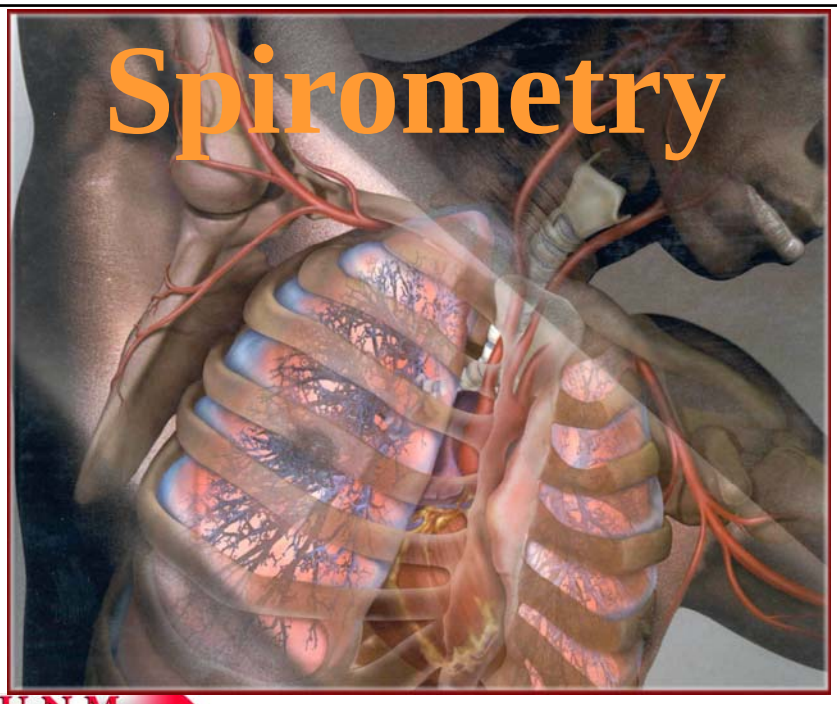
Spirometry



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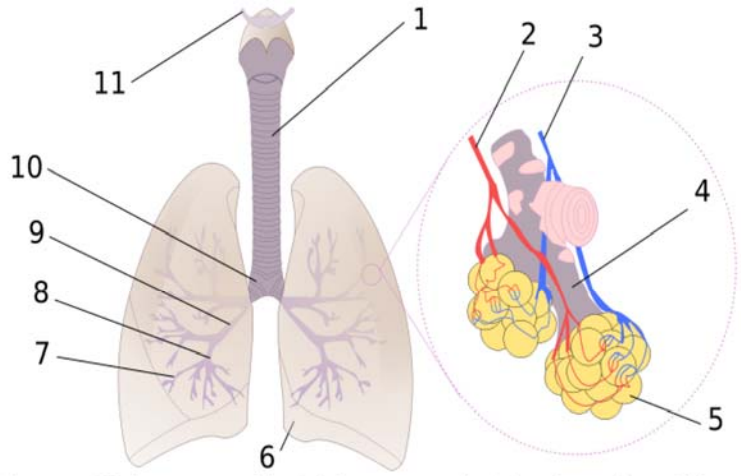
The Respiratory System



1 Larynx; 2 Pulmonary arteriole; 3 Pulmonary venule; 4 Respiratory bronchiole;
5 Alveoli; 6 Lnugs; 7 Tertiary bronchiole; 8 Secondary bronchiole; 9 Prinmary bronchi;
10 RIght bronchi; 11 Trachea

Items 1, 10, 9, 8, 7 = conduting zone
Items 4 and 5 = respiratory zone

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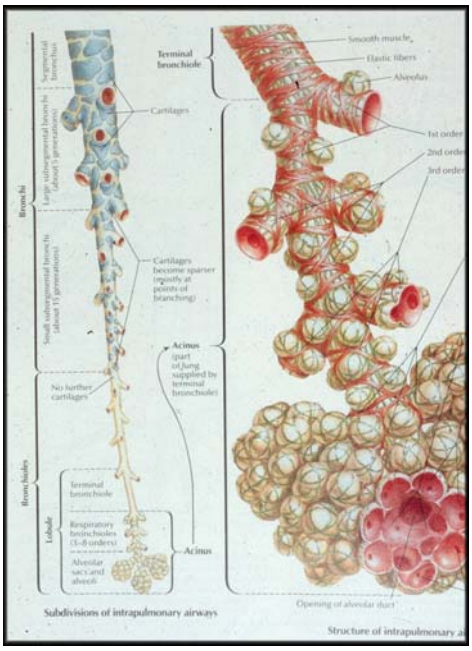
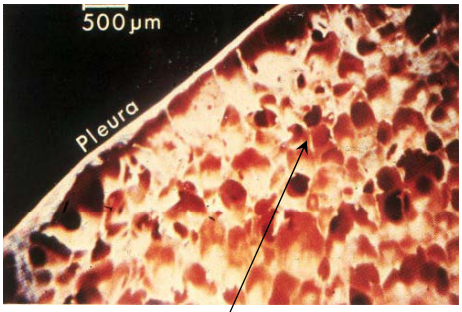
This is a cast of the airways that conduct air to the lungs.

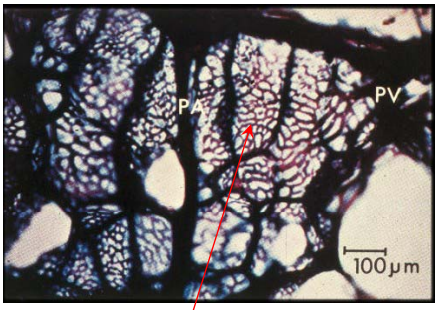
Why is this morphology potentially detrimental to air conductance into and from the lungs?



Note;
The respiratory zone has the greatest surface area and a dense capillary network.



Note the density of the alveoli and their thin walls.



Note the dense capillary network that surrounds alveoli.

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Surfactant

A phospholipoprotein molecule, secreted by specialized cells of the lung, that *lines the surface of alveoli and respiratory bronchioles*. Surfactant *lowers the surface tension* of the alveoli membranes, *preventing the collapse* of alveoli during exhalation and *increasing compliance* during inspiration.

Respiration

The process of gas exchange, which for the human body involves oxygen (O_2) and carbon dioxide (CO_2).

Internal respiration - at the cellular level

External respiration - at the lung

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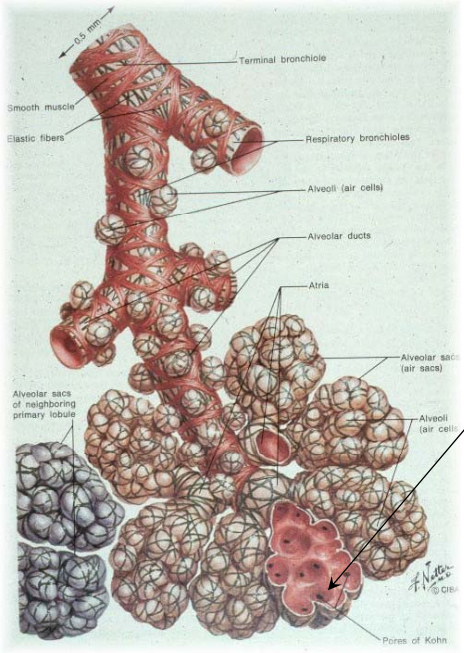

The distribution of surfactant is aided by holes that connect alveoli called Pores of Kohn.

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Ventilation

The movement of air into and from the lung by the process of bulk flow.

Ventilation (V_E) (L/min) = frequency (br/min) x tidal volume (L)

For rest conditions,

V_E (L/min) = 12 (br/min) x 0.5 (L) = 6 L/min

For exercise at VO_2max,

V_E (L/min) = 60 (br/min) x 3.0 (L) = 180 L/min

Compliance - *the property of being able to increase size or volume with only small changes in pressure.*

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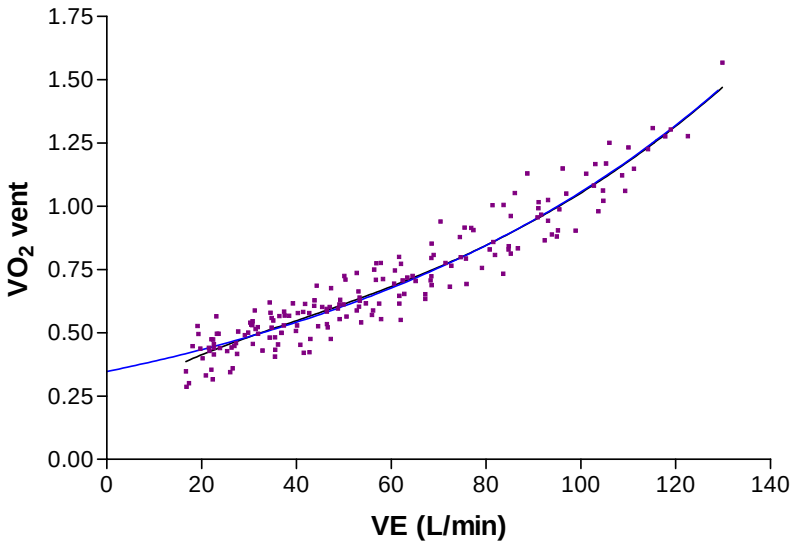
Work of Breathing



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Alveolar Ventilation

The volume of "fresh" air that reaches the respiratory zone of the lung.

Alveolar Ventilation (V_A) (L/min)

V_A = frequency (br/min) x (tidal volume - 0.15) (L)

For normal breathing conditions,

V_A = 12 (br/min) x (1.0 - 0.15) (L)

= 12 x 0.85 = 10.2 L/min

For rapid shallow breathing conditions,

V_A = 60 (br/min) x (0.2 - 0.15) (L) **(8.2b)**

= 60 x 0.05 = 3.0 L/min

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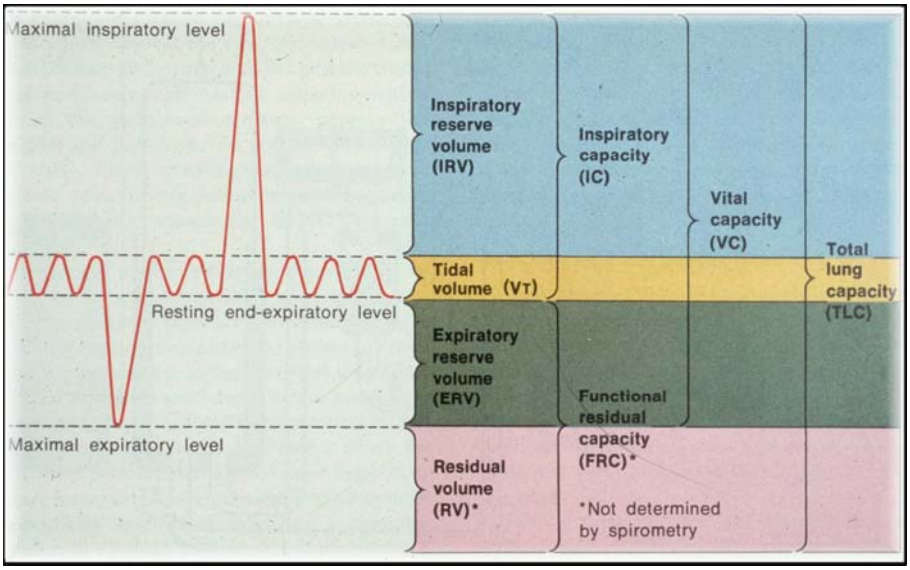
Lung Volumes and Capacities



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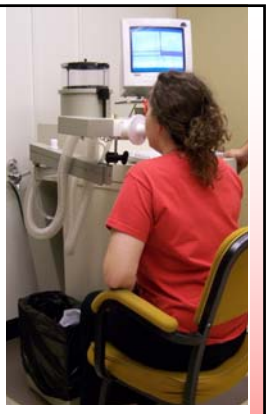
Measurement	Abbreviation	Description
Can be measured from spirometry		
Tidal volume	V_T	Volume of air inhaled and exhaled each breath
Inspiratory reserve volume	IRV	Maximum volume of air that can be inhaled after a normal resting end tidal inspiration
Expiratory reserve volume	ERV	Maximum volume of air that can be exhaled after a normal resting end tidal expiration
Inspiratory capacity	IC	Sum of IRV + V_T
Expiratory capacity	EC	Sum of ERV + V_T
Vital capacity	VC	Maximum volume or air exhaled after reaching IC = IC + ERV
Forced vital capacity	FVC	Same as for VC, but with forced rapid exhalation
Forced expiratory volume in 1 s	FEV1	Maximum volume of air that can be expired in 1 s when starting at IC
Maximal voluntary ventilation	MVV	Maximum rate of ventilation that can be attained with voluntary effort
Cannot be measured from spirometry		
Residual volume	RV	Volume of air remaining in the lungs at ERV.
Functional residual capacity	FRC	Sum of RV + ERV
Total lung capacity	TLC	Sum of V_T + IRV + ERV + RV



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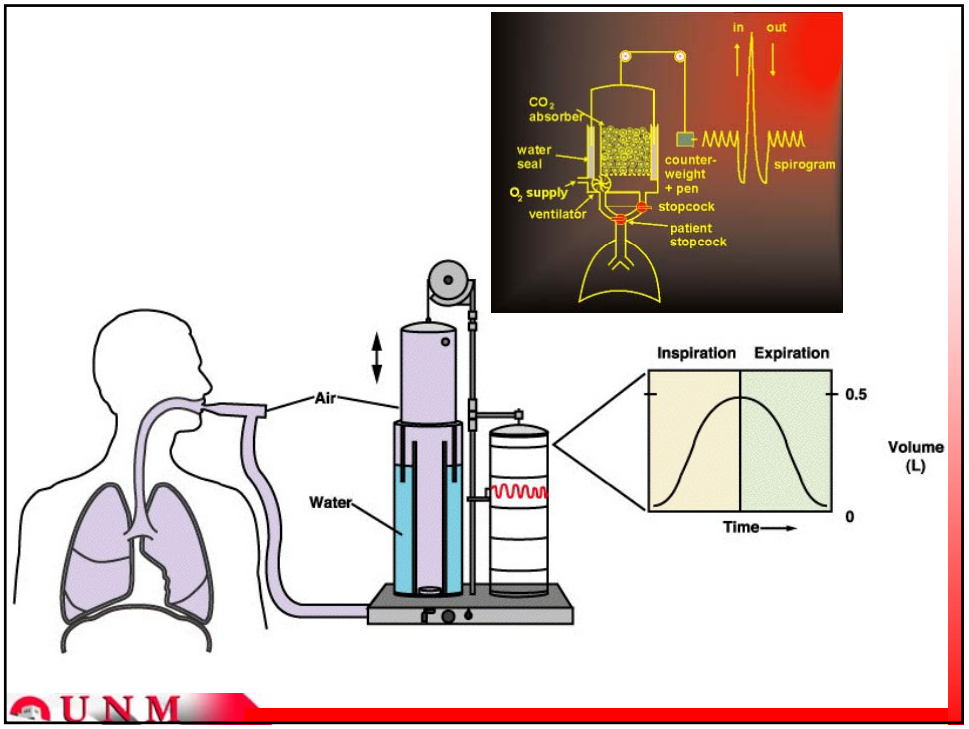
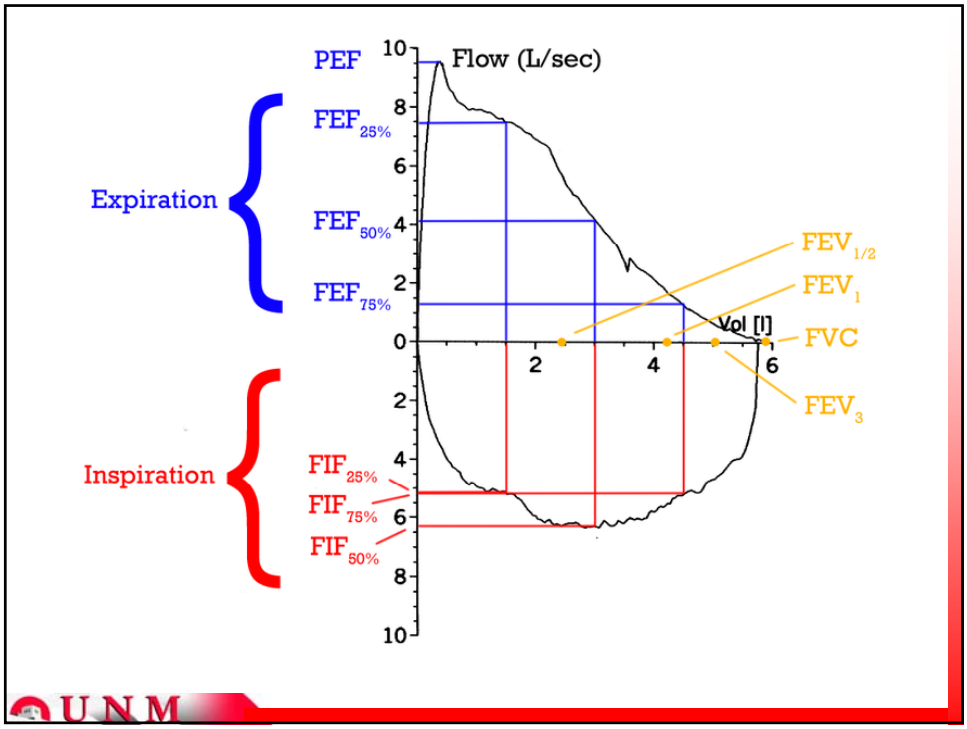

in
out
CO_2 absorber
water seal
O_2 supply
ventilator
counter-weight + pen
stopcock
patient stopcock
spirogram
Air
Water
Inspiration
Expiration
0.5
0
Volume (L)
Time
UNM


Astra 200™
UNM


PEF
Flow (L/sec)
FEF25%
Expiration
FEF50%
FEF75%
FEV1/2
FEV1
Vol [l]
FVC
FEV3
Inspiration
FIF25%
FIF75%
FIF50%
10
8
6
4
2
0
2
4
6
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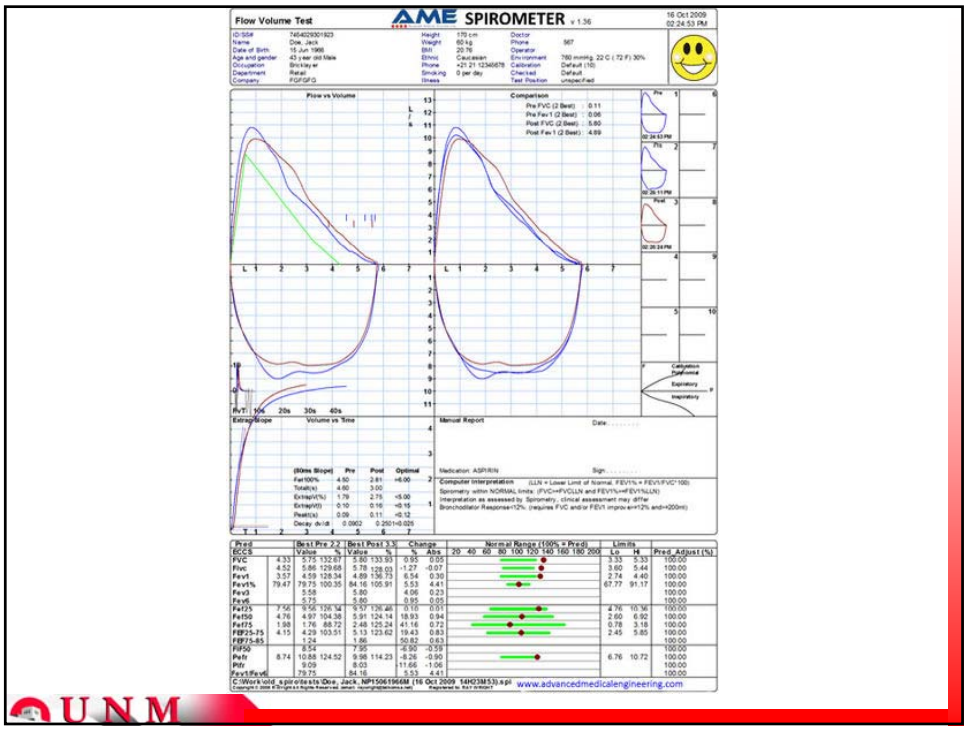
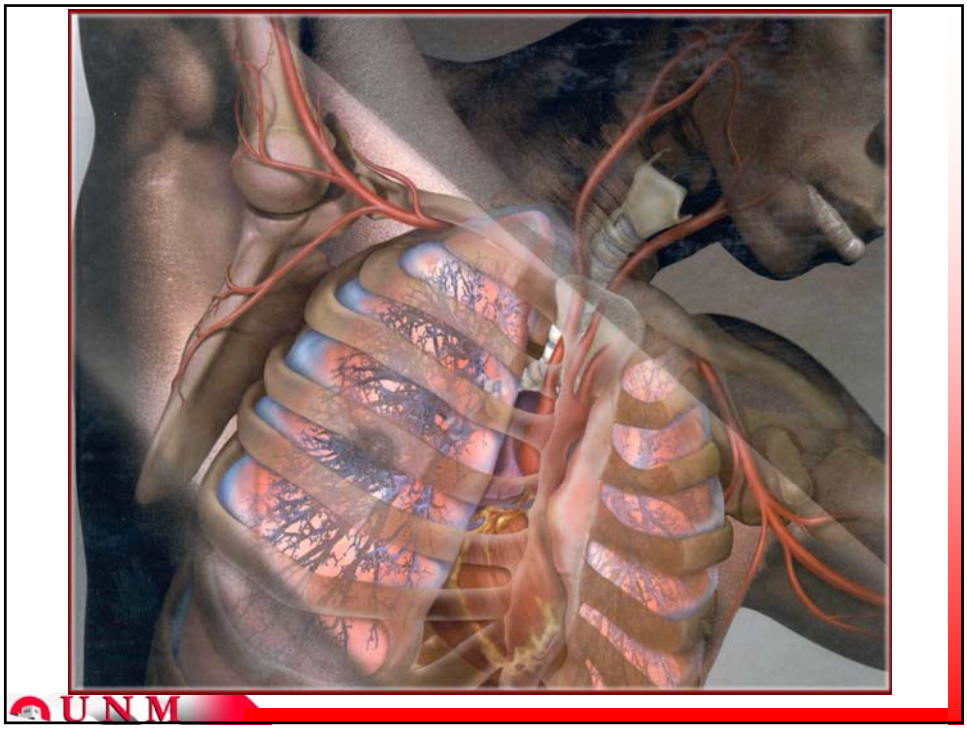
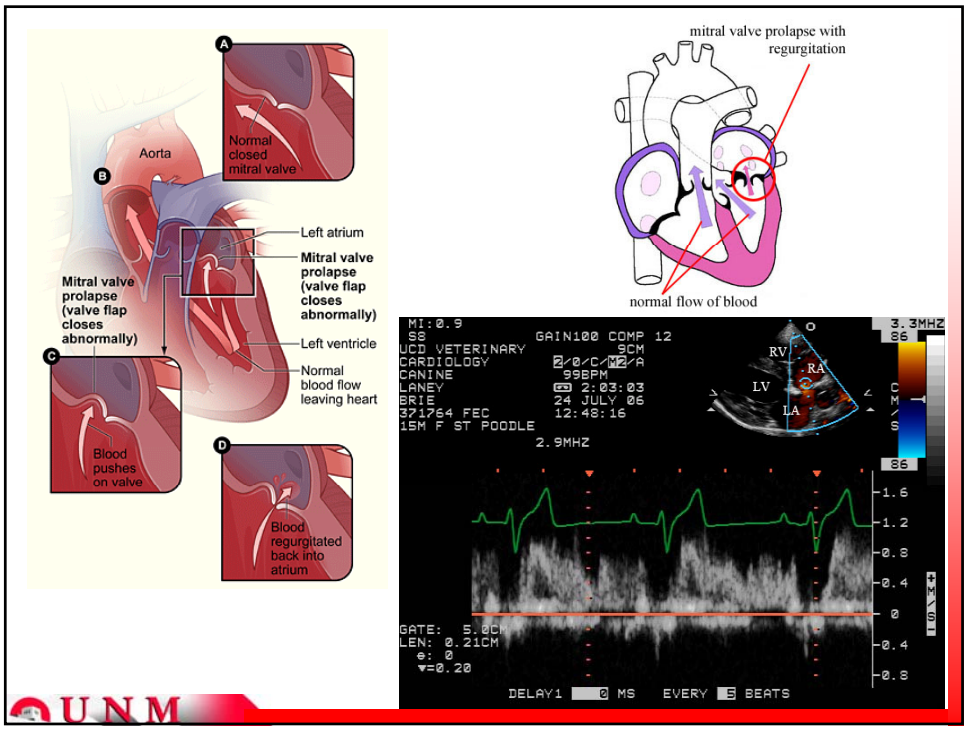
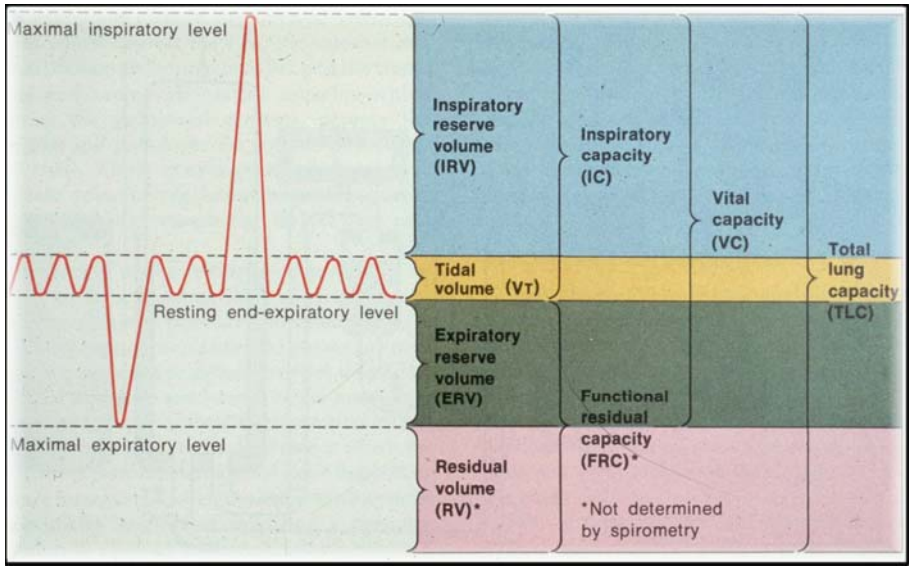

Flow Volume Test
AME SPIROMETER
UNM
www.advancedmedicalengineering.com




A
Normal closed mitral valve
Aorta
B
Left atrium
Mitral valve prolapse (valve flap closes abnormally)
Left ventricle
Normal blood flow leaving heart
Mitral valve prolapse (valve flap closes abnormally)
C
Blood pushes on valve
D
Blood regurgitated back into atrium
mitral valve prolapse with regurgitation
normal flow of blood
RV
RA
LV
LA
2.9MHZ
DELAY1 0 MS EVERY 5 BEATS

Lung Volumes and Capacities



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