

Respiratory System – Breathing and Ventilation

Dr. John Campbell, *Respiratory System 2, Breathing and ventilation*, 14.09.2015 [dostęp: 30.09.2023]. Dostępne w Internecie: https://www.youtube.com/watch?v=MfKSOL_zFO0

I. Answer the questions:

1. What do you understand by the term 'mechanics of breathing'?

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2. What respiratory structures are involved in the process?

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II. Listen to dr John Campbell's description of the mechanisms governing the act of breathing and make a diagram/notes:

https://www.youtube.com/watch?v=MfKSOL_zFO0

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III. Study the script below and match the words in bold with the following definitions:

1. _____ (n.) – the state of being deprived of oxygen, with the result similar to suffocation
2. _____ (n.) – a hollow space in an organ or body part
3. _____ (n.) – the major muscle of respiration located below the lungs
4. _____ (adj.) – shaped like a hemisphere or inverted bowl
5. _____ (n.) – breathing out air
6. _____ (v.) – become flat
7. _____ (n.) – breathing in air
8. _____ (adj.) – running between the ribs
9. _____ (adj.) – occurring within the lungs
10. _____ (n.) – a group of atoms linked together by sharing electrons in a chemical bond
11. _____ (adj.) – involving backward movement
12. _____ (n.) – the amount of space, measured in cubic units that an object or substance occupies

Let's think now about how air is getting in and out of the lungs. And this is vital for us to understand so we can rectify it when it goes wrong because A & B – airway and breathing of course, are our clinical priorities.

So if you put your hands on your chest for me like that, take a breath in, I think you can see that your hands move up and out when you are breathing. If you put your hand on your tummy and take a deep breath in, I think you can see that your hand moves out. So to facilitate inspiration, breathing in, the chest wall moves up and out and the **diaphragm** moves down. [...] Now, what actually happens, for the ribs to go up and out, is the external intercostal muscles contract, and that pulls the ribs up and out. And the reason your tummy goes out the way is because the diaphragm goes down the way pressing on the abdominal contents. So **inspiration** is ribs up and out, diaphragm down. As the diaphragm goes down that moves the tummy up the way. [...] We have two sets of **intercostal** muscles, the external intercostal muscles on the outside, and the internal intercostal muscles on the inside. Now to breathe in, the external intercostal muscles contract, and that brings the ribs up and out, it's an active muscular contraction. And to breathe in, the muscle of the diaphragm also contracts, and when the muscle of the diaphragm contracts, what the diaphragm does is it flattens, it moves down the way and **flattens**. So when the diaphragm is **domed** up the way, it's relaxed. When it contracts to facilitate inspiration, it moves down and flattens, and as the diaphragm moves down, it is pressing on the abdominal contents. And 75% of respiratory effort is facilitated by the diaphragm. That's why if people have someone sitting on their tummy, or there is some rubble, for example, on this tummy, or after a road traffic accident, and they can't move the abdominal wall out the way, that stops the movement of the diaphragm down the way and that can actually be a cause of **asphyxiation**. To be able to breathe freely you have to be able to move your chest and your abdominal wall, you need both. So external intercostal muscles are contracting, bringing the ribs up and out, diaphragm going down.

So to breathe in: it's ribs – up and out; diaphragm – down. Now, both of these will increase the **volume** of the thoracic **cavity**. So if you think about me, if the ribs move up and out, so instead of being there [sound of breathing in], they are now out there, and the diaphragm instead of being domed up when I breathe in, is now flattened. So on this diagram what we have is the chest wall is further out now and the diaphragm is now flattened. Can you see that both of these effects are going to increase the volume of the chest? So ribs up and out, diaphragm down, therefore the volume has increased. And when you increase the volume, if you have the same number of air **molecules** in the lungs, the air molecules have now got more space to move around. Therefore, when you increase the volume, you decrease the pressure. So the increase in volume of the thoracic cavity is going to decrease the **intrapulmonary** pressure, the pressure inside the lungs. [...] As a result, air will come into the airway, down the airways, into the lungs, to equalise the pressure. So the movements of the thoracic wall and diaphragm are going to increase the volume, therefore decrease the pressure. [...] So we can see the air is sucked into the lungs by generating negative intrapulmonary pressures. So we are negative pressure ventilators.

In you at the moment, when you're relatively relaxed and not exercising, **expiration** is just a passive **recoil** process. So the external intercostal muscles will relax, and that allows the chest wall to fall down and in. And when the diaphragm relaxes, the diaphragm goes up when it relaxes. So to expire, to breathe out, ribs go down and in, diaphragm goes up, into the domed position, because in the domed upward position the diaphragm is relaxed. And both of these effects – the downward movement of the chest wall, the upward movement of the diaphragm – is going to reduce the volume in the thoracic cavity. The volume will now be reduced. If the number of air molecules is the same and we have reduced volume, that means each air molecule has less space to move around, therefore, the pressure will be increased. The pressure of the air inside the lungs now is going to be greater than the external atmospheric pressure. And as a result of that, the air will be blown out of the lungs.

So inspiration is facilitated by reducing the pressure, sucking air in; expiration is facilitated by increasing the pressure, blowing air out. So remember: air is sucked in but blown out.

IV. Complete the two sentences with: in/out, up/down

During inspiration the ribs go _____ and _____, and the diaphragm goes _____.
During expiration the ribs go _____ and _____, and the diaphragm goes _____.

V. Work with a partner. Take turns describing inhalation and exhalation in more detail focusing on what happens with the diaphragm, ribs, intercostal muscles, and lungs. Use the following verbs to describe the processes:

expand/ flatten
raise/ lower
contract/ relax
inflate/ deflate
increase/ decrease

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