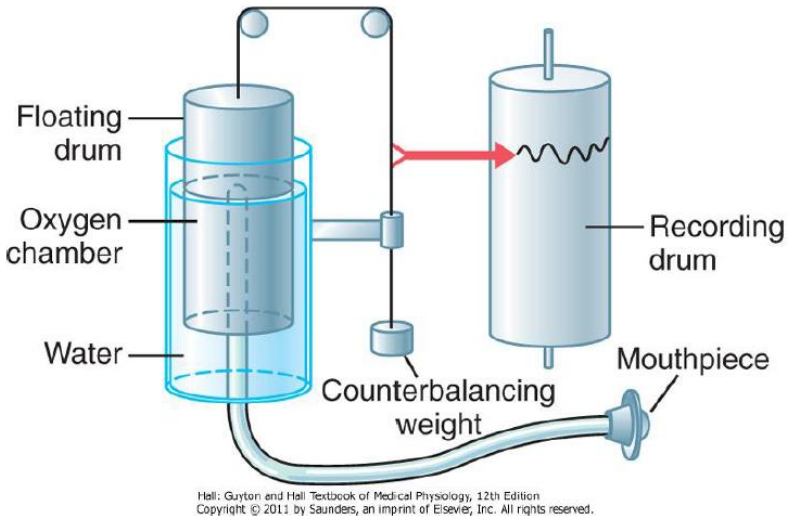
Physiology lab (RS)

** Objectives :-

1. Spirometry in general .
2. Spirogram (volumes and capacities) .
3. The importance of vital capacity in diagnosis .
4. Flow volume loop .
5. Miss Arwa's part (the practical part) .

First : Spirometry .

In the past we used an old spirometer ,but nowadays we're using the new digital device with different mechanism. However we're going to study about the old one in order to know the principles used to draw the spirogram .



A typical basic spirometer (the old device) consists of a drum inverted over a chamber of water. In the drum there is a space usually filled with atmospheric air; and it's connected to the lungs by closed system. The drum is connected to a recording pin .

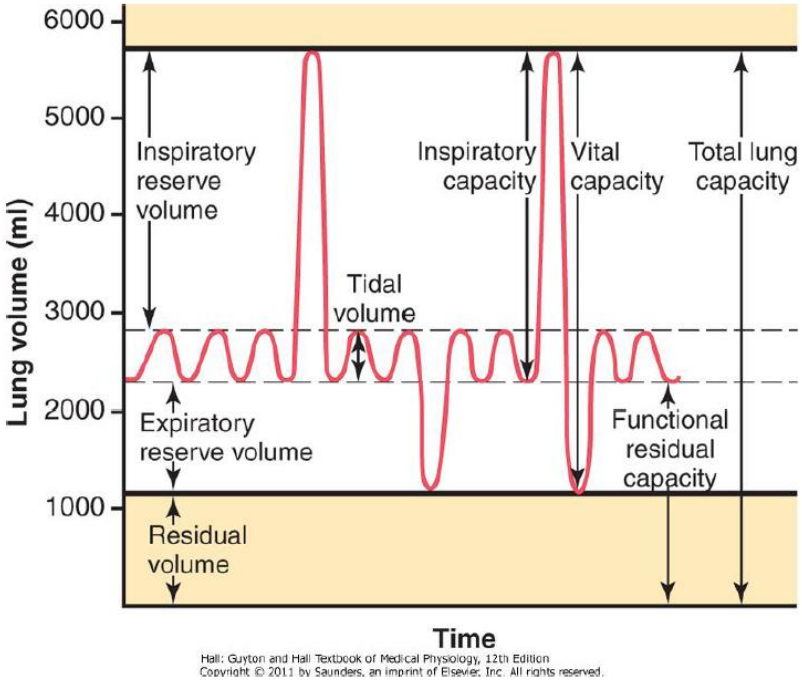
So once you have:

1. Inspiration → the space will decrease → and the pin will go up .
2. Expiration → the space will increase → and the pin will go down .

And then we'll get a graph, which we call it "spirogram" .

Second : Spirogram, volumes and capacities .

*spirogram: A graph of respiratory movements made by the spirometer.



- If you ask the patient to inhale and expire normally ,i.e normal respiration, the device will record the Vt (**Tidal volume**: volume changing during normal respiration either during normal inspiration or normal expiration) .
- If you ask the patient to take deep inspiration the device will record the IRV (**Inspiratory reserved volume**: Volume that can be inspired deeply beyond normal inspiration) .
- If you ask the patient to patient to expire forcefully we're getting the ERV (**Expiratory reserved volume**: amount of air that can be expired forcefully after normal expiration) .

** The question now: Is the volume after maximal expiration equal zero?
NO! we still have **Residual volume** (RV) .

- If we add 2 or more volumes together we are getting **capacities .**
  1. The sum of everything → total lung capacity (TLC) .
  2. The sum of IRV, ERV, Vt → we are getting vital capacity (VC) .

3. The sum of ERV, RV → we are getting functional residual capacity (FRC) (important) .
4. The sum of IRV, Vt → we are getting inspiratory capacity (IC) .

*** **REMEMBER** any capacity that include **RV can't be measured by spirometry** (we can't measure TLC or FRC) .

So we measure these capacities by dilution by allowing the patient inhale for example helium .

helium dilution technique is the way of measuring **the functional residual capacity of the** lungs .
We bring closed system (amount before = amount after) with known amount of helium (known volume and concentration) and ask the patient to breathe in, the new volume will be FRC and the V before breathing so we calculate FRC by this equation:

$C1 \times V1 = C2 \times V2$

$C1 \times V1 = C2 \times (V1 + FRC)$

$FRC = ((C1 \times V1)/C2) - V1$

Here the doctor's voice wasn't so clear -.- he talked about the method in a brief way and then he said he don't want to go into so many details .

<u>Third:</u> The importance of vital capacity in diagnosis:

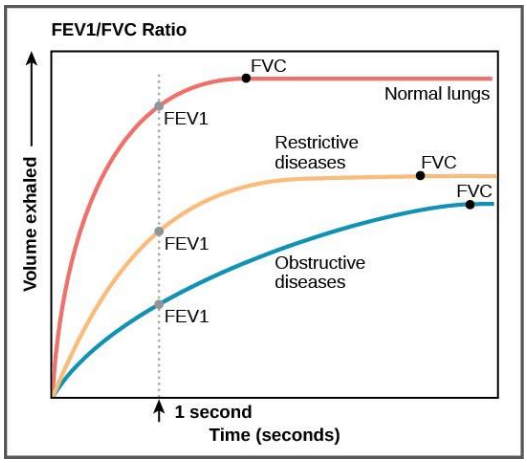
- What is the importance of knowing the vital capacity? It helps us in diagnoses .

  ➔ Normally vital capacity around 4.5 L .

  Cases:
  Patient with vital capacity= 2.5 L
  No expansion of the lung or the patient can't expire all of the air during expiration
  →This is restriction of the lung (restrictive lung diseases)
  <u>So whenever you see reduced vital capacity then the patient has restrictive lung disease .</u>

  <u>* Causes of restriction:</u>
  1. Related to lung tissue .
  2. Related to the chest cage itself .
  3. Transitional (the doctor said something but the voice wasn't clear -.-" I think it's not that important :3) .

  Now we'll be specific and concentrate only about the amount of air that will be expired forcefully after deep inspired in the 1st second .
  And we call it **FEV1 .**



The x axis (time) the y axis (volume) .
So we take the volume which was expired during the 1st second and usually it's about **80% of vital capacity** (forced vital capacity) .

➔ **<u>The ratio FEV1/FVC = 80% normally .</u>**

** But what if the ratio was 50%?
It means the patient has obstructive lung disease (during expiration→ higher resistance → longer time to expire → less volume expired in the 1st second so the ratio will decrease) .

➔ **once you see the ratio very low → obstruction lung disease .**

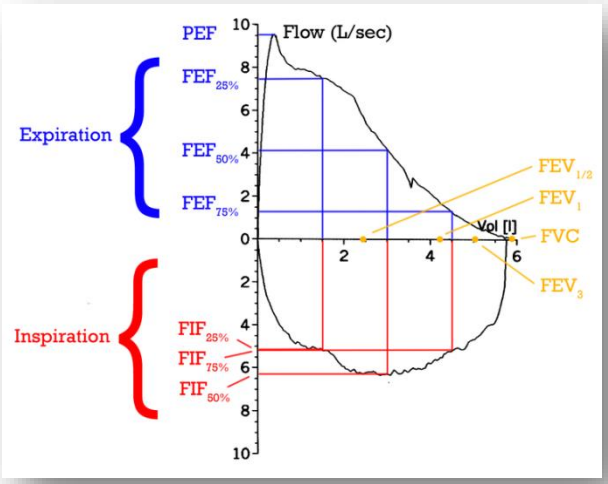
<u>** Mixed conditions:</u>
Vital capacity is reduced at the same time ratio also reduced .
For ex: VC was 2.5 but what that patient did by forced expiration was 40% → this happens in a condition called emphysema (RV increase) .

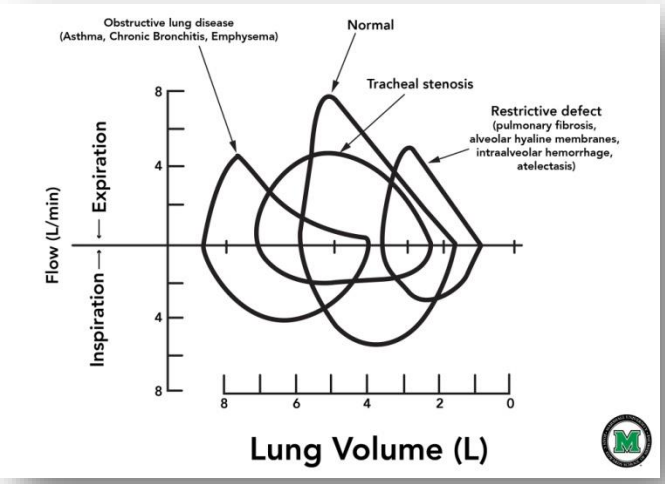
How that shifting happens?
That starts with obstruction. So the expiration is facing higher resistance → more volume in lungs → expansion of the lung → VC decrease .
Now, depending on the size of obstruction in this case, you may see it as restrictive .

➔ If the size of obstruction is severe → you're finding constrictive and restrictive .
➔ If the obstruction is not severe → inflation of the chest, increasing in the residual volume, reduction in vital capacity, FEV1/FVC maybe 80% or more .

<u>Fourth:</u> Flow volume loop:

- Now, what we use in labs are the new devices with different mechanisms. First they record the graph upside down so:
  ➔ Inspiration :down ➔ Expiration: up





This is called flow volume loop which is drawn by the digital spirometry (x axis: volume while y axis: flow) and all we have to know the FVC and FEV1 .

- During expiration:
  - ➔ Normal lung: At the beginning the rate was very high and then by time it's reduced .
  - ➔ Restrictive lung: the VC is reduced (note the picture on the right) .
  - ➔ Obstructive lung: flow is slower thus lower curve (note the picture on the left) → note that the curve is concave (normally it's straight line) .

** We can diagnose from these loops, for example if obstruction; is this obstruction outside the trachea; maybe the thyroid gland is pressing over the airways and the patient is getting obstruction. Or laryngeal problems inside the airways .

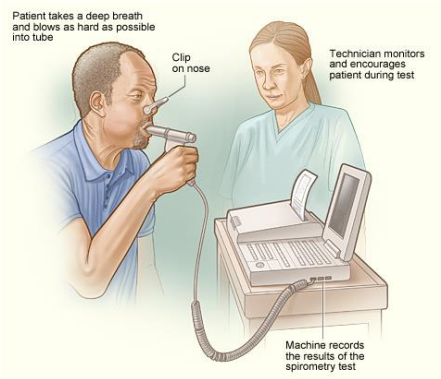
** The doctor won't ask us about diagnosing all the problems from this loop. But maybe Dr. Yanal will ask about it in the theory exam :3

** remember:

- ➔ Restrictive diseases: reduced vital capacity but normal ratio .
- ➔ Obstructive diseases: normal vital capacity but reduced ratio .
- ➔ Sometimes a patient comes to the clinic with mixed condition so he will have reduction in both vital capacity and ratio .

Fifth: Miss Arwa's part: (the practical part)

1. Enter the patient ID (name, age, gender, population, height, weight) .
2. Ask the patient to take normal respiration .
3. Ask him to put the mouth piece (disposable) in his mouth and make sure that there is no space between the piece and his lips. Then close his nose by a nose clip. (closed system) .
4. Ask him to inspire and expire slowly for 3 times .
5. Then ask him to inspire slowly → expire fastly → inspire fastly .
6. Print the result .
   ** Note the FEV1 .
   ** The new digital device will write at the bottom of the paper if the patient have restrictive or obstructive lungs .
   ** You can't do this test for :-
   1. Children <6 years old .
   2. Patients with asthma (give them bronchodilators first) .



Done by: Lina F.Khatib
Sorry for any mistake ☺
Special thanks for Omyma Al Otoom :3
" Always laugh when you can, it's cheap medicine" – Lord Byron :D