Use of Breathing Devices

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Excerpted from
Arnold Jacobs: *Song and Wind*

With a teaching career spanning seven decades, Arnold Jacobs commented, "The most common problems I have seen over the last sixty-odd years I have been teaching are with respiration and the tongue. Surprisingly enough, I rarely find problems with the embouchure. That might sound strange because people come to see me because of problems with their embouchure, but frequently it is the embouchure reacting to a bad set of circumstances and failing--it is simply cause and effect. If we change the cause of the factor, it is easy to clear up the embouchure. The embouchure is not breaking down, it is trying to work under impossible conditions. When you are starving the embouchure for air volume, giving it all sorts of air pressure but not quantity, it cannot work. Very quickly you will be struggling to produce your tone. Just increase your volume of air not by blowing hard, but by blowing a much thicker quality of air. Very frequently the air column is just too thin."

When a student came to Jacobs, he always asked them their age, height and weight. Through experience, he determined their vital capacity [the amount of lung tissue with the physical capability of holding a certain volume of air]. Total lung capacity cannot be increased beyond what nature grants to a particular body. Only the elasticity of the lung tissue or chest wall can be increased.

The following charts based on a formula from the American Thoracic Society can determine an estimate of a person's vital capacity [in liters] based on height, age and gender.

	20	25	30	35	40	45	50	55	60	65	70	75	80
4'	1.8	1.8	1.7	1.7	1.6	1.5	1.5	1.4	1.3	1.2	1.1	1.0	0.9
4' 1"	1.9	1.8	1.8	1.7	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.0
4' 2"	2.0	1.9	1.9	1.8	1.7	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.0
4' 3"	2.1	2.0	1.9	1.9	1.8	1.7	1.6	1.5	1.5	1.4	1.3	1.1	1.0
4' 4"	2.1	2.1	2.0	1.9	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1
4' 5"	2.2	2.2	2.1	2.0	1.9	1.9	1.8	1.7	1.6	1.5	1.4	1.2	1.1
4' 6"	2.3	2.2	2.2	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2
4' 7"	2.4	2.3	2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.3	1.2
4' 8"	2.5	2.4	2.3	2.3	2.2	2.1	2.0	1.9	1.8	1.6	1.5	1.4	1.2
4' 9"	2.6	2.5	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.6	1.4	1.3
4' 10"	2.7	2.6	2.5	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.6	1.5	1.3
4' 11"	2.8	2.7	2.6	2.5	2.4	2.3	2.2	2.1	1.9	1.8	1.7	1.5	1.4
5'	2.8	2.8	2.7	2.6	2.5	2.4	2.3	2.1	2.0	1.9	1.7	1.6	1.4
5' 1"	2.9	2.9	2.8	2.7	2.6	2.5	2.3	2.2	2.1	1.9	1.8	1.6	1.5
5' 2"	3.0	3.0	2.9	2.8	2.7	2.5	2.4	2.3	2.2	2.0	1.9	1.7	1.5
5' 3"	3.1	3.1	3.0	2.9	2.7	2.6	2.5	2.4	2.2	2.1	1.9	1.7	1.6
5' 4"	3.2	3.2	3.1	2.9	2.8	2.7	2.6	2.4	2.3	2.1	2.0	1.8	1.6
5' 5"	3.3	3.2	3.1	3.0	2.9	2.8	2.7	2.5	2.4	2.2	2.0	1.9	1.7
5' 6"	3.4	3.4	3.2	3.1	3.0	2.9	2.7	2.6	2.4	2.3	2.1	1.9	1.7
5' 7"	3.6	3.5	3.3	3.2	3.1	3.0	2.8	2.7	2.5	2.3	2.2	2.0	1.8
5' 8"	3.7	3.6	3.4	3.3	3.2	3.1	2.9	2.8	2.6	2.4	2.2	2.0	1.8
5' 9"	3.8	3.7	3.5	3.4	3.3	3.1	3.0	2.8	2.7	2.5	2.3	2.1	1.9
5' 10"	3.9	3.8	3.7	3.5	3.4	3.2	3.1	2.9	2.7	2.6	2.4	2.2	1.9
5' 11"	4.0	3.9	3.8	3.6	3.5	3.3	3.2	3.0	2.8	2.6	2.4	2.2	2.0
6'	4.1	4.0	3.9	3.7	3.6	3.4	3.3	3.1	2.9	2.7	2.5	2.3	2.1
6' 1"	4.2	4.1	4.0	3.8	3.7	3.5	3.4	3.2	3.0	2.8	2.6	2.3	2.1
6' 2"	4.3	4.2	4.1	3.9	3.8	3.6	3.4	3.3	3.1	2.9	2.6	2.4	2.2
6' 3"	4.5	4.3	4.2	4.0	3.9	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.2
6' 4"	4.6	4.4	4.3	4.2	4.0	3.8	3.6	3.4	3.2	3.0	2.8	2.5	2.3
6' 5"	4.7	4.6	4.4	4.3	4.1	3.9	3.7	3.5	3.3	3.1	2.9	2.6	2.3
6' 6"	4.8	4.7	4.5	4.4	4.2	4.0	3.8	3.6	3.4	3.2	2.9	2.7	2.4
6' 7"	4.9	4.8	4.7	4.5	4.3	4.1	3.9	3.7	3.5	3.3	3.0	2.7	2.5
6' 8"	5.1	4.9	4.8	4.6	4.4	4.2	4.0	3.8	3.6	3.3	3.1	2.8	2.5
6' 9"	5.2	5.0	4.9	4.7	4.5	4.3	4.1	3.9	3.7	3.4	3.2	2.9	2.6
6' 10"	5.3	5.2	5.0	4.8	4.6	4.4	4.2	4.0	3.8	3.5	3.2	3.0	2.7
6' 11"	5.5	5.3	5.1	5.0	4.8	4.6	4.3	4.1	3.9	3.6	3.3	3.0	2.7
7"	5.6	5.4	5.3	5.1	4.9	4.7	4.4	4.2	3.9	3.7	3.4	3.1	2.8
7' 1"	5.7	5.6	5.4	5.2	5.0	4.8	4.5	4.3	4.0	3.8	3.5	3.2	2.9
7' 2"	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.4	4.1	3.9	3.6	3.3	2.9

*Estimated vital capacities for **females** in liters. Follow height (in left column) and age (at top, in five year increments). Based on a formula from the American Thoracic Society*

	20	25	30	35	40	45	50	55	60	65	70	75	80
4'	2.1	2.1	2.0	2.0	1.9	1.8	1.8	1.7	1.6	1.5	1.4	1.3	1.2
4' 1"	2.2	2.2	2.1	2.1	2.0	1.9	1.8	1.8	1.7	1.6	1.5	1.4	1.3
4' 2"	2.3	2.3	2.2	2.1	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3
4'3"	2.4	2.4	2.3	2.2	2.1	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4
4' 4"	2.5	2.4	2.4	2.3	2.2	2.2	2.1	2.0	1.9	1.8	1.7	1.6	1.4
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5'	3.3	3.3	3.2	3.1	3.0	2.9	2.8	2.6	2.5	2.4	2.2	2.1	1.9
5' 1"	3.4	3.4	3.3	3.2	3.1	3.0	2.8	2.7	2.6	2.4	2.3	2.1	2.0
5' 2"	3.6	3.5	3.4	3.3	3.2	3.1	2.9	2.8	2.7	2.5	2.4	2.2	2.0
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6' 7"	5.8	5.6	5.5	5.3	5.2	5.0	4.8	4.6	4.3	4.1	3.8	3.6	3.3
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6' 10"	6.2	6.1	5.9	5.7	5.6	5.4	5.1	4.9	4.7	4.4	4.1	3.9	3.6
6' 11"	6.4	6.2	6.1	5.9	5.7	5.5	5.3	5.0	4.8	4.5	4.2	4.0	3.7
7'	6.5	6.4	6.2	6.0	5.8	5.6	5.4	5.2	4.9	4.6	4.4	4.1	3.7
7' 1"	6.7	6.5	6.4	6.2	6.0	5.8	5.5	5.3	5.0	4.7	4.5	4.2	3.8
7' 2"	6.8	6.7	6.5	6.3	6.1	5.9	5.7	5.4	5.1	4.9	4.6	4.3	3.9
7' 3"	7.0	6.8	6.7	6.5	6.3	6.0	5.8	5.5	5.3	5.0	4.7	4.4	4.0
7' 4"	7.2	7.0	6.8	6.6	6.4	6.2	5.9	5.7	5.4	5.1	4.8	4.5	4.1
7' 5"	7.3	7.2	7.0	6.8	6.5	6.3	6.1	5.8	5.5	5.2	4.9	4.6	4.2
7' 6"	7.5	7.3	7.1	6.9	6.7	6.4	6.2	5.9	5.6	5.3	5.0	4.7	4.3

*Estimated vital capacities for **males** in liters. Follow height (in left column) and age (at top, in five year increments). Based on a formula from the American Thoracic Society*

To determine a person's actual vital capacity, a test is given to determine how much air [in liters] can be moved in or out of the lungs in a single breath. These tests are given on medical equipment such as a respirometer or spirometer. In 1982, Jacobs introduced to the music world the Voldyne®, an inexpensive medical device that can give an approximate reading up to five liters. There are two chambers--the larger [right] is to measure the air volume and the smaller [left] for air pressure.

To use, place the tube between the teeth over the tongue so as not to obstruct the air passageway. Inhale with a fast breath, keeping the ball in the pressure chamber as close to the top as possible. Watch the main chamber for the amount of air inhaled indicated by the top of the disk. There is a marker to manually mark the amount of air previously inhaled.

In hospitals, after determining both the estimated vital capacity [from the formulas] and the actual vital capacity [from pulmonary function testing], the ratio is reported. It is determined by dividing the actual capacity by the estimated capacity. If, for example, a person has an actual capacity of two liters and an estimated capacity of four liters, this person would have a capacity of 50 percent of normal. If there was an actual capacity of five liters and an estimated capacity of four liters, this person would have a capacity of 125 percent of normal. It is important to realize that wind musicians seem to have a higher than normal vital capacity.

Most wind players use less than one-half of their vital capacity when playing their instrument. Jacobs stated, "One of the difficulties, with men as well as women, is that the player rarely, if ever, uses all the usable air in their lungs. They may have a vital capacity of four-and-a-half liters, but that is not what they use. They use only a fraction of that capacity. A trained person might use 75 or 80 percent of their vital capacity, others will use half or less.

For those who are well under 100 percent of their normal capacity, Jacobs had the student put down their instrument. While teaching music, he divorced remedial function matters from the actual playing of the instrument, and used a variety of external devices away from the instrument, seeking to develop new habits of breathing and air usage with his students.

Since the early 1960's, Jacobs developed and used various gauges and other such devices to help the student. In 1982, he introduced to the music world some inexpensive devices that, for the first time, allowed the student to use their own equipment on a daily basis.

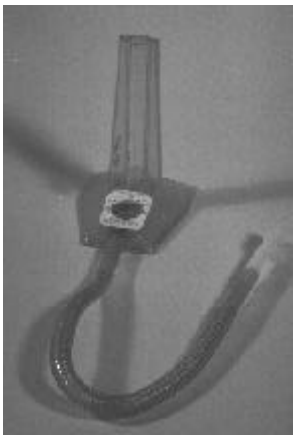
The simplest to use is the Breath Builder. Developed by Bassoonist Harold Hansen of Las Vegas, Nevada, the Breath Builder is a device used to feel the sensation of inhaling and exhaling. It is a tube of plastic [at least six inches tall] with a ping-pong ball inside. The bottom is sealed and the top has three holes drilled to vary the resistance.

To use the Breath Builder, place the tube between the teeth on top of the tongue. Next, get the ball to the top of the tube by either inhaling or exhaling, [which is easier]. Then hold the ball at the top of the tube while slowly inhaling and exhaling. The Breath Builder requires fourteen ounces of pressure to hold the ping-pong ball at the top of the column.

In use, visualize a string player bowing from frog to tip. Keep the motions of inhalation and exhalation as long as possible, increasing the length of the bow. Find the minimal function to keep the ball at the top. Look in the mirror and observe the body's motions to keep the wind moving with minimal effort. Exaggerate inhalation [expansion of the body] and exhalation [contraction of the body].

Next, lower the resistance by closing more of the holes on the top of the tube. Go for length of breath and

mentally increase the length of the imaginary string player's bow.



Another device Jacobs used is the incentive spirometer, or Inspiron [Inspirx®]. It is a device used in hospitals to give respiratory patients a visual demonstration of how much air they can inhale. While the instrument was designed for inhalation, if it is turned upside down, it can also be used for exhalation. There is a gauge to measure resistance, with the most open position providing the most resistance.

Place the tube between the teeth and on top of the tongue so as not to obstruct the air passage. With the gauge set to maximum resistance, inhale and move the ball to the top. If there is a problem, lower the resistance. Just before exhalation, turn the Inspiron upside down and when exhaling, move the ball to the top. Continue the inhalation/exhalation series.

Keep inhalations and exhalations as slow as possible and exaggerate. Next, lower the resistance and keep the cycles as long as possible. Reduce suction and control the ball. Observe the body motions in a mirror.

Another use of the inspiron is in conjunction with mouthpiece practice. Remove the large hose at the base, replace with a four-inch rubber hose, and place a mouthpiece in the other end. The Inspiron must be upside down [the exhalation position]. Adjust the resistance so the ball can remain in the up position while buzzing several notes on the mouthpiece. Imagine that the air supporting the ball is a fountain of water--its height will vary but it should not hit the bottom between notes. The object is to play throughout the range of the instrument while keeping the ball suspended. When moving into the high range any attempt to increase pressure while decreasing the rate of air flow will cause the ball to drop. One of the most important uses of the incentive spirometer is to teach the relaxed low pressure/high flow rate concept of playing.

With any of these devices, remember that oxygen is being breathed in and hyperventilation can easily occur. Do only three or four inhalation/exhalation cycles in a row. When dizziness starts, rest for a few minutes and let the oxygen content of the blood return to normal levels.

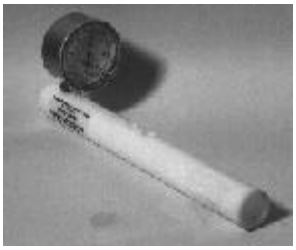
Using a five or six liter rubber bag, inhalation and exhalation can be practiced. Since the same air is breathed, carbon dioxide, rather than oxygen, is transferred avoiding hyperventilation.

Practice emptying and filling the lungs by slowly rebreathing air several times in a row. In this exercise the muscles of enlargement will learn to work apart from the muscles of reduction. It is important that the lungs go from extremes, empty to full. Rebreathing air from a breathing bag can be done repeatedly for about twenty seconds without discomfort.

An air bag can also be used as a rough gauge of a person's vital capacity. Another use is with an instrument. After a full inhalation, exhale into the bag filling it as much as possible. Hold the air in the bag with a finger over the tube. After positioning the instrument for playing inhale from the bag and start playing the instrument. The bag gives a visually known quantity of air.

Before Jacobs introduced these devices to the music world in 1982, he made several devices. As a part of the original studio (around 1960), Mr. Jacobs attached a compound gauge (for both inhalation and exhalation) to an aluminum pipe with holes drilled to vary resistance This is a tool that he used for decades and many of his students have desired this for use with their own students. Working with Mr. Jacobs, we developed the *Variable Resistance Compound Gauge* using a similar gauge developed for use by respiratory

technicians.



The gauge for the original cost over $300 (in 1960). The key to the reproduction was to make it affordable - the primary cost of this tool being the gauge. Rather than developing expensive molds or using computerized lathes, the pipe is hand-made of inexpensive but sturdy delrin. While not having the cosmetic perfection of more expensively produced pipes, this is just as functional at a fraction of the cost.

In the use of the gauge, inhalation should be emphasized for both air volume and time. First, cover the two largest holes and inhale and exhale until the meter shows 40 (inner dial) on both sides. Do this as slow as possible trying to maintain 40. After resting a few minutes (to avoid hyperventilation) cover the largest hole and one of the small holes. Inhale and exhale until the meter reads 20. Finally, the three smaller holes are covered, exposing the largest and the inhalation/exhalation cycle is repeated. Try to get the meter to 20. The key with these exercises is to concentrate on inhalation which should take as much time as possible before exhalation.

Now it is a good time to use the Voldyne® and check vital capacity again. There should be an improvement more towards the estimated vital capacity. At this point, exercise can continue or resume playing the instrument.

At this point, Jacobs commonly set the marker on the Voldyne® to the highest point the student previously reached. While they prepared their instrument, he would hold the Voldyne® while the student inhales through it to the set point. Often the improvement in the resulting sound is dramatic!

Unfortunately, A musical phrase does not make a distinction with the lung capacity of the performer. Two players require roughly the same amount of air to play a specific phrase on the same instrument. A smaller person with only a three-liter lung capacity would have to take a full breath to get what a larger colleague with a six-liter capacity gets in a partial breath.

Observing Mr. Jacobs in masterclasses finds that results vary from student to student. By taking in deeper breaths, longer phrases can result with a flute student playing the introduction Debussy's *Prelude to the Afternoon of a Fawn* on a single breath. The tubist can sustain low notes longer in Wagner's *Ride of the Valkyrie* or the trumpet player can have a larger, darker sound in the Promenade to Mussorgsky's *Pictures at a Exhibition*. For those who are questioning their embouchure, the additional air volume to fuel the lip's vibration could rapidly solve their problems. The most important results are from older players who have been life-long shallow breathers. With age, vital capacity diminishes and many are having problems. By developing full inhalations, the result is commonly adding years to their career.

For many, Mr. Jacobs recommends these breathing devices be used as a part of daily practice.

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