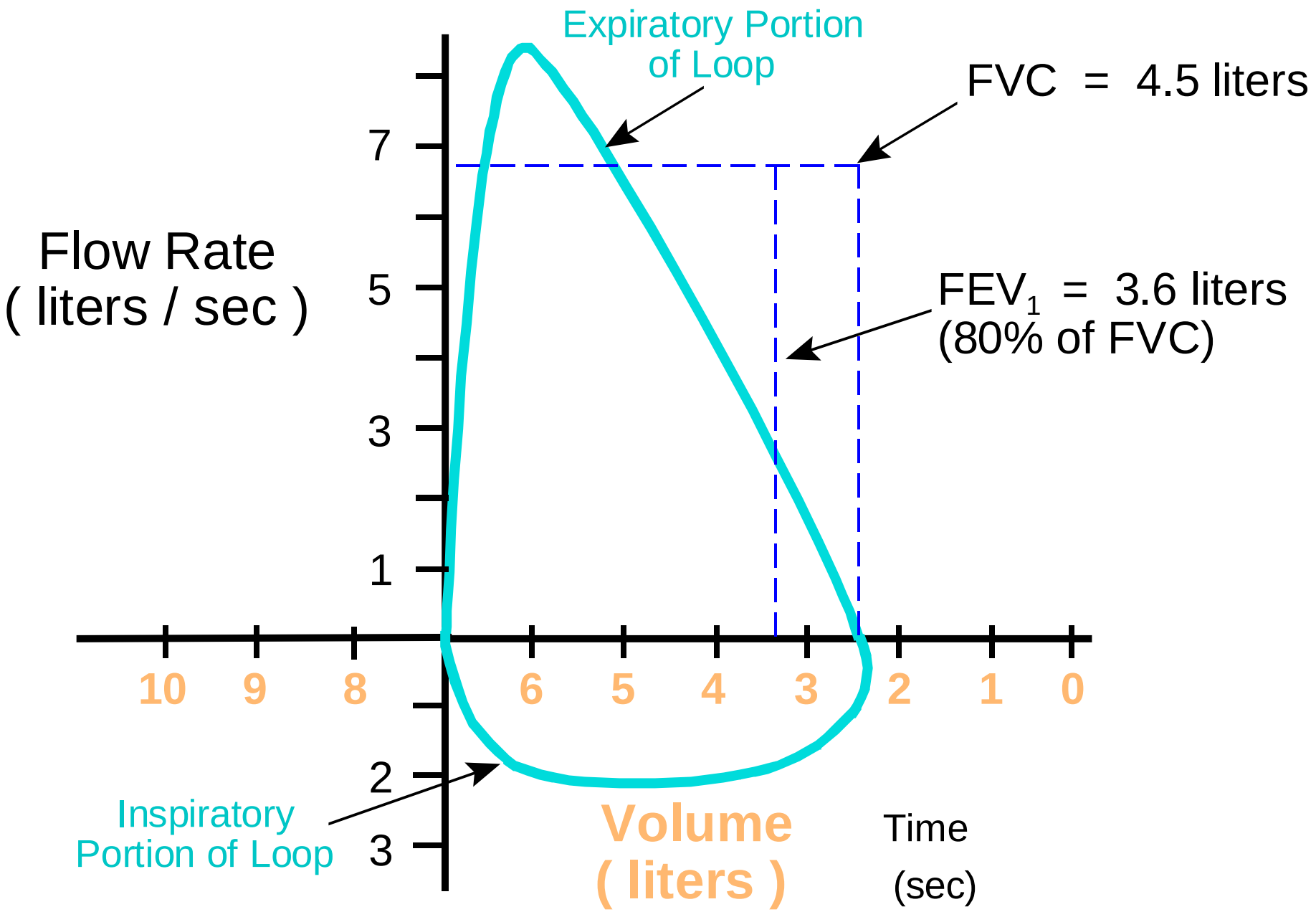
Chronic Obstructive Pulmonary Disease (COPD)

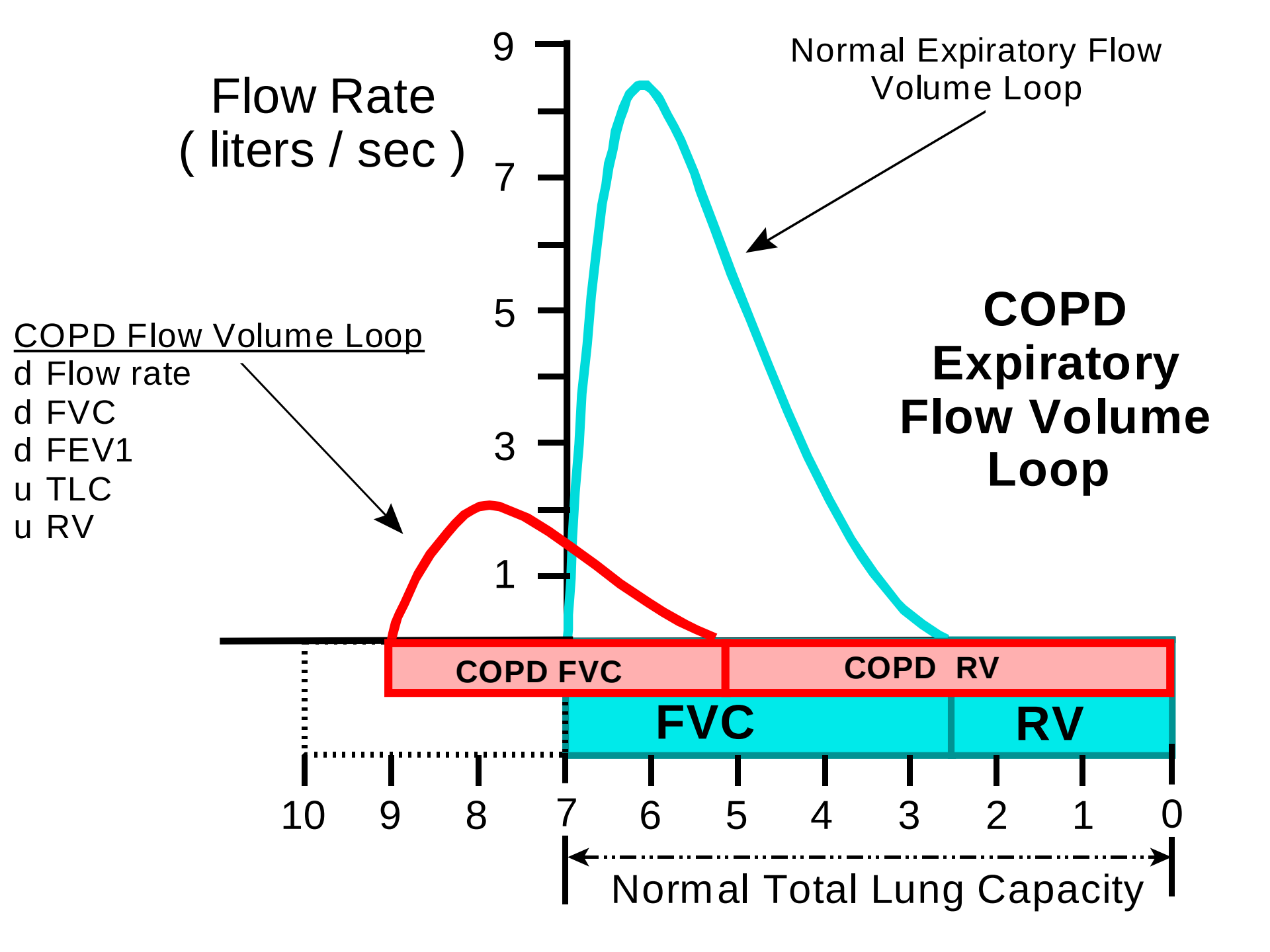
- **COPD epidemiology**
  - **COPD's affect 32 million people in US - 4th leading cause of death**
  - **10 year mortality rate after diagnosis of chronic bronchitis: 50%**
  - **10 year mortality rate with FEV_1 < 20% predicted: 95% (any COPD)**
  - **Asthma is leading disease in those < 17 years of age**
    - Responsible for 23% of days off school in young people
- **COPD pathophysiology notes**
  - **COPD r uu chance of secondary infections: pneumonia & flu**
  - **Initially, COPD may be difficult to distinguish from CHF**
    - Earliest sign of emphysema is exertional dyspnea
  - **Many patients have symptoms of both emphysema & bronchitis**
    - Most COPD cases are individual combinations of bronchitis & emphysema
  - **Onset of chronic bronchitis is insidious**
    - Person never fully recovers from a cold or a bout of influenza
    - Has relapsing respiratory infections that become increasingly worse

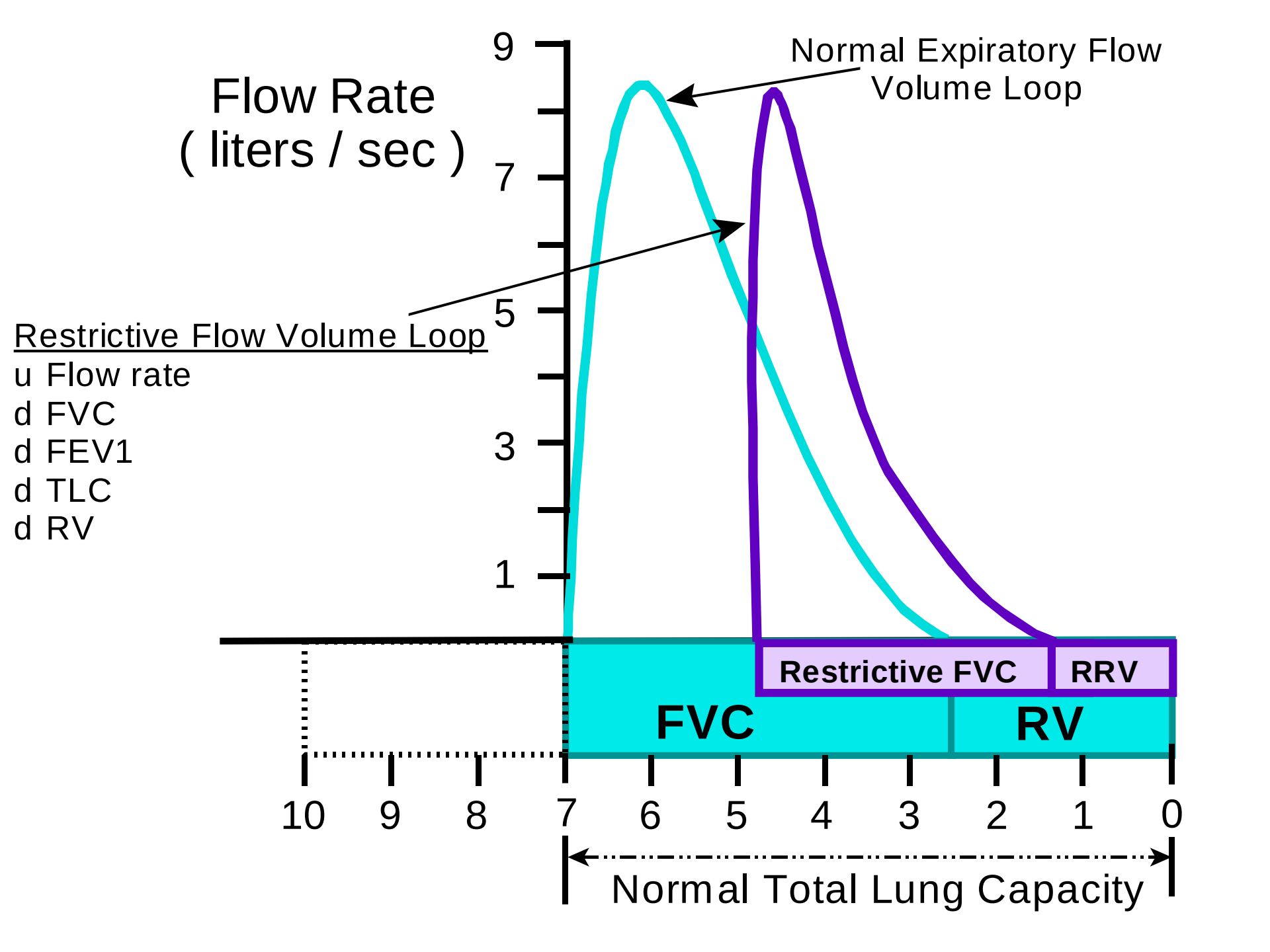
Chronic Obstructive Pulmonary Disease (COPD)

- **COPD pathophysiology notes (cont.)**
  - **In COPD, as the disease progresses:**
    - d ventilation r d V_E / Q r d O_2 (hypoxia) + u CO_2 (hypercapnea)
      - hypercapnea r headache
    - u amount of lung tissue not ventilated r body will not perfuse these areas
      - hypoxic vasoconstriction **(HV)**
    - d lung vascular tissue (emphysema) + HV r u PA pressure
      - u PA pressure (pulmonary hypertension) r RV failure
        - RV failure called Cor Pulmonale
    - u work of breathing (up to 17 fold)
    - In emphysema: lung hyperinflation r "barrel chest" (u lung capacity)
    - Person breathes through pursed lips to optimize airflow
    - Person may have a bluish discoloration (cyanosis) due to hypoxia
- **Diagnosis of COPDs**
  - **FVC and FEV_1 < 85% of predicted (severe: < 50% predicted)**
  - **FVC : FEV_1 ratio < .75** (others: chest x-ray, blood gas analysis)

Normal Flow Volume Loop




Flow Rate
(liters / sec)
9
7
5
3
1
Normal Expiratory Flow
Volume Loop
COPD Flow Volume Loop
d Flow rate
d FVC
d FEV1
u TLC
u RV
COPD
Expiratory
Flow Volume
Loop
COPD FVC
COPD RV
FVC
RV
10 9 8 7 6 5 4 3 2 1 0
Normal Total Lung Capacity


Flow Rate
(liters / sec)
9
7
5
3
1
Normal Expiratory Flow
Volume Loop
Restrictive Flow Volume Loop
u Flow rate
d FVC
d FEV1
d TLC
d RV
Restrictive FVC
RRV
FVC
RV
10
9
8
7
6
5
4
3
2
1
0
Normal Total Lung Capacity

Lab Assignment for Data Collection #5

Directions: Students should work in groups of 2 with each student serving as both a subject and a data collector. Each student will complete the assignment using his partner's data. Note: after selecting an icon on the screen, hit enter to complete the command.

1. **Using the 1070 PFT system for measurement of FVC, FEV_1, and MVV**
    1. Attach 3L calibration syringe to hose and the hose to the pneumotach port
    2. Using the arrow/tab keys, select ***Calibration***, then select ***Spirometry Pneumotach***
    3. Follow directions on withdrawal and injection (a series of 5) until the calibration is complete
    4. Note: sometimes the flow meter must be "zeroed" and calibration may take more than one try
        1. If problems are encountered during calibration, notify Dr. Green or a lab staff member
    5. Enter correct room temperature, barometric pressure, and relative humidity
    6. Using arrow keys, highlight ***Home***
    7. Select ***Patient Information*** then ***Enter New Patient*** and enter data using arrow/tab keys
    8. Select ***Home***. Then select ***FVC***
    9. Press the spacebar to start the test,
    10. When the subject is ready, press spacebar again to begin the breathing maneuver:
        1. Have subject inhale maximally
        2. Then exhale as hard and as forcefully as possible **(exhalation must be maintained for 7 seconds)**
        3. Then inhale maximally again
    11. When the subject finishes inhaling, press the spacebar again to stop the test.
    12. Repeat 3 times and select best effort using the F7 key and arrow keys
    13. Press the END or F10 button to go back to main spirometry menu
    14. Now, to do the Maximum Ventilatory Volume test, select ***MVV***
    15. Press the spacebar to start the test (notice the "countdown breaths" before actual test begins)
    16. After the 1st countdown breath, have subject inhale and exhale as rapidly and deeply as possible
    17. After 1st test, repeat 1 time and select best effort using the F7 key and arrow keys
    18. Press the END or F10 button to go back to main spirometry menu
    19. Select ***Print Report*** to print both the flow volume test and the MVV test results

Lab Assignment for Data Collection #5

2. Using the 1070 PFT system for measurement of residual volume (RV).

1. Turn on O_2 and N_2 gases, push in the button activating the N_2 pump, and wait 15 minutes
2. Place a hose and cardboard mouthpiece on the pneumotach port and a mouthpiece on the N_2 port
3. Using the arrow/tab keys, select ***Calibration***, then select ***Spirometry Pneumotach***
4. Follow directions on withdrawal and injection (a series of 5) until the calibration is complete
5. Note: sometimes the flow meter must be "zeroed" and calibration may take more than one try
    1. If problems are encountered during calibration, notify Dr. Green or a lab staff member
6. Enter correct room temperature, barometric pressure, and relative humidity, the press ***End***
7. Select ***N_2 Analyzer*** – wash out head mouthpiece with calibration syringe
8. If N_2 is still out of range, adjust the level using the Nitrogen adjustment control on the front panel
9. Press phase delay – if problems are encountered notify Dr.Green – press ***End*** then ***Home***
10. Select ***Patient Information*** then ***Enter New Patient*** and enter data using arrow/tab keys
11. Select ***Home***. Then select ***SVC.*** Make sure the hose is connected to the pneumotach port
12. Press the spacebar to start the test, perform 4 tidal breaths, the slowly inspire and expire fully
13. Press the spacebar again to stop the test, the press ***End*** to return to main menu
14. Select ***N_2FRC*** and connect pneumotach hose to the "T" port on the arm of the N_2 analyzer
15. Adjust the arm of the N2 analyzer to accommodate the height of the seated subject
16. Have the subject start breathing normally the press the ***spacebar*** to start the test
17. After 4 tidal breaths, the machine will switch the subject over to pure O_2 and the washout will begin
18. It is important for the subject to take normal breaths until the N2 bars are close to the bottom
19. When N2 bars are close to the bottom the machine will instruct the subject to perform slow FVC
20. After the FVC, continue breathing normally for a few breaths
21. Press the spacebar to stop the test, then press end to go back to the main menu
22. Select ***Print Report*** to print out the results

Lab Write-up for Assignment #5

1. In this laboratory, we discussed chronic obstructive pulmonary diseases such as asthma and emphysema and examined the flow volume loops related to this type of lung disorder. Discuss and illustrate (using a graphics program) what changes would occur in the flow volume loop (expiratory portion only) of someone with **restrictive lung disease** (fibrotic diseases such as cystic fibrosis, etc.) Be sure to construct a comparative illustration and construct and reference your discussion as outlined in the syllabus.

2. In this lab we measured residual volume (RV) using a nitrogen washout technique. Discuss what, factors determine residual volume in health healthy people, athletes, and those with lung disease.

3. In this lab we also performed the maximum breathing capacity or maximum voluntary ventilation (MVV). Discuss the the usefulness of this measurement in a pulmonary diagnostic setting. In other words, what diseases would make this test abnormal and why?.

4. Discuss whether or not FVC, FEV_1, and MVV change as a result of an endurance exercise training program.

5. Using a Physicians Desk Reference or other drug publications, discuss how (by what physiological mechanistic alterations) the following medications aid in the treatment of asthma: **Singulair Theodur Proventil Advair**