

## No 8 BREATHING

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1. Today is the last talk of the term. I think it would be useful to use it to do a quick review of the question of breathing.
2. Breathing is the most important thing we do and we are naturally adapted to doing it properly, efficiently and effortlessly. We start to do it within moments of being born; we continue to do it whether we are stupid or clever. We do it in our sleep. The only time we stop doing it is when we are dead.
3. But one of the side-effects of our intelligence is that, unlike the rest of the animal kingdom, we are able to interfere with this wholly instinctive breathing process. That is something that can cause us a surprising number of problems.
4. First the basic physiology of breathing. What happens is that the air is taken in through our nose or mouth, down through the pharynx (the throat) to the trachea (the windpipe) and into the bronchi which lead into the lungs.
5. Once inside the lungs, the bronchi divide into smaller bronchioles which lead into tiny little air sacs called alveoli – a single one is called an alveolus. There are about 300 million of them in the lungs. The lungs are like sponges, filled with very tiny air-spaces.
6. The air we breathe is a mixture of colourless odourless gases. The main one is nitrogen which accounts for 78 percent of the volume; next comes oxygen which accounts for 21 percent; that is 99 percent of the total.
7. The remaining 1 percent is divided between water vapour, small amounts of helium and other gases including carbon dioxide. Although it is the cause of global warming, the carbon dioxide content of the air is just three hundredths of a percent (.03%).
8. Most of what we breathe is nitrogen which is a more or less inert gas. There are little bugs in the soil which can turn it into plant fertiliser but it does nothing directly for us.
9. Oxygen is another matter. It is essential to the functioning of all the organs in the body. If the brain is deprived of it, for more than a few minutes irreversible damage usually occurs.
10. The muscles use it to provide the energy they need to do their work. Without it, the heart stops.

11. As the various organs use the oxygen, they produce waste products. The main one of these is carbon dioxide.
12. It is the blood which does the job of bringing the oxygen to all the bits of the body and collecting the waste material.
13. When the air is drawn into the alveoli in the lungs, what is known as a gas-exchange takes place. The red cells in the blood surrounding the alveoli absorb oxygen from the fresh air coming in and give up the carbon dioxide they have accumulated in their way round the body.
14. The out-breath has 4-5 percent carbon dioxide and a corresponding decrease in the amount of oxygen it contains.
15. From the lungs the oxygen-enriched blood goes to the left chamber of the heart. The heart then sends it round the body via the arteries. At this stage, it is bright red.
16. When the blood has done its job of giving up its oxygen to the body's organs and picking up to their waste carbon dioxide it is returned by the veins to the right side of the heart where it is pumped back into the lungs and the cycle begins again.
17. At this stage, the blood has changed colour and turned a much darker red.
18. Next let us look at the mechanics of breathing. The in-breath involves expanding the thoracic area and the out-breath involves contracting it. The two most important elements in this process are the ribs and the diaphragm.
19. The ribs first. They are fixed into the spinal vertebrae but they have a certain amount of freedom to rotate up and down. The common analogy is with the handle on a bucket. When the ribs come upwards towards the horizontal, the volume they enclose is increased and the air comes in. When they go back down, the volume is decreased and the air goes out.
20. The other major element in breathing is the action of the diaphragm. The diaphragm is a more or less dome-shaped sheet of muscle and connective tissue separating the thoracic cavity from the abdomen. When the diaphragm tightens, it flattens downwards.
21. In normal breathing, two things happen together. The diaphragm flattens at the same time as the ribs are folding upwards so that both are contributing to the increase in volume in the thoracic cavity.

22. The lungs more or less fill the thoracic cavity and are attached to it by the pleural membrane. That means that when the thoracic cavity expands, so do the lungs and the air flows into them.
23. In the out-breath, the ribs are folding downwards and the diaphragm is relaxing and moving upwards, both of which are decreasing the volume of the thoracic cavity.
24. This the outline of what happens but it is actually quite complex. When I was preparing this talk, I looked up breathing in the recent edition of Gray's Anatomy.
25. It says: *In summary, breathing is a complex and highly orchestrated neuromuscular activity, about which there is still much to be learned. That knowledge is unlikely to be acquired by the study of individual muscles in isolation.*<sup>1</sup>
26. Orchestrated is a good word for what is going on.
27. Our rate of breathing changes greatly depending on what we are doing. The sort of gentle kind of breathing that happens when we are relaxed or sleeping is called tidal breathing. This happens between 12-16 times a minute.
28. When we are breathing in this way the air usually comes in through the nose. This is much kinder to the lungs because as it passes through the nasal passage the air is warmed and dust and other pollution are filtered out.
29. When we are exercising, the body needs more oxygen and our breathing rate becomes more rapid. It can go up 80 times a minute in vigorous exercise. Depending on our level of activity, we take about 25 000 breaths per day. That is about 9 million breaths per year.
30. Although breathing comes completely naturally, as I mentioned earlier, we are able to interfere with it in a wide variety of ways. Playing various wind instruments, scuba diving, blowing up balloons for the party, or singing Wagner all require special breathing techniques.
31. This ability to breathe in a large variety of ways other than nature intended in addition to enabling us to widening our scope of activity can also bring problems.
32. You remember I said the blood takes up oxygen and gets rid of carbon dioxide in the lungs. If we interfere with our

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<sup>1</sup> Williams (1995) p819

breathing so that the gas exchange does not take place as it should, we run the risk of altering the chemical composition of the blood.

33. One of the rather surprising ways we can do this is by getting into the habit of over-breathing, in other words breathing faster or deeper than we need. Technically, this is known as hyperventilation
34. One of the physiological effects of such over-breathing is that it increases the amount of carbon dioxide expelled with each breath. We often think of hyperventilation as a kind of panicky gasping but it does not need to be particularly dramatic to cause quite serious problems.
35. Carbon dioxide makes the blood slightly acidic which is the way it should be. If we over-breathe, this reduces the amount of carbon dioxide in the blood and makes it more alkaline. This brings about a condition known as alkalosis. It is also known as hypercapnia.
36. One of the effects of alkalosis is that it triggers the classic “fight or flight” symptoms.<sup>2</sup> It leads to the anxiety and tension we feel when we are in danger. If it goes on for a long time, it can lead to hand trembling, numbness or tingling in the face or extremities, dizziness and so forth.
37. As AT teachers we tend not to have to deal with acute cases of hyperventilation. But it is wise to be aware of the cumulative effects of slightly disordered breathing.
38. If we are getting every breath even slightly wrong, so that the gas-exchange in our lungs is not happening quite as it should, the cumulative effect over days and months and years can be quite big.
39. And the fact that we are repeating the breathing process about 9 million times a year means any bad breathing habits we develop can become pretty deeply engrained. Over time, people become completely unaware of what they are doing and the problems they are creating for themselves.
40. It is also worth remembering that breathing was very much a concern of Alexander’s and it was as a promoter of respiratory re-education that he first made his name.

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<sup>2</sup> Lum (1981) p3 This paper has a comprehensive discussion of hyperventilation and its consequences

41. He never wavered in his belief in the importance of breathing properly. When he published MSI, Part III consisted of a reprint of a pamphlet he first published in 1907 entitled *The theory and practice of a new method of respiratory education*. You find him coming back to the same theme at various places in his last book, CCCI.
42. Alexander was particularly scathing about “breathing exercises” and what he called “sniffing”. This is often associated with deep breathing and is a result of tightening up the nostrils when we are drawing in the air.
43. If we ask someone to take a deep breath, we almost invariably find they tighten their chest muscles, which prevents their thorax from expanding. They also tighten their stomach muscles which prevents the diaphragm from descending and increasing the volume of the thoracic cavity.
44. If they also tighten their nose and face muscles which constricts the air passages and reduces the inward flow of air through them. The sniffing we hear is the air-flow being constricted.
45. The overall effect of “trying” to take a deep breath is to set up the conditions under which we use maximum effort to take a breath which is considerably shallower than we would do if we were not thinking about it. Yes, we are taking air in, but we are making it as hard as we can for ourselves and achieving less than if we took a normal breath. One of the results of “deep breathing” is that it can leave us gasping for air and hyperventilating.
46. Where does this leave us as AT teachers? The first thing is we do not teach people directly how to breath properly. As Walter Carrington used to say, if you are doing anything about your breathing, you are probably making it worse.
47. We leave the specialist forms of breathing to those who know about them. If we can get people able to calm down and allow their tidal breathing to happen as it should we have provided them with the baseline to which they automatically return when they have finished the specialised forms of breathing they have to use for their Wagner singing, tuba playing or other specially demanding activities.
48. Our aim as AT teachers in the area of breathing, as in so much else, is to stop doing the wrong things so as to give the

right thing a chance to happen. In the case of breathing, there is quite a good chance it will.

## **References**

- L. C. LUM (1981) *Hyperventilation and anxiety state* - Journal of the Royal Society of Medicine, Vol 74 January
- P. L. WILLIAMS.(1995) *Gray's Anatomy* Churchill Livingstone Edinburgh