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An Evaluation of Aspects in the Applied Physiology of Brass Players

Marius Pheiffer PHFMAR001

A dissertation submitted in fulfillment of the requirements for the award of the Degree of
Master of Music

Faculty of the Humanities

University of Cape Town

2008

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Title:	Mr.	Student No:	PHFMAR001
Name, Surname:	Marius Pheiffer		
Postal address: (to which result can be posted)	PO Box 334 Rondebosch 7701		
Telephone No's:	021 787 1990		082 735 6713
Email address:	mpheiffer@webmail.co.za		
Dissertation Title:	An evaluation of aspects in the applied physiology of brass players.		
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Abstract

The study is based on the research of Arnold Jacobs, one of the most influential teachers and performers in the brass community. The first chapter gives a background and rationale to the study and a biography of Jacobs. The second chapter introduces the reader to concepts in anatomy and the physiology of brass players. The knowledge of anatomy is necessary to counter the misinformation circulating in the brass and musical community. One such topic is the notion of diaphragmatic support, one of the most misunderstood topics in brass playing. This dissertation tries to provide the correct anatomical information to the reader in order for him/her to make correct decisions with regard to efficient performance practice. The section also deals with other physiological processes, such as hyperventilation and the Valsalva Maneuver, the musician may encounter. The chapter concludes with a review of the literature relating to lung function in brass playing.

The third chapter gives an overview of some of the breathing exercises and tools that are available to the brass player, and also of advanced breathing beliefs, such as yoga. These exercises and tools provide a means for the musicians to train their respiratory systems away from their instrument. Chapter 4 provides the research methodology and the hypothesis used in this study. Standard lung function tests were performed at the South African Sports Science Institute. The subjects took part in two concurrent studies. One investigating fitness levels and hand grip strength in musicians. The other, the subject of this dissertation, compared lung function between brass players and musicians that do not require breath for sound production. The brass players were also compared to each other; players identified as "Ideal Players" were compared with the all brass players in Cape Town. Intra-oral pressure was also measured and compared between the two groups. The dissertation concludes with a presentation of the results and suggestions for further research.

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Chapter 1

Introduction

This study is interdisciplinary in nature, an attempt to combine musicology and science/physiology. On a macro scale the dissertation follows the standard scientific paper format of background information/ literature study – research methods – presentation of results and a discussion of the results. In the first section of this dissertation (chapters 1-3), I present the background information on various aspects related to the anatomy and physiology of brass playing, some of the breathing exercises and breath training tools available, and some of the mystic-philosophical aspects of breathing. These chapters conform to the Humanities concept of a literature review. In a purely scientific paper the background information would not be as detailed, as the reader would be expected to know of, or at least be familiar with most of the information. The background information may be used to highlight salient points relevant to that particular study. A writer in a physiology journal would not need to provide information on the anatomy of his subject as his audience will possess this knowledge already; s/he can address the experiment directly. There would also be no discussion of the philosophical thoughts behind the concepts. As of chapter 4 the scientific structure supersedes that of the humanities.

Chapter 1 provides the background and rationale for the study.

At the outset of my studies I was interested to know whether or not brass playing could be used as a complementary treatment for children with pulmonary disorders, particularly those suffering from asthma. There have been claims that this statement was true and seemed a common belief among laypersons. Some parents believe that learning a brass or woodwind would either cure the problem or, at the very least, that it would strengthen the respiratory structure.

Worldwide asthma affects 10% of children and is diagnosed in only 5% of adults¹. The prevalence of asthma world wide rises by 50% every ten years². Industrialized nations have a higher occurrence rate than rural countries, except in communities where

¹ Price et al. 2004: 9

² <http://www.asthma.ca/corp/newsroom/pdf/asthmastats.pdf>.

genetics have played a role³. In South Africa 14% of children are affected, up from 10% in the previous decade⁴.

Asthma is described as a chronic inflammatory disorder of the airways⁵. The inflammation causes a narrowing of the airway resulting in breathing difficulty; the characteristic wheezing and shortness of breath. This narrowing could be the result of mucus in the airway, a swelling of the lining of the airway, a spasm of the muscle in the walls of the airway or a combination of all three⁶. Asthma is a response to a wide range of stimuli, it responds well to treatment and is occasionally reversible⁷. The stimuli, also known as triggers; include allergens, exercise, environmental factors or psychological triggers. Allergens include reactions to animal residue such as fur, fungal spores and in particular dust mites. Non-allergens that trigger asthma include tobacco smoke and pollution from industrial areas⁸.

Price et al. claims that 'Exercise Induced Asthma' is a sign of a poorly treated condition⁹. An attack of 'Exercise Induced Asthma' usually presents after exercise is completed¹⁰. The attack will reach its peak in a few minutes but the sufferer will generally recover in about thirty minutes. There is a refractory period of two hours after which a patient can exercise further without suffering another attack¹¹.

Lane documents cases where perceived presence of allergens or particular situations triggered an attack¹². Lane also documents that when asthmatic children were removed from their parents to a school for asthmatic children, their condition improved¹³. There was improvement even though the children were exposed to the same amount of allergens at the school as at home. Tomatis has also observed that childhood asthma is often triggered by an overbearing mother¹⁴.

³ Lane, 1996: 126

⁴ Noble, 2007

⁵ Price et al. 2004: 9

⁶ Lane, 1996: 27 – 28

⁷ Price et al. 2004: 9

⁸ <http://www.asthma.ca/corp/newsroom/pdf/asthmastats.pdf>.

⁹ 2004: 47

¹⁰ Lane, 1996: 33

¹¹ Price et al. 2004: 47

¹² 1996: 27

¹³ Lane, 1996: 85 - 86

¹⁴ Kierman, 2008: personal communication.

Brass playing may be able to alleviate both the psychological and physical symptoms of asthma. Brass playing can build self-confidence and a sense of accomplishment, although playing one of the more aggressive instruments, such as the trumpet or the difficult horn, can just as easily break it down. Ben-Tovim and Boyd found that brass playing not only builds a healthy body but also provides a social outlet as brass players will almost always play in an ensemble of some sort¹⁵. Brass players have the reputation of being the 'social animals' among musicians. There are reasons why the University of Cape Town's Brass Department is, unofficially of course, known as the Brass Club. The only requirement for acceptance in the Club is the ability to play a brass instrument. Students from other faculties are often welcomed into the group. The Club also could be seen to extend to include all brass players in Cape Town, whether professional or amateur. The club has also included "honorary members", i.e. the odd woodwind player.

Prof. Neil White¹⁶ advised me that, to achieve scientific regard, the logistical implications of this study would render it impractical. The study group would have had to be statistically significant i.e. large. About 100 children would need to take part and commit to participate for the duration of the study. Each child would also need his/her own instrument and there would be a need for teachers. The control group and the study group would have to be about equal in number; they would have to be in a similar age range; and the two groups would have to be composed of similar numbers of males and females. They should also take the same medication. The only difference between the two groups should be that the participants in the study group play a brass instrument and the control group do not. With these restrictions in mind I have abandoned this study at this stage. I was advised to build on research already done, as this would serve as a stepping stone in my own research career. I therefore looked to the work of Arnold Jacobs, who laid the foundations of this genre of research in brass playing.

¹⁵ Ben-Tovim and Boyd. 1985: 62

¹⁶ Neil White (1954-2004) was an Assistant Professor at the UCT Lung Institute, with research interests that included; occupational asthma, asbestos-related lung disease and the radiological classification of pneumoconiosis. He was also an activist, particularly for mine workers' rights.

Arnold Jacobs: the man and his teachings

The modern school of brass playing relies heavily on the research done by Arnold Jacobs (1915 – 1998), an American tuba player and teacher. Jacobs was considered one of the finest orchestral tubists of the twentieth century. In addition to this he was also one of the brass fraternity's most respected teachers. Unfortunately Jacobs never published his research in the scientific literature and has only one paper published in the brass literature¹⁷. This paper was not written by Jacobs, but was transcribed from private tuition, master classes and anecdotes by former students¹⁸. One short article remained unpublished but still circulates in the brass fraternity¹⁹. Most information on his theories comes from his biography, some interviews, and anecdotes by former students.

As a teacher, Jacobs taught all the brass instruments and on occasion, other wind instruments as well as singers. His students ranged from beginners to professional players. Jacobs is best known for his research regarding the physiology of brass playing and in particular the mechanics of breathing. He also researched the psychological aspects of musicianship²⁰. My study will focus on the physiological research done by Jacobs.

Jacobs was born on the 11th of June 1915²¹. The family moved to California soon after Jacobs' birth where his father took up a position as the paymaster of a shipyard²². Jacobs started piano lessons aged four with his mother as his tutor. At the age of ten or eleven Jacobs started to play the bugle, learning bugle calls by ear²³. He later started learning the trumpet and trombone, both with some success. Around 1927 the bandmaster of his junior high school informed Jacobs that there was no trombone for

¹⁷ Mind over metal. 1992.

¹⁸ The writers of this article are not identified.

¹⁹ Attached as Appendix A. this brief text is a difficult one, as Jacobs' style is rather obscure. This paper may be seen as delineating the 'divine mysteries' of brass breathing. This example of Jacobs' style may indicate why he never published anything else. Hereafter cited as "Jacobs. unpublished"

²⁰ For more information on a similar approach to this aspect see "The Inner Game of Music"

²¹ Kagarice, 1999: 33

²² Frederiksen, 1996: 1

²³ Frederiksen, 1996: 2

him to play but that the school had a new sousaphone²⁴. Jacobs changed to tuba. The family moved back to Philadelphia in 1929²⁵.

In 1930, at the age of fifteen, Jacobs successfully auditioned for the Curtis Institute of Music²⁶ in Philadelphia²⁷. Mary Louise Bok founded the Curtis Institute of Music in 1924. Admission, now as then, is by audition and enrolment is kept to a minimum²⁸. Only 5% of all applicants are accepted each year²⁹. All students receive a full-tuition scholarship to ensure that talent is the only consideration for entry. Curtis gives classes in all orchestral instruments, piano, organ, opera, composition and conducting. Students are taught by the leading artists in their field. Jacobs studied tuba with Philip Donatelli and cited Renee Longy-Miquelle (solfege) and Marcel Tabuteau (phrasing) as influential teachers³⁰. During his time at Curtis he also began his long association with the conductor Fritz Reiner³¹. Jacobs graduated in 1936³².

After graduation Jacobs successfully auditioned for the Indianapolis Symphony Orchestra, even appearing with the orchestra as soloist³³. From 1939 - 1944 he joined the Pittsburgh Symphony under Fritz Reiner³⁴. During 1941 Jacobs toured the United States with the All-American Youth Orchestra under Leopold Stokowski. Jacobs was on loan to the Philadelphia Orchestra for their tour to England and Scotland in 1949³⁵.

Jacobs joined the Chicago Symphony Orchestra³⁶ in 1944³⁷. The CSO was founded in 1891 and has its home in Orchestra Hall and, during the summer, at the Ravinia Festival³⁸. Jacobs retired from the orchestra in 1988³⁹. During his tenure with the CSO, Jacobs performed as soloist⁴⁰, was a founding member of the Chicago Symphony Brass

²⁴ Frederiksen. 1996: 3

²⁵ Frederiksen. 1996: 4

²⁶ Hereafter: Curtis

²⁷ Frederiksen. 1996: 6

²⁸ <http://www.curtis.edu/html/20000.shtml>

²⁹ <http://www.curtis.edu/html/10000.shtml>

³⁰ Frederiksen, 1996: 6 – 9

³¹ Frederiksen, 1996: 8

³² Frederiksen, 1996: 6

³³ Frederiksen, 1996: 18

³⁴ Kagarice, 1999: 33

³⁵ Frederiksen, 1996: 27

³⁶ Hereafter: CSO

³⁷ Frederiksen, 1996: 28

³⁸ Frederiksen, 1996: 33

³⁹ Kagarice, 1999: 33

⁴⁰ Frederiksen, 1996: 39

Quintet and played on the legendary recording of Gabrieli's antiphonal music with members of the Philadelphia and Cleveland Orchestras⁴¹.

Although my dissertation is primarily concerned with Jacobs' work on physiology, it would be impossible to discuss his teaching method without referring to his theories on the psychological issues of brass playing and music.

Jacobs did not seem to have a set teaching method; he catered for the individual needs of the student⁴². In the earlier years his lessons were geared towards the physical aspects of playing, such as breathing. In later years he emphasised the psychology of making music. Scarlett⁴³ said that Jacobs' teaching changed over the years: in the fifties he emphasized the medical aspects of brass playing. As the years progressed he dropped the medical terminology that his students usually didn't understand and used simpler explanations, explanations brass players could understand. By the end of his career he talked about the concept of "song and wind" an irreducible minimum of words to encompass his theories. "Wind" refers to the breath which provides fuel for the music. "Song" is the music in the musicians' head.

Jacobs taught the art of music. He believed that a person was a musician first. The musician communicated his/her message through the instrument in his/her hand, and whether it is a tuba or a trumpet should be irrelevant. He used imitation as a way to improve the quality of the player's sound. Johnson⁴⁴, also a student of Jacobs', used the example of how children learn to speak⁴⁵. The child's parents will provide the sound example of how a word should sound. The child will try to imitate that sound. Parents do not give up if their child does not get it right the first time; they continue to provide the example until their child gets it right. It should be the same for brass players. The player should find the example they prefer, usually one of the many soloists available on recordings, then practice to imitate that sound. Jacobs' preferred model for trumpeters was Adolph Herseth, the legendary principal trumpet of the CSO⁴⁶. He would first let the

⁴¹ Kagarice. 1999: 33

⁴² Scarlett, 1999: 18

⁴³ Loubriel (a). 2006: 46

⁴⁴ Keith Johnson is Regents Professor of Trumpet at the University of North Texas (UNT). He is a well known performer (on both modern and baroque trumpets) and the author of several articles and books. He is a regular clinician in South Africa.

⁴⁵ Johnson. 1990: 57 – 58

⁴⁶ Scarlett, 1999: 21

student play an extract, possibly the notorious opening of Mahler's 5th symphony; he would then ask the student if he had heard Herseth playing it. When the student replied in the affirmative Jacobs would say: "Please play it like Mr. Herseth."

Jacobs taught that one should first have a concept of the sound that one wishes to produce. He said that he always played two tubas simultaneously, the one in his hand and the one in his mind. The tuba in his hand was a mirror of the one in his mind⁴⁷. This meant that the student should first hear the tone s/he wanted to produce with his/her inner ear (a trumpet student would hear Herseth) and then go on to produce it with the instrument in his/her hand. He commented that some musicians don't have an instrument in their mind, and therefore made mistakes. He emphasised this in all his teaching.

Thus Jacobs taught that if the player fed the right information to the brain (a good concept of sound), the body will produce the desirable effect. This is not a new concept, Arban in his Cornet Method advised students to listen to the best instrumentalists and singers they could find, as often as they could⁴⁸. Today's students should do the same.

From Jacobs' theories we have condensed the following:

The ideal brass player would use maximal abdominal relaxation, use his vital capacity to the fullest, generate minimal intra-oral pressure and use the minimum mouthpiece pressure to generate the greatest flow rate possible.

This statement will be tested by dividing the statement into sections and creating a hypothesis for each section. Most of the hypothesis can be tested using standard lung function tests available at the South African Sports Science Institute. A questionnaire will account for variables among the subjects.

In chapter 2, I will examine the literature regarding brass physiology, supplementing it with articles drawn from the medical literature. Chapter 3 investigates the various philosophies behind breathing and some of the exercises and devices used to improve

⁴⁷ Frederiksen. 1996: 137

⁴⁸ 1907: 192

breathing. In chapter 4 I will present the research methodology. Chapter 5 will document the results of the various tests and a discussion thereof.

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Chapter 2

The Anatomy and Physiology of Brass Playing

This chapter serves to introduce the brass player to some of the physiological processes related to brass playing, lung function in particular. The first section deals with human anatomy in order to understand the structure of the body. The second section covers topics in the physiology of brass playing. Special mention will be made of the concept of diaphragmatic support, a subject of great importance to brass players. Physiological topics not directly related to the brass playing, or of minor importance, may be discussed as part of the anatomy section. A review of previous studies will conclude this chapter.

We could assess the value of the knowledge of anatomy and physiology in brass playing against Johnson's⁴⁹ two criteria for judging information. His two criteria are:

1. Is the information correct?
2. Can the information be presented in a simple, direct manner that will be accessible in the heat of performance, and will it improve performance?

There are some misconceptions in the brass playing community on how the breathing apparatus functions, as can be seen in the section on "diaphragmatic support". This chapter aims to provide correct information regarding the anatomy and physiology that concerns brass players. Knowledge of the physiology and anatomy may be complex and may not be accessible in the heat of battle, nor should it be, as thinking about what your body is doing while in live performance will only hinder any artistic statement you intend to make. This knowledge should be used and applied while practising where habits are formed and the musician can take his/her time to make conscious decisions about what will improve his/her performance. What is practised must become an automatic response in performance. Vizzutti⁵⁰ contradicts my statement in his Trumpet Method by saying that the only technical thoughts on stage should concern breathing⁵¹. Correct

⁴⁹ 1990: 57

⁵⁰ Alan Vizzutti (1952) is a renowned soloist, composer and educator. He is fluent in both classical and jazz styles. He is the composer of many solo works for trumpet and the author of a method for trumpet at the intermediate level (grades 5-7). He is the editor of the latest edition of the Arban method, the first revision undertaken in decades. He is a Yamaha performing artist.

⁵¹ 1991: 6

breathing can and should be practiced with the instrument, or away from the instrument, using some of the exercises and devices discussed in Chapter 3.

Anatomy for the Brass Player

The skeleton

The skeleton provides a rigid framework and support for the entire body⁵². It is divided into two sections; the axial skeleton and the appendicular skeleton. The appendicular skeleton is made up of the upper and lower extremities (arm and legs). The upper extremities contain the bones of the shoulders, pectoral girdles, arms, wrists and hands. The lower extremities contain the bones of the hip, pelvic girdles, legs, ankles and feet⁵³.

The axial skeleton

The axial skeleton is the major support structure of the body. It is made up of the spine, the skull and the ribcage⁵⁴.

The spine

The spine (vertebral column) forms the primary part of the axial skeleton. The spine serves as a pivot for the skull, and protects the spinal cord and spinal nerves. It further provides an axis for movement of the body and it supports the weight of the body⁵⁵. The vertebrae are small irregular bones that vary in size.

The adult vertebral column contains 33 vertebrae and is arranged in five regions:

1. The cervical (neck) spine contains seven vertebrae.
2. The thoracic spine contains twelve vertebrae.
3. The lumbar spine contains five vertebrae.
4. The sacrum
5. The coccyx⁵⁶

The vertebrae of the sacrum and coccyx are fused to form single structures. Five vertebrae fused to form the sacrum while four fused to form the coccyx⁵⁷.

⁵² Thibodeau and Patton, 2000: 97

⁵³ Thibodeau and Patton, 2000: 103

⁵⁴ Thibodeau and Patton, 2000: 103

⁵⁵ Moore and Dalley, 1999: 432

⁵⁶ Thibodeau and Patton, 2000: 109

The characteristic curves of the spine appear at critical times in a child's development. A newborn baby starts life with a completely convex spine. The first curve (Cervical Curvature) develops a concave curve at the neck as a baby learns to hold up its head. Another concave develops at the lumbar region (Lumbar Curvature) as a baby learns to stand. An adult therefore has four curves in the vertebral column; a concave curve at the neck, a convex curve at the thorax (Thoracic Curvature), a concave curve in the lumbar region (sacral curvature) and the convex curve of the sacrum. The curves give strength to the vertebral column in order to support the weight of the body. These curves are also known as "lordosis" of the spine. The term "lordosis" is more often used to refer to a condition where there is an excessive curvature of the spine, particularly of the lumbar curvature. Women, for example, develop temporary lordosis during pregnancy. Lordosis may also be seen in the aged⁵⁸.

The vertebral column moves during breathing. During inhalation the vertebral column gathers and lengthens again during exhalation, quite the opposite of what one would expect.

The role of the spine in posture is discussed below.

The skull

The skull is a bony structure with two main parts: the neurocranium (brain box or cranial vault) and the viscerocranium or splanchnocranium (facial skeleton)⁵⁹. The neurocranium is formed into a spherical structure by eight flat curved bones. These bones are united by fibrous interlocking sutures.

The facial skeleton is formed by 14 irregular bones⁶⁰. These bones form the nasal and ocular orbits⁶¹. The maxilla (upper jaw) and mandible (lower jaw) contain the teeth.

The skull also contains the six bones of the middle ear, three per ear⁶².

⁵⁷ Moore and Dalley, 1999: 432

⁵⁸ Kierman, 2008: Personal communication

⁵⁹ Moore and Dalley, 1999: 832

⁶⁰ Moore and Dalley, 1999: 832

⁶¹ Moore and Dalley, 1999: 832

⁶² Thibodeau and Patton, 2000: 104

The Thoracic wall

The thoracic wall houses and protects the lungs and heart. It has two main functions:

1. To protect the vital organs it contains (the heart, major arteries and lungs) and
2. to aid with the mechanical process of breathing.⁶³

The supporting structure of the thoracic wall is provided by the ribcage. The ribcage includes 12 pairs of ribs, the 12 vertebrae and intervertebral (IV) discs and the sternum⁶⁴.

The sternum

The sternum is a flat, elongated bone that forms the anterior part of the ribcage. It consists of three parts: the manubrium (top), the body and the xiphoid process.

The Ribs

There are three types of ribs:

1. True ribs (the first 7 ribs⁶⁵). So called because they are linked directly to the sternum via their own costal cartilages.
2. False ribs (the 8th to 10th ribs). These ribs connect to the sternum via the cartilage of the rib directly superior to them.
3. Floating ribs (the 11th and 12th ribs) do not connect to the sternum at all.⁶⁶

Ribs are further identified as typical (3rd to 9th) and atypical (1st, 2nd and 10th to 12th) ribs⁶⁷.

The ribs form joints where they meet the processes of the spine and are flexible where the ribs meet the cartilage at the sternum. This mobility, known as the ribs' excursion, allow the ribs to move up and out during inhalation, and down and in during exhalation⁶⁸.

⁶³ Moore and Dalley, 1999: 62

⁶⁴ Moore and Dalley, 1999: 62

⁶⁵ Counting from the top of the ribcage.

⁶⁶ Moore and Dalley, 1999: 62

⁶⁷ Moore and Dalley, 1999: 63

⁶⁸ Conable, 1998: 83

The Musculature

Muscle tissue

Muscle tissue is divided into three groups. Each group can be identified by its appearance, location, type of activity and its source of stimulation.

Smooth muscle

Smooth muscle forms the walls of most blood vessels and hollow organs. It aids movement of substances through the viscera⁶⁹. The fibres are nonstriated, taper towards the end and have a single nucleus located in the center of the cell⁷⁰. The contractions of these muscles are also rhythmic, but these contractions are much slower than that of the cardiac muscle. Smooth muscles are usually involuntary⁷¹.

Cardiac muscle

Cardiac muscle forms the wall of the heart and some of the adjacent parts close to it. These fibres are shorter than skeletal muscle⁷². The fibres branch into complex junctions, then reconnect to form a mass of interconnected tissue⁷³. The junctions are visible as dark bands known as intercalated discs which are unique to cardiac muscle⁷⁴. The nucleus is centrally located. Cardiac muscle pumps blood from the heart. It is an involuntary muscle that contracts rhythmically. The rate and strength of the contractions are regulated by the automatic nervous system⁷⁵.

The heartbeat can be heard in the brass playing at times, particularly when there is insufficient breath⁷⁶. This phenomenon is possibly the Korotkov⁷⁷ sounds made audible by the amplification of the instrument.

⁶⁹ Moore and Dalley, 1999: 26

⁷⁰ Thibodeau and Patton, 2000: 134

⁷¹ Moore and Dalley, 1999: 27

⁷² Moore and Dalley, 1999: 26

⁷³ Thibodeau and Patton, 2000: 134

⁷⁴ Thibodeau and Patton, 2000: 134

⁷⁵ Moore and Dalley, 1999: 27

⁷⁶ Kierman: personal communication, 2007

⁷⁷ Named after the Russian surgeon, Nikolai Sergeievich Korotkov (1874-1920), who first described the sounds and their use in the measurement of blood pressure (www.whonamedit.com/doctor.cfm/2254.html).

Skeletal muscle

Skeletal muscle connects directly or indirectly to other parts of the skeleton, or in some cases to organs⁷⁸. Its main functions are movement of the body, maintenance of posture and muscle tone, and heat production to maintain homeostasis⁷⁹. These fibres are large, very long and unbranched, with transverse striations (stripes). They are arranged in parallel bundles with peripherally located nuclei. These muscles are controlled by the somatic nervous system and are voluntary or reflexive⁸⁰.

Skeletal muscle is the muscle type directly concerned with brass playing. The muscles of the ear⁸¹, the hand, the facial muscles, the abdominal muscles and the major muscles of the respiratory system are made up of this type of muscle fibre.

The muscles

Facial muscles

Current brass teaching states that the facial muscles act around, and respond to, sound respiratory principles, conferring the notion that brass problems are “blown away”. The activity of the facial muscles is an enormous study in itself, and little is published authoritatively on this topic. Due to its complexity, this topic is beyond the scope of this dissertation. The facial muscles will only be listed in the illustrations below⁸².

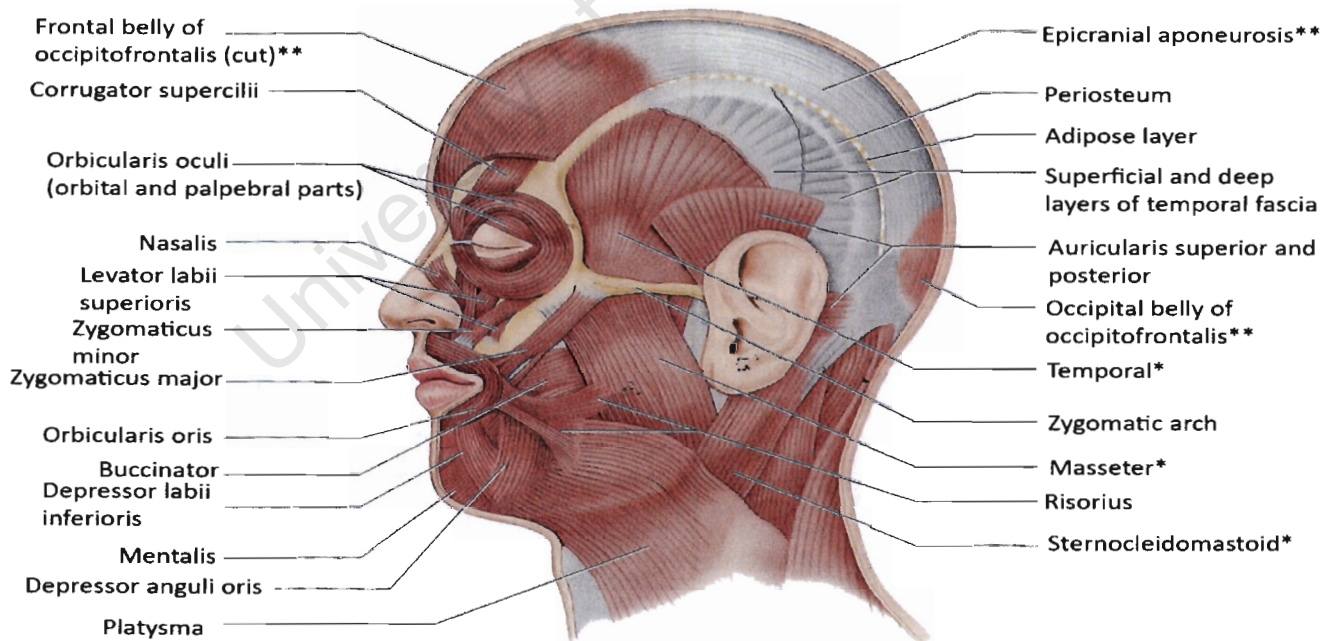
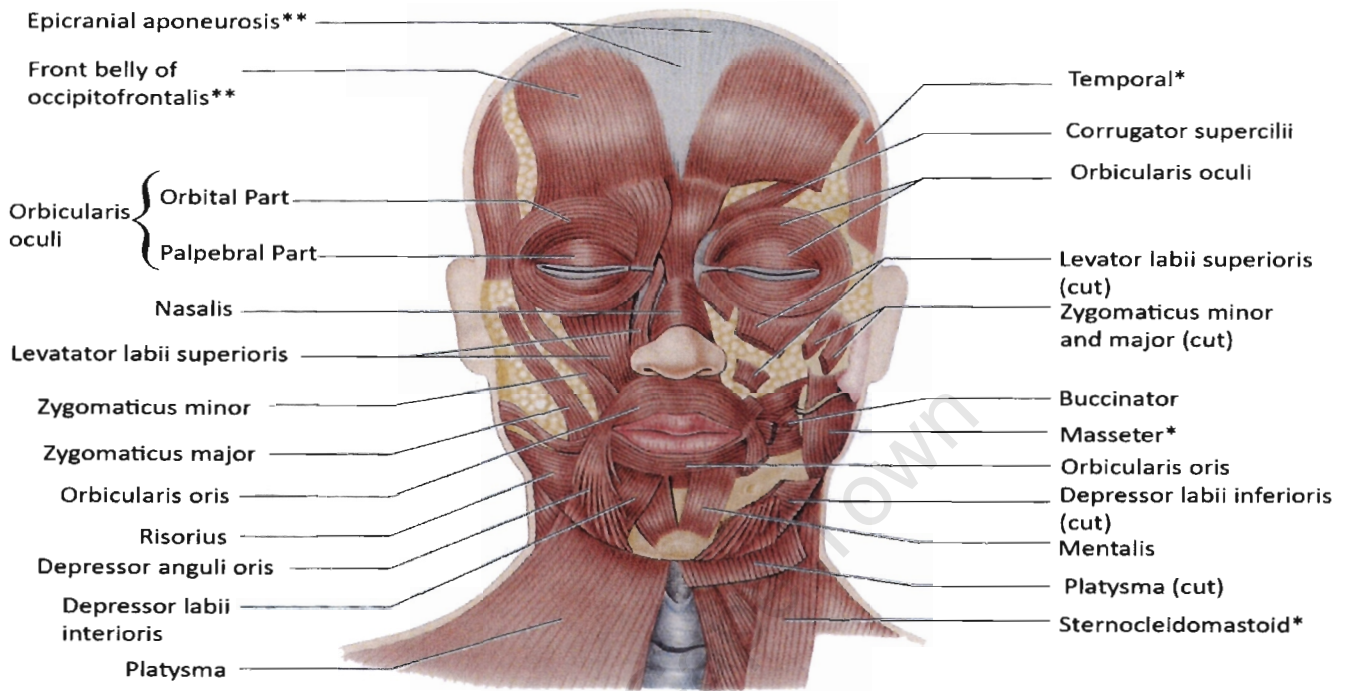
⁷⁸ Moore and Dalley, 1999: 26

⁷⁹ Thibodeau and Patton, 2000: 137

⁸⁰ Moore and Dalley, 1999: 27

⁸¹ The muscles of the ear are some of the most important muscles to musicians. These muscles provide constant feedback of the musical environment to which the musician must respond by making slight adjustments. The ear contains the smallest voluntary muscle: the stapedius (Moore and Dalley, 1999: 971).

⁸² A note of interest, buccinator derives from buccino, the Latin term for trumpet.



*Not part of muscles of facial expression
 **Collectively = epicranium

Fig 1⁸³

⁸³ Moore and Dalley, 1999: 853 (1) Permission requested

Intercostal muscles

The external intercostal muscles (11 pairs).

The external intercostal muscles are the muscles of inspiration. They elevate the ribs. They attach to the borders of the ribs above and below.

The internal intercostal muscles (11 pairs).

The internal intercostal muscles are muscles of expiration. They run at right angles to the external intercostals.

The Diaphragm

The diaphragm is considered the primary muscle of inspiration. It is a dome-shaped partition consisting of muscles and tendons, which separates thoracic and abdominal cavities. The apex of the dome faces the thoracic cavity. The only movement is in the centre as the muscle is fixed to the thoracic cage.⁸⁴

The central tendon is not exactly in the centre of the diaphragm; it is situated slightly towards the back of the thoracic cavity. The tendon consists of three separate sheets of tendon. There is an opening in the tendon (the caval foramen) through which the inferior vena cava passes⁸⁵. The muscular sheet that surrounds the central tendon forms a continuous sheet which, for illustrative purposes, is divided into three parts: a sternal section, a costal section and a lumbar section.

During breathing the tendon contracts towards the center of the diaphragm, causing the diaphragm to move down (flatten) towards the abdominal cavity. During normal quiet breathing the diaphragm descends as little as a centimeter; while during forced breathing the diaphragm may descend as much as ten centimeters. The diaphragm of professional athletes, singers and wind instrumentalists descends three or four centimeters. These individuals develop the greater range of movement required by their activities through training. Females seem to make little use of their diaphragms when

⁸⁴ Moore and Dalley, 1999: 289

⁸⁵ Moore and Dalley, 1999: 289

compared to males, a trend that starts soon after puberty and may be exacerbated by pregnancy⁸⁶.

Abdominal muscles

The abdominal muscles form a band around the abdomen that some Pilates' practitioners call the "girdle of strength"⁸⁷. The area extends at the front and the back of the body from the bottom of the ribcage to the horizontal line between the hip bones⁸⁸. The muscles that form this girdle are the external oblique, the internal oblique, the transverse abdominal, the rectus sheath, the rectus abdominis and the pyramidalis muscles. The abdominals support and protect the trunk. These muscles⁸⁹ also influence respiration because the fibers arise from or are inserted into the lower rib or costal cartilages and because contraction raises intra-abdominal pressure. The abdominal muscles come into play during the expiratory phase of the breathing cycle⁹⁰.

The Air way

The oral cavity

The oral cavity contains structures such as the teeth, palate and tongue. For most brass players the mouth is the means of primary air intake. Rarely, some brass players take in air through the nose (other than those who use circular breathing).

Mouth breathing vs. Nose breathing

Humans are able to breathe through either their mouths or noses. According to yogi teaching one should breathe only through the nose as mouth breathing invites disease to enter the body without hindrance. Ramacharaka does not mention anything about breathing under physical exertion⁹¹.

⁸⁶ Backhouse and Hutchings, 1986: 218

⁸⁷ Robinson and Thomson, 1999:

⁸⁸ Fröhlich, 1998: 14

⁸⁹ The abdominal area is also linked to the mystical center of energy known as the tan tien in the east. It is this center of energy that the practitioners of the martial arts are told to move and draw energy. The location of the tan tien is described as follows: about 6 inches (15.24cm) down from the navel on a diagonal line aimed at the anus. In women this would be the cervix. In the Western Mystery tradition it is located at the base of the spine (Jayran in Harvey and Hardman, 1996: 214). For more information on some of the philosophical ideas of breathing see Chapter 3.

⁹⁰ Cotes, 1993: 93

⁹¹ 1905: 27

In brass playing, young students are taught to inhale through the corners of the mouth. Some children have difficulty with this and continue to breathe in through the nose. Jacobs had no preference but thought that breathing through the nose is too slow⁹². He thought that it would be beneficial to be able to breathe through both at the same time as it would increase the amount of air inhaled.

Nose breathing is one of the “Rules” in Caruso’s Method: “Calisthenics for brass players”. In this method the mouthpiece is not removed during any exercise in order to keep the embouchure from changing. To further discourage any change in the embouchure, the student inhales through the nose. The Caruso method has helped many brass players recover from injury, as was the case with the trumpeter Charly Raymond. Caruso helped Raymond rebuild his embouchure after injuring it in a season of excessive playing⁹³. The exercises Caruso used can be found in his book “Musical Calisthenics for Brass, although most of his students would quickly add that the exercises were not “the method”, Caruso’s approach was. He adapted his exercises to the needs of the student, often improvising new ones on the spot. Thompson⁹⁴, a student of both Caruso and Jacobs, uses a similar approach in his buzzing method. He uses many of Caruso’s principals in his method.

Palate

The palate is the arched roof of the mouth. It separates the oral cavity from the nasal cavity and the nasopharynx. The superior surface is covered with respiratory mucosa and the inferior region is covered with oral mucosa. The palate has two regions; the hard palate towards the front of the mouth and the soft palate at the back.

Hard palate

The hard palate is filled by the tongue when it is at rest⁹⁵. The hard palate is constructed from the hard bones of the palatine and maxillary bones⁹⁶.

⁹² Frederiksen, 1996: 101

⁹³ <http://abel.hive.no/trumpet/interview/caruso/>

⁹⁴ James Thompson is professor of trumpet at the Eastman School of Music, and a Yamaha Performing artist. He has performed as soloist with many orchestras in Europe and the United States. He is a sought-after clinician especially with regards to his buzzing method.

⁹⁵ Moore and Dalley, 1999: 934

⁹⁶ Thibodeau and Patton, 2000: 364

Soft palate

The soft palate is the back third of the palate and is suspended from the hard palate. The structure consists mainly of muscle⁹⁷.

The tongue

The tongue together with the palate plays a very important part in brass playing⁹⁸. The tongue is the primary means to modify articulation, the means of adding and varying expression in music. The alveolar ridge and teeth act as a striking point which the tongue can use to create articulation. Brass players are expected to use techniques such as single, staccato, legato, double, triple and unequal (in period instrument performance) tonguing. The tongue seems to consist of one muscle but is in reality a complex group of muscles covered by a mucous membrane⁹⁹. The muscles of the tongue do not act in isolation but are synchronized to act as a unit. The tongue is divided into a root, body and apex¹⁰⁰. There is no consensus as to the exact divisions of the tongue but generally, the body is considered to be the anterior two thirds of the tongue. This would include the apex¹⁰¹. The body and the apex are very mobile. The root is the posterior third of the tongue and is fixed relatively fixed.

The tongue consists of two types of muscles, intrinsic and extrinsic muscles. Intrinsic muscles alter the shape of the tongue, while extrinsic muscles control the position of the tongue. Again this is a generalization, because either type of muscle might help with the function of the other¹⁰². The tongue also houses the sensory receptors for taste¹⁰³.

The pharynx

The pharynx acts as a passage for both air and food. Air leaves the pharynx via the larynx, while food leaves via the oesophagus. The pharynx has three sections;

- the nasopharynx, which lies behind the nasal cavity,

⁹⁷ Thibodeau and Patton, 2000: 364

⁹⁸ For a more detailed account of articulation and the tongue's role see the thesis by Ayers, 2004

⁹⁹ Moore and Dalley, 1999: 941

¹⁰⁰ Moore and Dalley, 1999: 940

¹⁰¹ Moore and Dalley, 1999: 940

¹⁰² Moore and Dalley, 1999: 941

¹⁰³ Thibodeau and Patton, 2000: 365

- the oropharynx, which lies behind the oral cavity and
- the lowest section, the laryngopharynx

The larynx

The larynx is also known as the voice box. It is made up of several pieces of cartilage and contains the vocal chords¹⁰⁴. The epiglottis is a piece of cartilage that closes off the larynx during swallowing to prevent food from entering the trachea.

The trachea is the main air pipe before it splits into the bronchi that feed air into each lung. Each bronchus of each lung divides further into lobar (secondary) bronchi then into segmental (tertiary) bronchi and lastly into terminal bronchi. The terminal bronchi divide into alveoli. The alveoli are small balloon-like structures where gas exchange takes place.

The lungs

The lungs are encased in the thoracic cavity along with the heart. The lungs are invested by a pleural sac that consists of two membranes, the pleurae. The visceral pleura enfolds the lungs, and it cannot be detached from the lungs by dissection.

The pulmonary cavity is lined by the parietal pleura. There is a potential space between the two pleurae which contains a capillary layer of pleural fluid. The fluid enables the pleurae to slide over each other with ease.

Humans have two lungs. The lungs are divided into various sections, lobes, by horizontal and oblique fissures. The right lung has three lobes while the left lung has two. The lung can be divided further as follows:

- An apex, the blunt superior end of the lung.
- Three surfaces, costal; mediastinal and diaphragmatic.
- Three borders; anterior, inferior and posterior.

¹⁰⁴ Thibodeau and Patton, 2000: 338

The lungs are pink in healthy young people and those who live in clean, remote areas. The lungs of adults, whether in urban or rural areas, become dark due to the accumulation of dust, carbon and other irritants. Smoking compounds this effect.

Below is an illustration of the lungs and the airway.

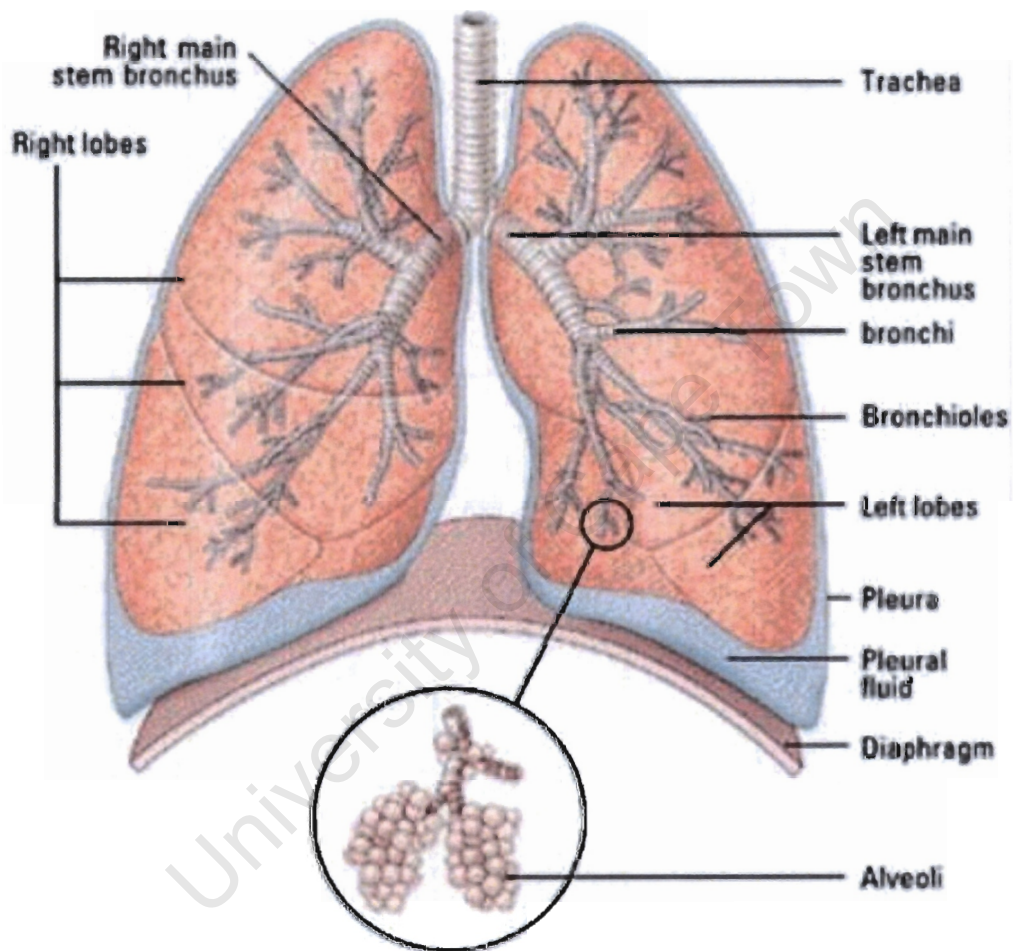


Fig 2¹⁰⁵

¹⁰⁵ <http://www.shoppingtrolley.net/images/anatomy/lungs.jpg>. Accessed May 2008.

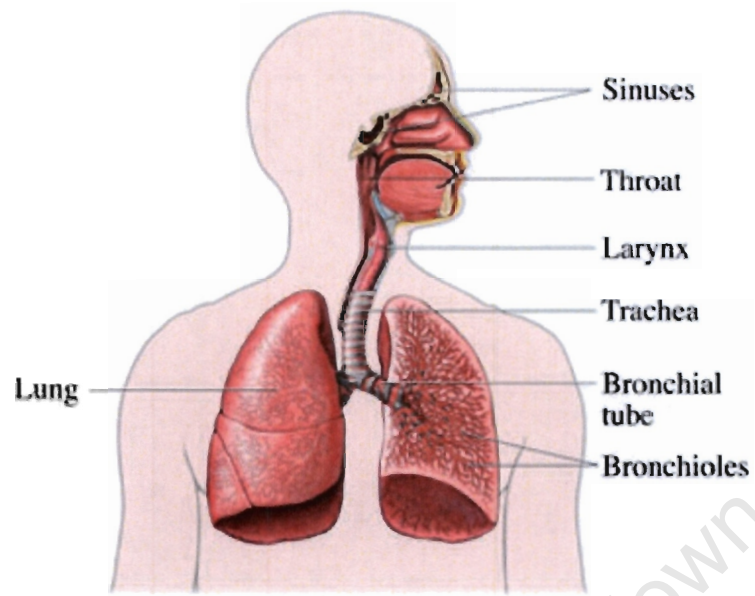


Fig 3¹⁰⁶

University of Cape Town

¹⁰⁶.www.elib.gov.ph/edatabase/elibgetdb.php/http/services.epnet.com/GetImage.aspx/getImage.aspx?ImageIID=5002. Accessed May 2008

Physiology

Posture

Posture is considered good when the spine is stretched to its full length. The pelvis should have a neutral tilt and the coccyx should be tucked under. The feet should be about hip distance apart and parallel with the body's weight equal on both feet. The knees should not be locked as this could cause hypertension.

The placement of the feet can be determined by starting to jump up and down, gradually getting higher, once you cannot jump any higher, stop. The position of the feet will now be in the optimal position¹⁰⁷.

Musicians should maintain good posture whilst seated. The position of the body should be the same as standing from the bottom of the thorax up. It is important to retain the lumbar curvature. Jacobs put it simply; stand while seated¹⁰⁸.

The figure below shows both good and bad posture.

¹⁰⁷ As demonstrated to me in a master class/ lecture by international horn soloist Andrew Joy.

¹⁰⁸ Frederiksen, 1996: 130

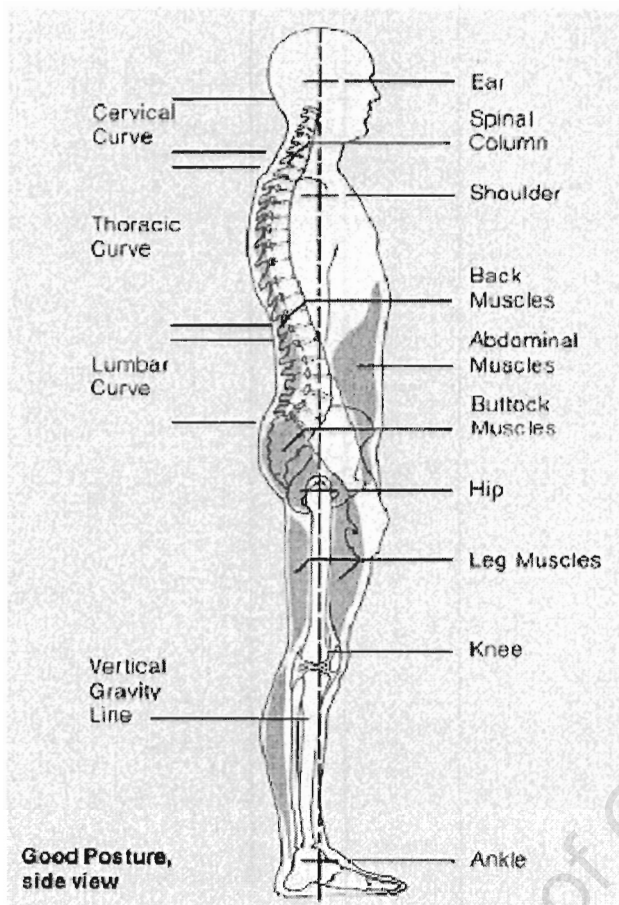


Fig 4¹⁰⁹

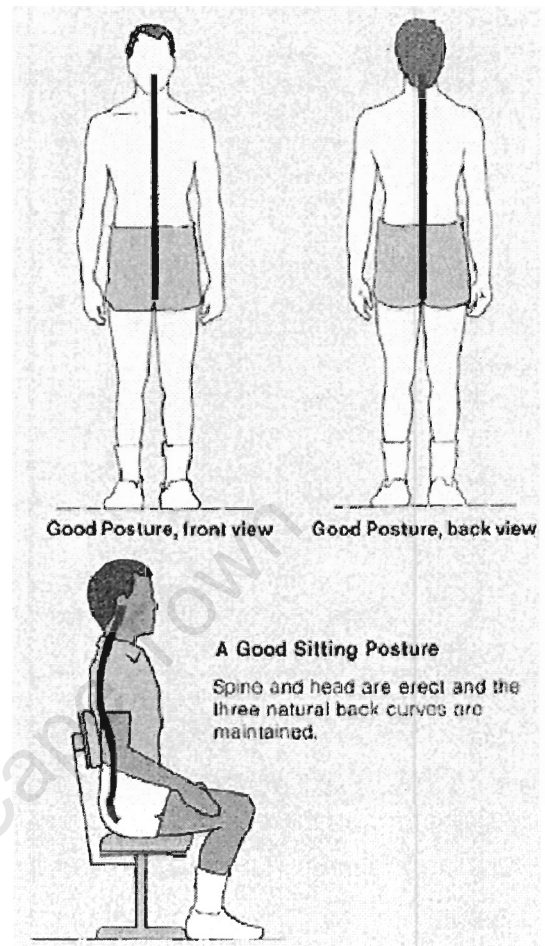


Fig 5

¹⁰⁹ American Physical Therapy Association. Permission requested

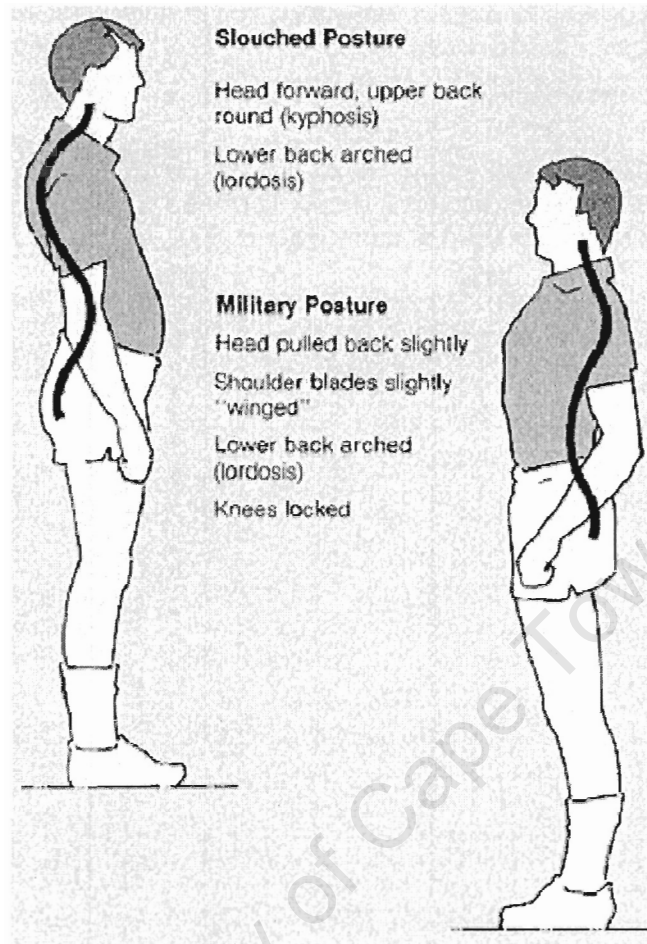


Fig 6

Breathing

Inspiration

For the purpose of illustration the breathing process begins with inspiration. Normal quiet breathing is accomplished almost entirely by the movement of the diaphragm. Inspiration starts when the diaphragm contracts, pulling it down into the abdominal cavity¹¹⁰. The dome shaped muscle now becomes flattened¹¹¹. The contraction of the diaphragm makes the chest cavity longer from top to bottom¹¹². At the same time the external intercostal muscles contract making the chest cavity bigger from front to back and from

¹¹⁰ Thibodeau and Patton, 2000: 346

¹¹¹ Fox (a), 1996: 470

¹¹² Thibodeau and Patton, 2000: 346

side to side¹¹³. The enlargement of the chest cavity causes a lower air pressure within the body than without and, in compliance with the principle of bulk flow¹¹⁴, air rushes into the body to equalize the pressure¹¹⁵.

Expiration

Normal quiet expiration is totally passive depending solely on the elastic recoil of the lungs. Once the diaphragm has relaxed the recoil of the chest wall, lungs and abdominal structures forces air out of the lungs¹¹⁶.

Forced inspiration

The body reacts to forced (or deep inspiration) by the increasing the size of the chest cavity even further than in normal respiration. Contractions of the scalenus, pectoralis minor and at times the sternocleidomastoid causes the rib cage to be elevated and the upper rib cage to be stabilized. This movement causes the intercostals to become more effective¹¹⁷.

Forced expiration

During forced expiration the internal intercostal muscles and the abdominal muscles contract. The abdominal muscles push the organs in the abdominal cavity against the diaphragm thus causing the diaphragm to become more dome shaped, thereby decreasing the size of the chest cavity more than normal. The decrease in the size of the chest cavity creates higher pressure than in the atmosphere outside the body causing the air to move out of the lungs¹¹⁸.

The Valsalva maneuver

Any forced expiratory effort against a closed airway is considered a Valsalva Maneuver. The airway is generally closed at the glottis; it could also be caused by an increase in

¹¹³ Thibodeau and Patton, 2000: 346

¹¹⁴ Jacobs said the mechanics of breathing complied with Boyle's Law, however this is not correct. Boyle's Law deals with the relationship between the pressure of a gas (P), its volume (V) and its temperature (k). Boyle's Law states that the volume of a given sample of gas at constant temperature varies inversely with the pressure (Zumdahl and Zumdahl, 2007: A28). It is expressed by the formula $PV=k$ (Zumdahl and Zumdahl, 2007: 182)

¹¹⁵ Frederiksen, 1996: 104

¹¹⁶ Guyton, 1981: 476

¹¹⁷ Fox (a), 1996: 470

¹¹⁸ Thibodeau and Patton, 2000: 346

pressure in the eustachian tube and middle ear, due to forcible exhalation against closed nostrils and mouth¹¹⁹. The Valsalva maneuver occurs when coughing, sneezing, strain during bowel movement, or weightlifting¹²⁰.

A Valsalva maneuver begins when the lungs inflate during a deep inhalation¹²¹. At the same time both the vestibular and vocal folds begin to close. By the end of the inhalation both sets of folds are tightly closed. The antolateral abdominal muscles then contract aggressively to increase the intra-thoracic and intra-abdominal pressures. The relaxed diaphragm passively transmits the increased pressure to the thoracic cavity.

Jacobs has encountered players who use the pressure generated by the Valsalva Maneuver to get the air through the instrument. He felt that this was not a very efficient way to play, as these players cannot use as much air as they should; the movement of air should be free-flowing¹²².

Hyper/ hypoventilation

Hyperventilation is a problem, mostly for the high flow-rate instruments such as the tuba and flute. Jacobs deliberately rebreathed air through his tuba to prevent the effects of hyperventilation. He refers to hyperventilation as a lowering of the carbon dioxide levels in the blood, rather than an increase of oxygen, as most medical professionals do¹²³.

Hypoventilation is the opposite of hyperventilation, there is a build-up of carbon dioxide levels in the blood. Hypoventilation is prevalent in low flow-rate instruments, such as the oboe¹²⁴.

Diaphragmatic support

In Brass-playing, diaphragmatic support refers to the use of the diaphragm to give a stream of air with a constant pressure. According to traditional teaching, the diaphragm is supposed to be kept tense or rigid whilst playing. The effect of this procedure is said to cause a better projection of sound.

¹¹⁹ Dorland, 2004; 509

¹²⁰ Moore and Dalley, 1999: 1043

¹²¹ Moore and Dalley, 1999: 1043

¹²² Frederiksen, 1996 : 103

¹²³ Frederiksen, 1996: 109

¹²⁴ Frederiksen, 1996: 111

Using the diaphragm to support breathing in brass playing is a common theme of lessons at the start of a brass player's tuition. It is also one of the brass community's greatest myths, and the single concept most inaccurately taught. Since the 1980's there has been a decline in this approach, known as the "hard belly" school of brass playing¹²⁵, largely due to the influence of Arnold Jacobs. Cichowicz has concluded that the "hard belly" concept was formed by instructors and players working backwards; they realized they were playing with tight abdominal muscles when they were in their high register and then taught that the abdominals should be tight in all registers¹²⁶.

In South Africa the concept of diaphragmatic support has been phased out since the arrival of mainly American teachers. It is, however, still prevalent in South Africa through the teachings of especially military musicians, who often have not had much or continuous access to higher education or professional teaching. Often these musicians are still involved in teaching in their communities and thus continue the teaching method as passed down to them¹²⁷. This section will examine the development of the concept of diaphragmatic support. For chronological clarity, articles published in "The Instrumentalist" will be referenced using the original date of publication. All the articles in it relating to brass were collectively published in "The Brasswind Anthology".

The main confusion in the brass community seems to be the location of the diaphragm and its function during breathing.

Thoughts on the location and function of the diaphragm are varied among the brass community. Smith¹²⁸ gives an account of how this concept was and is taught to brass players (and singers):

"The diaphragm is a muscle described as 'flat', 'tense', 'full' and even 'protruded'. One writer speaks of the lower region or the diaphragm located in the cavity below the rib cage – implying that there is also an upper region, possibly contained in the rib cage. Certain authorities say that the diaphragm pulls the air in; others, with equal conviction, dwell verbosely on the fact that it forces the air out in a steady, 'straight line'. One vocal treatise

¹²⁵ A term attributed to Edward Tarr, the distinguished trumpeter/musicologist.

¹²⁶ Loubriel (b), 2006: 26

¹²⁷ I have observed this phenomenon in the 15 years that I have been involved in with military bands. This situation might now change as a result of the Military Skills Development programme, where young musicians are enrolled in the Music Certificate programme presented by the University of Stellenbosch, as part of their training.

¹²⁸ 1966:263

advises the student to place his hand on his diaphragm as he exhales – it even shows a drawing of a student patting his stomach! A brass authority reminds his readers that ‘improper breathing comes from improper use of the diaphragm, or the failure to use the diaphragm at all.’”

Fox¹²⁹, as most other brass teachers, called the abdominal area the ‘diaphragm’. It seems that Fox may have known that this is anatomically incorrect yet he continues using this terminology. This is how many brass teachers, who may or may not know the true anatomical position and function of the diaphragm, teach breathing. Most brass players are taught that the abdominal muscles are the diaphragm and they are taught to tense this “diaphragm”, thus forming the “hard belly”. The students are told that the diaphragm can be felt just below the ribcage, resulting in some teachers pressing their fingers into this area to make sure that the “diaphragm” is active enough¹³⁰. To test the validity of diaphragmatic breathing, Miller conducted some tests on a number of brass players; none of the test subjects could consciously make any adjustments to the diaphragm without bringing the abdominal muscles into play¹³¹.

There are many articles that do describe, or mention in passing, the diaphragm and its function in the correct way¹³². The earliest of these was written in 1949 by Fitzgerald¹³³. It seems odd that if accurate information appears at this stage, the brass community did not respond to it. Smith¹³⁴ may have offered a valid reason for this: the vocabulary of diaphragmatic support produced successful results and brass players did not see any need to change it. The current trend in brass playing is to move away from rigidity. A new vocabulary is needed to convey the new concept to students. Ridgeon’s survey confirms Smith’s theory. He found that the teachers he interviewed that taught to support with the diaphragm (20% of those interviewed), found the terminology was adequate for their purposes, even if they didn’t think that the information would stand up to physiological examination¹³⁵.

¹²⁹ Fox (b), 1974: 27

¹³⁰ As experienced by myself in lessons with a well known teacher in Cape Town.

¹³¹ Gordon, 1987: 16

¹³² Johnson has observed that brass-players are rarely great book readers.

¹³³ Fitzgerald, 1949: 22

¹³⁴ Smith, 1966: 264

¹³⁵ 1986, 4

When he started his investigation into breathing (c 1944) even Jacobs also had incorrect information on the location of the diaphragm. When he mentioned the position of the diaphragm to his wife and pointed to his navel, she had to correct him and describe its positioning and function¹³⁶. He wrote in his unpublished article that pushing out the diaphragm would be wrong; it should be kept loose and relaxed and tension of the diaphragm should be avoided¹³⁷. It is likely that this article was written early on, before his study of physiology, as he became very knowledgeable about the structure of the respiratory system. Alternately, he may have used the standard brass vocabulary of that time in order to be understood.

“Flab is my friend”¹³⁸ was one of Jacobs’ favourite sayings. With this saying he is not condoning beer bellies (supplementary air pouch) as some brass players would like to believe. With this statement he would like to remind the player to remain relaxed rather than have the “hard belly”, as s/he was probably taught. It also doesn’t mean that there will be no muscular activity in the abdominal area; the player will use ‘minimal motors’ as Jacobs called it¹³⁹. Jacobs preferred his students not to think about how they were breathing, at least not while they were playing. He taught that the concept of sound was the most important. A student will listen to great artists of his/her instrument, s/he then had to concentrate reproduce the sound of the instrument in his mind; the body will learn how to produce the result by itself. Johnson¹⁴⁰ echoed this when he says that students must first develop a good concept of sound. The body will learn what to do to create that sound. The muscular activity will become an unconscious act.

Jacobs mentioned that the breath, not the body, should support the music¹⁴¹. I once had an interesting conversation with a German trumpeter turned opera singer. He told me that at the conservatoire where he studied they were taught “breath interpretation”, basically how to breathe in a musical way that supports the music. I have not found any other references to this method and it may be worthy of further study¹⁴². The breath can

¹³⁶ Frederiksen, 1996: 98

¹³⁷ Jacobs, unpublished

¹³⁸ Jacobs, unpublished. Or “Strength is your enemy – weakness is your friend” Frederiksen: 1996, 109

¹³⁹ Frederiksen, 1996: 109

¹⁴⁰ 1988: 7

¹⁴¹ Frederiksen, 1996: 107

¹⁴² Farkas mentioned a similar concept in “The Art of Musicianship” (1976: 12).

be trained by various exercises and tools, all away from the instrument. These tools are discussed in Chapter 3

Lung function

Lung function refers to how well the lungs (and the respiratory system as a whole) perform their task. The lung function tests are designed to identify and quantify defects and abnormalities in the function of the respiratory system.

Lung functions and capacities are influenced by various factors. The testee's physical position affects the performance of the respiratory system. A subject who is lying down records diminished results as opposed to when s/he is standing. This is due to the contents of the abdomen pushing against the diaphragm as well as an increase in pulmonary blood volume in the prostrate position. Obesity also hinders lung function, whereas athletic individuals record higher scores¹⁴³.

Graphically, the subdivisions of lung function are shown below.

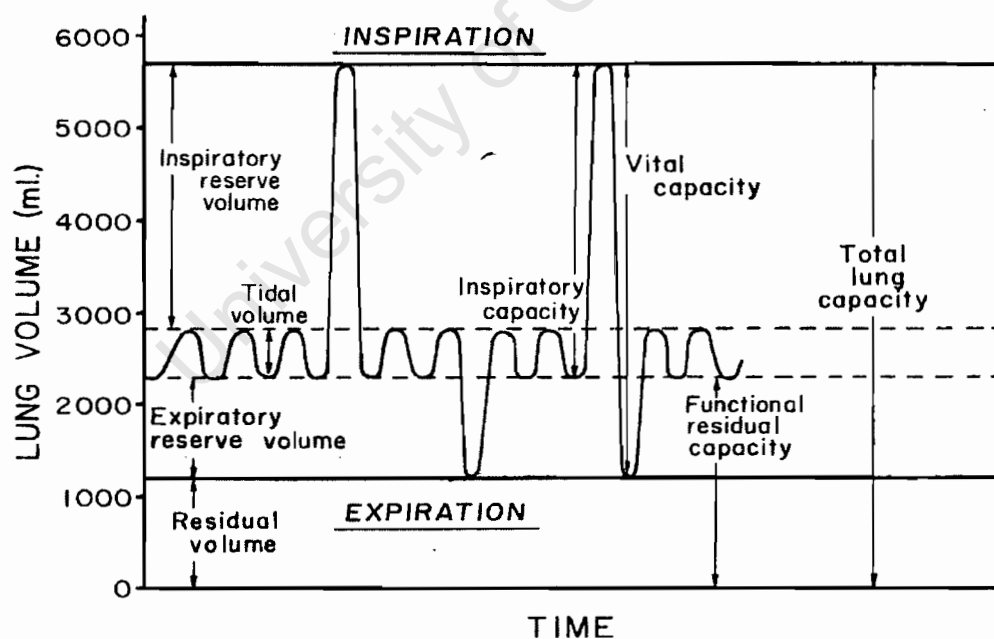


Fig 7¹⁴⁴

¹⁴³ Guyton, 1981: 481

¹⁴⁴ Guyton, 1981: 481

There are several measurements and tests to describe and measure lung function. The most common tests and measurements are listed below.

Tidal Volume (TV) refers to the amount of air that is inhaled or exhaled during each normal breath. Tidal volume is usually about 500 ml¹⁴⁵.

Inspiratory Reserve Volume (IRV) is the amount of air that can still be inhaled after a normal inspiration; this usually measures around 3000ml¹⁴⁶.

Expiratory Reserve Volume (ERV) is the amount of air that can still be forcefully exhaled after a normal expiration; it amounts to about 1100ml¹⁴⁷.

Residual Volume (RV) is the volume of air still remaining in the lungs after a most forceful exhalation; it averages 1200ml¹⁴⁸.

Inspiratory Capacity (IC) equals the tidal volume plus the inspiratory reserve volume. Its capacity is measured while a person takes a normal breath and then filling their lungs to the maximum. It measures around 3500ml¹⁴⁹.

Functional Residual Capacity (FRC) equals the expiratory reserve volume plus the residual volume. This is the amount of air remaining in the lungs after a normal expiration when the elastic recoil of the lungs and the chest wall are equal and opposite¹⁵⁰.

Total Lung Capacity (TLC) is the maximum volume to which the lungs can be expanded with the greatest possible inspiratory effort¹⁵¹ and the sum of the elastic recoils of the lungs and thoracic cage is equal and opposite to the inspiratory force developed by the respiratory muscles¹⁵².

¹⁴⁵ Guyton, 1981: 480

¹⁴⁶ Guyton, 1981: 480

¹⁴⁷ Guyton, 1981: 480

¹⁴⁸ Guyton, 1981: 480

¹⁴⁹ Guyton, 1981: 480

¹⁵⁰ Cotes, 1993: 104

¹⁵¹ Guyton, 1981: 480

¹⁵² Cotes, 1993: 105

The Forced Vital Capacity (FVC) test is considered one of the most important of the lung function tests. The vital capacity equals the inspiratory reserve volume plus the tidal volume plus the expiratory reserve volume¹⁵³. Vital Capacity records the volume of air a person can exhale after a maximum inhalation. There is a unique limit for maximal flow for each subject, this limit for FVC is reached with limited effort and increasing the force of the exhalation will not increase the flow¹⁵⁴.

The following tables are the estimated vital capacity in liters of normal males and females, based on age and height¹⁵⁵.

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¹⁵³ Guyton, 1981: 480

¹⁵⁴ Hyatt et al, 1997: 7

¹⁵⁵ Frederiksen, 1996: 114 – 115

	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
4' 5"	2.6	2.5	2.5	2.4	2.3	2.2	2.1	2.1	2.0	1.8	1.7	1.6	1.5
4' 6"	2.7	2.6	2.6	2.5	2.4	2.3	2.2	2.1	2.0	1.9	1.8	1.7	1.5
4' 7"	2.8	2.7	2.7	2.6	2.5	2.4	2.3	2.2	2.1	2.0	1.9	1.7	1.6
4' 8"	2.9	2.8	2.8	2.7	2.6	2.5	2.4	2.3	2.2	2.1	1.9	1.8	1.7
4' 9"	3.0	2.9	2.9	2.8	2.7	2.6	2.5	2.4	2.3	2.1	2.0	1.9	1.7
4' 10"	3.1	3.0	3.0	2.9	2.8	2.7	2.6	2.5	2.3	2.2	2.1	1.9	1.8
4' 11"	3.2	3.1	3.1	3.0	2.9	2.8	2.7	2.5	2.4	2.3	2.1	2.0	1.8
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
5' 3"	3.7	3.6	3.5	3.4	3.3	3.2	3.0	2.9	2.8	2.6	2.4	2.3	2.1
5' 4"	3.8	3.7	3.6	3.5	3.4	3.3	3.1	3.0	2.8	2.7	2.5	2.4	2.2
5' 5"	3.9	3.8	3.7	3.6	3.5	3.4	3.2	3.1	2.9	2.8	2.6	2.4	2.2
5' 6"	4.0	3.9	3.8	3.7	3.6	3.5	3.3	3.2	3.0	2.9	2.7	2.5	2.3
5' 7"	4.2	4.1	4.0	3.8	3.7	3.6	3.4	3.3	3.1	2.9	2.8	2.6	2.4
5' 8"	4.3	4.2	4.1	3.9	3.8	3.7	3.5	3.4	3.2	3.0	2.9	2.7	2.5
5' 9"	4.4	4.3	4.2	4.1	3.9	3.8	3.6	3.5	3.3	3.1	2.9	2.7	2.5
5' 10"	4.5	4.4	4.3	4.2	4.0	3.9	3.7	3.6	3.4	3.2	3.0	2.8	2.6
5' 11"	4.7	4.6	4.4	4.3	4.2	4.0	3.9	3.7	3.5	3.3	3.1	2.9	2.7
6'	4.8	4.7	4.6	4.4	4.3	4.1	4.0	3.8	3.6	3.4	3.2	3.0	2.8
6' 1"	4.9	4.8	4.7	4.6	4.4	4.2	4.1	3.9	3.7	3.5	3.3	3.1	2.8
6' 2"	5.1	5.0	4.8	4.7	4.5	4.4	4.2	4.0	3.8	3.6	3.4	3.1	2.9
6' 3"	5.2	5.1	4.9	4.8	4.6	4.5	4.3	4.1	3.9	3.7	3.5	3.2	3.0
6' 4"	5.3	5.2	5.1	4.9	4.8	4.6	4.4	4.2	4.0	3.8	3.6	3.3	3.1
6' 5"	5.5	5.4	5.2	5.1	4.9	4.7	4.5	4.3	4.1	3.9	3.7	3.4	3.1
6' 6"	5.6	5.5	5.4	5.2	5.0	4.8	4.6	4.4	4.2	4.0	3.8	3.5	3.2
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
6' 8"	5.9	5.8	5.6	5.5	5.3	5.1	4.9	4.7	4.4	4.2	3.9	3.7	3.4
6' 9"	6.1	5.9	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.3	4.0	3.8	3.5
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 Society²⁰⁵

Fig 8

	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
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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
7' 3"	6.0	5.8	5.6	5.4	5.2	5.0	4.8	4.5	4.2	3.9	3.6	3.3	3.0
7' 4"	6.1	6.0	5.8	5.6	5.4	5.1	4.9	4.6	4.3	4.0	3.7	3.4	3.1
7' 5"	6.3	6.1	5.9	5.7	5.5	5.2	5.0	4.7	4.4	4.1	3.8	3.5	3.1
7' 6"	6.4	6.2	6.0	5.8	5.6	5.4	5.1	4.8	4.5	4.2	3.9	3.6	3.2

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 Society²⁰⁵

Fig 9

Forced Expiratory Volume in one second (FEV¹) is the maximal volume of air that can be exhaled in the first second after a full inspiration¹⁵⁶. It is one of the most reproducible and most commonly performed tests. The FEV¹ test is one is considered one of the most easily obtained and useful measurements. The normal value depends on the subject's size, age, sex and race, similar indicators being as those for FVC¹⁵⁷.

Lung Function In Brass players

Numerous studies have been done to determine the effect of brass-and wind-playing on lung function. The studies have not come to any conclusion and have recorded differing results.

The main difficulty with a study in this field is that the study group will not be homogeneous. In order to have a sample representative of all peoples, the study group will have to comprise of people of various ages, body types, ethnicity, and across gender lines. The control group has to be selected to match the study group closely. This discrepancy may account for the many different results by each study. Here follows a review of the studies on brass and other wind instrumentalists.

Scorr-Lesnick points to flaws in the previous studies' group make up. Bouhuys¹⁵⁸, for example, used normal subjects from studies conducted separately from his current study as his control group. Scorr-Lesnick attempts to overcome this difficulty by using musicians that do not use breath as the means of tone production, e.g. piano and string instrumentalists. The reasoning is that all musicians will lead similar lifestyles. While that theory might be valid in a general sense, it is still not accurate. The only similarity would be working hours and working environment. Wind and brass players constitute a fairly homogeneous group as far as sound production is concerned; however each instrument still draws very psychologically specific types of personalities. Trumpet players for example, especially lead and principal players need to be A-type personalities if they wish to succeed in their careers. Each instrumental group draws very different people; string players are known to be more serious, usually perfectionists. Brass culture is considered very "laddish".

¹⁵⁶ Cotes, 1993: 135

¹⁵⁷ Hyatt et al, 1997: 11

¹⁵⁸ See below for a full reference.

In my study I use non-wind musicians as my control group and I will compare brass players with each other. This approach is still comparing apples with a whole fruit salad, thus not precisely comparable.

Below is a brief description of each previous study.

Year	1964	
Title	Lung Volumes and breathing patterns in wind-instrument playing	
Research Team	Arend Bouhuys	
What they measured	<ol style="list-style-type: none"> 1. Vital capacity 2. Total lung capacity, and 3. FEV¹ 	
Test Subjects	Control group	Brass players
	"Normal" people from studies conducted previously at the same laboratory.	Professional woodwind (and brass instrument players).
Results	The results for VC, TLC and FEV ¹ were larger in the younger wind players than in the control group.	

Year	1967	
Title	Lung volumes in wind instrument players	
Research Team	Necati Akgün and Hamit Özgönül	
What they measured	<ol style="list-style-type: none"> 1. Total lung capacity 2. Functional residual capacity 3. Forced expiratory volume in one second 4. Maximal inspiratory flow rate, and 5. Maximal expiratory flow rate 	
Test Subjects	Control group	Wind instrument players
	The control group was chosen because of physical similarities with the zurna players.	Zurna players. The zurna is a traditional Turkish instrument similar to the oboe. The players are not professionally trained nor do they read music.
Results	The study found reduced lung function in the players as compared to the control.	

Discussion	The fact that the instrumentalists were long term moderate to heavy smokers and the control group consisted of mostly of light smokers was not taken into account. The authors mentioned that the results of smoking were a likely cause for the reduced lung capacity. At the time of publication the adverse effects of smoking were only beginning to be realized.
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Year	1968	
Title	Lung function in wind instrument players and glassblowers	
Research Team	M. Navrátil and K. Rejsek	
What they measured	<ol style="list-style-type: none"> 1. Residual volume, 2. Forced expiratory index, and 3. Vital capacity. 	
Test Subjects	Control group	Wind instrument players
	63 patients with some form of pulmonary disease and a control group of 73 healthy men who have never before played a wind instrument.	84 wind instrumentalists (woodwind and brass), 83 glassblowers
Results	The musicians scored slightly higher than the control group in most of the lung function tests, except for Total Lung Capacity which was slightly lower. The greater scores in the subdivisions of TLC point the development potential of wind instrument playing.	
Discussion		

Year	1971	
Title	Electrocardiography and lung function in brass instrument players	
Research Team	Alan Tucker, Maurice E. Faulkner, Steven M. Horvath	
What they measured	<ol style="list-style-type: none"> 1. Vital capacity 2. Maximal mid – expiratory flow rate 3. Inspiratory capacity 4. Expiratory reserve volume 5. Total lung capacity 6. Residual Volume 7. Residual Volume/ Total Lung Capacity 	
Test Subjects	Control group	Brass players
	Normal men were selected from two previous studies.	45 young male brass players
Results	Larger VC's and TLC's were found in younger brass playing subjects. The musicians had smaller IC's but larger ERV's. RV/TLC ratios were larger in brass players.	
Discussion	Tucker's team concludes that the greater scores achieved by brass musicians was the result of the training brass playing provides.	

Year	1985	
Title	Pulmonary function in singers and wind-instrument players	
Research Team	Beth Schorr-Lesnack, Alvin S. Teirstein, Lee K. Brown and Albert Miller	
What they measured	<ol style="list-style-type: none"> 1. Maximum Voluntary Ventilation (MVV) 2. FEV¹ 3. FVC 4. Forced Expiratory Flow during the middle half of FVC (FEF 25-75%) 5. Peak Expiratory Pressure (PEP) 6. Peak Inspiratory Pressure (PIP) 7. FEV¹/FVC% 	
Test Subjects	Control group	Brass players
	Professional ¹⁵⁹ String and percussion players	Professional wind instrument players and singers
Results	No differences were found between the study and the control groups	

¹⁵⁹ A musician was considered professional if s/he was regularly employed or regularly engaged as a performing musician.

Intra Oral pressure

Intra-oral pressure is the pressure that forms in the oral cavity when a brass player performs on his/ her instrument. It is said that intra-oral pressure is related to pitch, thus, the higher the pitch the higher the intra-oral pressure, and also that enharmonic pitches will have the same pressure reading on all instruments, therefore concert middle C should give the same reading on all instruments¹⁶⁰.

Intra-oral pressure is not a phenomenon that has been studied extensively. Some of the studies above have measured intra-oral pressure and their findings are recorded below. Intra-oral pressure (together with mouthpiece pressure) may prove to be one of the most significant measures available to brass players.

In preliminary testing, one of my subjects was able to consciously bring down his intra-oral pressure considerably after he was told that lower pressure reading were thought to indicate better players. Sound quality did suffer in his high register. With practice the sound quality should improve.

The studies by Bouhuys¹⁶¹ and Tucker et al found the highest pressures in trumpet players, especially when playing at forte (up to 140 mmhg). Faulkner and Sharpey-Schafer¹⁶² found that professional trumpeters recorded higher pressures than amateurs or less experienced players. Navrátil and Rejsek¹⁶³ did not find exceedingly high pressures except when the musicians played very long phrases or when they played at very loud dynamics.

¹⁶⁰ Frederiksen, 1996: 120

¹⁶¹ 1964: 973

¹⁶² 1959: 685

¹⁶³ 1968: 281

Chapter 3

Breath and belief: Breath is Life.

According to the SAS Survival Handbook, the average person can survive three weeks without food and three days without water but every layman knows that humans can only survive for about four minutes without taking a breath¹⁶⁴. Even if one survives this period the danger of brain damage is a reality. The Survival Handbook states that water is the top priority in survival situations, it does however give detailed instructions on various methods of artificial respiration and, goes on to say that if needed artificial respiration should be carried out almost indefinitely, for once the supply of oxygen to the brain is stopped death is inevitable¹⁶⁵.

Although the four minute limit may hold true for most humans, some dare to push the physical boundaries to seemingly impossible limits. Not only do wind musicians develop their breathing capacity, there are also the glassblowers and the famous Japanese pearl divers. Free divers constantly strive to go deeper than before. Currently the records are as follows: for the deepest variable-weight freedive the record stands at 117m (95m for women), for the deepest constant-weight freedive the record is 87m (70m for women) and the record for deepest dynamic apnea freedive without fins a depth of 134m (95m for women) has been reached. It is interesting that the record for the deepest no-limit freedive is held by a woman, who reached 160m (the record for men is 154m)¹⁶⁶.

Breath can also be used as a devastating weapon. It is said that in a minor key, Kiai, the battle cry of Japanese martial artists can cause partial paralysis by a reduction of the arterial blood pressure¹⁶⁷.

Watson draws between the relationship of life, breath, and the divine. The excerpt below is from his book "Heaven's Breath"¹⁶⁸.

¹⁶⁴ Wiseman, 2003: 40

¹⁶⁵ Wiseman, 2003: 403

¹⁶⁶ Guinness book of world records: 2004, 267

¹⁶⁷ Watson, 1973: 94

¹⁶⁸ Watson, 1984: 327 - 328

"A newborn child, mouth wide, reaches hungrily for air.

Eyes closed, arms flailing, it gags on the unfamiliar medium, holding the air not yet quite sure what to do with it. Then suddenly, sometimes with the assistance of a friendly slap, there is a gasp, a release, a small puff followed almost instantly by a new and larger intake of air. The pump is primed, automatic processes take over, the body draws the third of six or seven hundred million breaths that constitute a lifetime.

It is a magic moment. Not the beginning of life, but such a clear transition, that it is easy to understand why the ideas of life and breath and spirit and creation should have become so intertwined.

In many languages they go by the same name. *Ruh* in Hebrew and Arabic means both breath and spirit. The Dakota and the Sioux called it *niya*, and the Aztec *ehcatl*. Whatever the word, it is also concepts of wind and divinity. Quetzalcoatl, the god of sun and wind and air, is born when the lord of existence breathes on his mother. It is a common belief amongst some Mexicans still, that a man's breath is more responsible for conception than his semen.

The Melbourne tribes of Australia claimed that the creator Pundjel made humans of clay and then 'he lay upon them, and blew his breath into their mouths, into their noses, and into their navels; and breathing very hard, they stirred.'

The Batek negrito people say that *nawa angin*, 'the wind-life-soul', is blown into their bodies through the soft fontanelle of the skull. The Navaho agree and know the name of the god responsible. The Baiga in India called him Bhagavan and said, 'he blew also on the earth and made it hard and firm'. In Teutonic myth, Odin was the wind god, 'the wild huntsman among the raging host' who gave soul to logs of ash and alder that became human when he breathed upon them. In Orissa, the god was Labosum and the creative wind was just one of his stray belches. In other areas the origin of vital air was more mundane, even scatological, but in every case life began with the inspiration of moving air, with wind as breath, bearing spirit.

'Breath is life', say the yogis, because it contains prana – which they see as the source of all energy. Pranayama is the art of controlling breath in such a way that physical, mental, intellectual, sexual, spiritual and cosmic energy are maximized in

an individual. 'When the breath is regular, so is the mind, it becomes attuned to the winds of the universe.'

The system of yoga is one of the prime sources for those who want to develop themselves to the full physical, mental and spiritual human potential. In the development of breathing almost all the available systems owe some debt to yoga.

This chapter provides an overview of some of the exercises used by brass players today. It looks at both the more philosophical and progressive systems available to the brass player and, also at the tools available where the brass player can practise breathing away from the instrument.

Yoga

Yoga is one of the six orthodox systems in Indian philosophy. Pantanjali compiled and organized the 185 aphorisms in the classical work, the Yoga Sutras. Yoga is one of the means for the human soul to unite with the Supreme Universal Spirit. Yoga is derived from the Sanskrit word yuj which means to yoke, or bind together. It also means unity. In the context of the spiritual practice of Yoga, it refers to the unity of mind body and spirit¹⁶⁹.

Yoga sets several goals for its students; they are expected to regain, and then retain their health. The students should work to end their suffering. Everything they do, is done with grace. They must acquire self-knowledge and, integrate that knowledge. These goals, plus the practices of one or more of the principal schools of yoga leads to liberation¹⁷⁰.

The six schools considered principal are:¹⁷¹

1. Raja (royal)
2. Hatha (forceful)
3. Mantra (hymn)

¹⁶⁹ Iyengar, 1976: 19

¹⁷⁰ Rosen, 2002: 14

¹⁷¹ Rosen, 2002: 15

4. Jnana (wisdom)
5. Bhakti (devotion)
6. karma (selfless action)

These schools are introduced below.

The eight steps of attainment in Yoga

1 and 2: Yamas and Niyamas

The Yamas and Niyamas supply the code of conduct for the practitioners of yoga. The Yamas detail which practices should be avoided and the Niyamas those that should be cultivated. The two stages flow into each other. Once a student has learnt what should be avoided, s/he will naturally choose those practices that are to be encouraged. The Yamas and Niyamas are seen as articles for detachment from the material world¹⁷².

The Yamas are injunctions against certain practices, these practices are: violence (ahimsa¹⁷³), stealing (asteya), lying (satya), greed (aparigaha) and sensuality (brahmacarya)¹⁷⁴. The practitioner should also suppress the desire to engage in these activities. For example, not stealing is one part of the Yama; the other part is not having the desire to steal.

The Niyamas to be cultivated are: purity of the body and mind (shauca), simplicity, contentment (santosa), character building (tapas), education of the Self through study of the scriptures (svadhyaya), and the dedication to the Lord¹⁷⁵.

3: Asana

Asana is the practice of assuming prescribed bodily postures, the most recognizable posture being the Lotus position. This is the face of yoga that the West is most familiar with. It is also the chief concern of those who practice Hatha Yoga¹⁷⁶. The Asanas are

¹⁷² Hittleman, 1975: 49

¹⁷³ The spelling used in this dissertation will conform to that used by Rosen.

¹⁷⁴ Hittleman, 1975: 47

¹⁷⁵ Rosen, 2002 :299

¹⁷⁶ Gibson, 1958: 20

used to train the body to be comfortable in the required positions in order to free up the mind in the practices required in the next step¹⁷⁷.

4: Pranayama

Pranayama is the yoga of breath. Pranayama will be discussed in greater detail below.

5: Pratyahara

The west would view pratyahara as “concentration”. The senses are applied inward instead of outward. The student (chela) learns to retain a chain of thought of his/ her choosing and dismiss those that are irrelevant. This is considered an intermediate stage of Yoga, where the student has learnt to control his/ her body and is now training to control the mind. Pratyahara prepares the student for the higher phases of Yoga¹⁷⁸.

Pratyahara calls for a temporary suspension of the senses. This withdrawal and suspension of the senses are in itself a form of concentration. The senses are rendered senseless¹⁷⁹.

6: Dharana

In Dharana the student focuses the mind on a single point to the exclusion of all else. This step can be compared to the asanas, only Dharana strengthens the mind rather than the body¹⁸⁰.

The student chooses a focus for meditation whether it be a sound, an image or an object. He performs the required preliminaries and then starts contemplation of the chosen point. The student advances by learning to suppress all thought that distract from the chosen point of contemplation. By learning to control the distractions the student moves automatically from Dharana to Dhyana¹⁸¹.

¹⁷⁷ Hittleman, 1975: 47

¹⁷⁸ Gibson, 1958: 22

¹⁷⁹ Hittleman, 1975: 46

¹⁸⁰ Gibson, 1958: 23

¹⁸¹ Hittleman, 1975: 46

7: Dhyana

Dhyana is a continuation of Dharana. Once the mind is stilled and fixed on a point (Dharana), Dhyana is holding on to that point. Dhyana is also concerned with abstract concepts¹⁸².

Through Dhyana the student achieves deepening states of Knowing. The illusions of the Self are penetrated. Thinking is suspended and the mind transcends the fixed contemplation point. The student moves to Samadhi¹⁸³.

8: Samadhi¹⁸⁴

Samadhi is the state of profound contemplation. The body and the senses of the yogi are at rest, yet his/her mind is alert¹⁸⁵. The true Self is freed from the worldly illusion and is attuned to the Universal Mind. Samadhi represents attainment in Yoga¹⁸⁶.

The principal schools of yoga

Raja Yoga

Raja Yoga is known as the royal path¹⁸⁷. It has a direct link with Hatha Yoga in that it develops the concepts of Hatha Yoga further but it also draws on the other forms of Yoga as is required.

Hatha Yoga

Hatha Yoga is concerned with the body and its development. Breathing plays an important part in this form of Yoga, inhalation is called the Sun Breath and exhalation is called the Moon Breath. Hatha Yoga teaches the release of physical limitations. Hatha Yoga takes the Asanas to greater lengths¹⁸⁸.

¹⁸² Gibson, 1958: 23

¹⁸³ Hittleman, 1975: 46

¹⁸⁴ The trumpet maker David Monette is heavily influenced by the philosophy of yoga. He has named several of his instruments after yogic concepts such as prana, raja and Samadhi. He goes as far as specifying that if a player doesn't embrace this way of thinking and playing, s/he shouldn't buy one of his instruments.

¹⁸⁵ Iyengar (1), 1976: 52

¹⁸⁶ Hittleman, 1975: 45

¹⁸⁷ Hittleman, 1975: 71

¹⁸⁸ Gibson, 1958:13

Hatha Yoga has three objectives:

1. To cultivate a high level of health and promote longevity.
2. To stabilize and quiet the ordinary mind
3. To awaken the Kundalini

Mantra

There seems to be some debate as to whether Mantra yoga is a branch of Yoga on its own. Hittleman¹⁸⁹ says that it forms a part of Bhakti Yoga whereas Gibson¹⁹⁰ classes it as a branch of its own. Hittleman does state that mantras could be used on their own, to gain some form of material success. In the West this practice is known as positive affirmations.

Jnana Yoga

Jnana is the intellectual path of Yoga and, being open minded is one of this form's characteristics¹⁹¹. The students of Jnana (Jnani) seek Actuality in the Mind. All expressions of spirituality are viewed as containing parts of the truth, though not the whole truth. In the student of Jnana the intellect predominates and s/he needs to cultivate his/ her intuition, as s/he does not trust it¹⁹². Jnana Yoga is both active and passive in its application. Active discrimination is complimented by passive meditation. The Jnani meditates on questions such as "Who am I?" "Who is troubled?" The Jnani will ask these questions until the conscious mind runs out of answers. The Jnani might then perceive the true answers.

Bhakti Yoga

Bhakti yoga is the most accessible form of Yoga and the ancient practitioners declared this form of Yoga fit for all to practice¹⁹³. Bhakti Yoga is the path of devotion and therefore suits those who are devotional by nature. It can be practiced along with any other branch of yoga¹⁹⁴.

¹⁸⁹ Hittleman, 1975: 56

¹⁹⁰ Gibson, 1958: 15

¹⁹¹ Gibson, 1958: 17

¹⁹² Hittleman, 1975: 61

¹⁹³ Hittleman, 1975: 53

¹⁹⁴ Gibson, 1958: 16

Bhakti Yoga has two methods of practice; visualization and the recitation of Japas. Japas are the recitation of mantras done according to a prescribed rhythm and number of repetitions.

Karma

The concept of karma is usually misunderstood in the West. It is seen in an almost negative light. Westerners see occurrences in life as the product of either “good karma” or “bad karma”. The law of Karma should be thought of as the Newton’s law: for every action there is an opposite but equal reaction. Thus in the spiritual law good practices begets good consequences. The religion of Wicca has a similar concept, known as the threefold law: “ever mind the law of three, whatever you put out will come back to thee”. This law states whatever the practitioner puts out whether good or bad will be precipitated but magnified three times. The modern western esoteric traditions have incorporated the term Karma into their vocabulary but it varies slightly in meaning from the eastern concept. In the Kabala¹⁹⁵, the Judaic mystery tradition, the concept is known as Tee-koon¹⁹⁶.

Pranayama

Prana

Prana is found everywhere, it is in the atmosphere. All matter that vibrates and all sources of energy such as heat and magnetism is prana¹⁹⁷. Humans take prana in while breathing, where it is absorbed by the entire astral body. Once prana is taken up in the body it is converted into individual prana (vasti-prana). Vasti-prana divides into 5 major “winds”¹⁹⁸. These winds are present in everybody, the yogis train to be aware and to control these forces¹⁹⁹.

The five winds are:

¹⁹⁵ There are various ways of spelling this word; Q. B.L. Cabala, ect. This is due to the English transliteration of the Hebrew word QBL (Qoph Beth Lamed) Reed, 1989: 4.

¹⁹⁶ Kraig, 1998: 204

¹⁹⁷ Iyengar, 1976: 12

¹⁹⁸ Rosen, 2002: 24

¹⁹⁹ Rosen, 2002: 25

1. *Prana-vayu* (forward wind) which is seated in the heart. Prana-vayu regulates the absorption and assimilation of energy.
2. The *apana-vayu* (downward wind) is located in the lower pelvis and regulates the excretion of energy.
3. *Samana-vayu* (middle wind) is situated at the navel and regulates the absorption and assimilation of energy from the mundane world, such as food.
4. *Vyana-vayu* circulates through the body and distributes energy through the body and,
5. *Udana-vayu* (upward wind) is seated in the throat and creates the energy of expression²⁰⁰.

The term “pranayama” would translate directly as “breathing that is lengthened by a pause”²⁰¹. The pause is an interruption of the breathing process by a planned suspension. In Yoga tradition the breathing process is broken down into three stages: Puraka, Rechaka and Kumbhaka. Puraka is a deep, almost forced, inhalation similar as breathing in through a straw or smelling a flower²⁰². Rechaka (Exhalation) is used to clear the lungs of as much air as possible. Kumbhaka is the retention of the breath²⁰³. In some of the classical texts Kumbhaka becomes a synonym for pranayama²⁰⁴.

Retention can be practiced in several ways. The breath may be retained immediately following an inhalation (Puraka), this is known as the **Inward Chalice**. The **Outward Chalice** is retention after exhalation (Rechaka) where no air, except for residual air, is retained. In the **Absolute chalice (absolute retention)**, the breath is retained, for a desired time, at any point during puraka or rechaka. This practice leads to kevala kumbhaka, the highest attainment in Pranayama²⁰⁵.

Concepts

The yogis teach that there are four methods of breathing

²⁰⁰ Rosen, 2002: 24

²⁰¹ Hittleman, 1975: 104

²⁰² Gibson, 1975: 101

²⁰³ Gibson, 1975: 102

²⁰⁴ Hittleman, 1975: 104

²⁰⁵ Gibson, 1975: 102

1. **High breathing** is known as clavicular breathing in the west²⁰⁶. With this method the ribs, collarbone and shoulders are raised while the abdomen is drawn in, which in turn pushes the contents thereof against the diaphragm, thereby raising the diaphragm. Only the upper parts of the lungs are used. High breathing is considered one of the worst ways to breathe²⁰⁷. It takes a great deal of effort, with the minimum benefit. The gaspy open mouth breathing that results in not an effective use of energy²⁰⁸.
2. **Mid Breathing** is also known as rib or intercostal breathing²⁰⁹. The diaphragm is raised and the abdomen drawn in, the ribs elevate slightly and the chest becomes partially expanded. Low breathing is considered better than high breathing, as it gets more air into the lungs²¹⁰, but is still a lesser form than low breathing or the complete breath²¹¹.
3. **Low Breathing** is a far better method than the previous methods mentioned. In the West it is known as abdominal or diaphragmatic breathing²¹². As the diaphragm is lowered, the abdomen is caused to move out, thus causing a bit of a tummy²¹³.
4. In **Yogi Complete Breathing** the full respiratory system comes into play²¹⁴. It draws on all the methods above to move as much air as possible into the lungs.

Below are some exercises used in pranayama:

²⁰⁶ Ramacharaka, 1905: 33

²⁰⁷ Ramacharaka, 1905: 34

²⁰⁸ Gibson, 1975: 82

²⁰⁹ Ramacharaka, 1905: 35

²¹⁰ Gibson, 1975: 82

²¹¹ Ramacharaka, 1905: 35

²¹² Ramacharaka, 1905: 35

²¹³ Gibson, 1975: 82

²¹⁴ Ramacharaka, 1905: 37

The Cleansing breath

1. Inhale a complete breath
2. Retain the air for a few seconds
3. Pucker the lips as if to whistle (but do not swell the cheeks), then exhale a little air through the opening, with considerable vigor.
4. Stop for a moment, retaining the air, then exhale a little more.
5. Repeat until all the air is completely exhausted.

The Yogi Nerve Vitalizing Breath

The purpose of this exercise is to stimulate the nervous system, develop the nerve force, energy and vitality. It brings stimulating pressure to bear on important nerve centers, which stimulates the entire nervous system.

1. Stand erect
2. Inhale a Complete Breath and retain same
3. Extend the arms straight in front of you, letting them be somewhat limp and relaxed, with only sufficient nerve force to hold them out
4. Slowly draw the hands back towards the shoulders, gradually contracting the muscles and putting force into them, so that when they reach the shoulders the fists will be so tightly clenched that a tremulous motion is felt.
5. Then, keeping the muscles tense, push the fists slowly out, and then draw them back rapidly (still tense) several times.
6. Exhale vigorously through the mouth.
7. Practice the Cleansing Breath.

The efficiency of this exercise depends on the speed of the drawing back of the fists, the tension of the muscles and the fullness of the lungs.

The Yogi Vocal Breath

This exercise produces a pleasant and strong voice for which the Yogis are known. It should not be done as part of a regular routine, on occasion will suffice.

1. Inhale a Complete Breath very slowly, but steadily, through the nostrils, taking as much time as possible in the inhalation.
2. Retain for a few seconds
3. Expel the air vigorously in one breath, through the wide open mouth
4. Rest the lungs by the Cleansing Breath.

The Seven Yogi Developing Exercises

These exercises are used to develop the lungs, muscles and ligaments of the respiratory system.

1. The Retained Breath

This breath is used to clear the respiratory system and is said to help with disorders of the stomach, liver, blood and it may even relieve halitosis.

1. Stand erect
2. Inhale a Complete Breath.
3. Retain air as long as you can comfortably.
4. Exhale vigorously through the open mouth.
5. Practice the Cleansing Breath.
6. Practice to increase the retention period.

2. Lung Cell Stimulation

This exercise stimulates the air cells. Beginners should be careful not to overdo it, as this exercise can cause hyperventilation.

1. Stand erect, with the hands at the sides
2. Breathe in very slowly and gradually
3. While inhaling, gently tap the chest with the finger tip. Constantly changing position

4. When the lungs are filled, retain the breath and pat the chest with the palms of the hands.
5. Practice the Cleansing Breath

3. Rib Stretching

1. Stand erect
2. Place the hands on each side of the body, as high up under the armpits as convenient, the thumbs reaching toward the back, palm on the side of the chest, fingers to the front over the breast.
3. Inhale a Complete Breath
4. Retain the air for a short time
5. Then gently squeeze the sides, at the same time slowly exhaling
6. Practice the Cleansing Breath. Use moderation in this exercise and do not overdo it.

4. Chest Expansion

1. Stand erect
2. Inhale a Complete Breath
3. Retain the air
4. Extend both arms forward and bring the two clenched fists together on a level with the shoulder.
5. Then swing fists back vigorously until the arms stand out straight sideways from the shoulders.
6. Then bring back to "Position 4" and swing to "Position 5"
7. Exhale vigorously through the open mouth.
8. Practice the Cleansing Breath. Use moderation.

5. Walking Exercise

1. Walk with head up, chin drawn slightly in, shoulders back, and with measured tread.

2. Inhale a Complete Breath, counting (mentally) 1, 2, 3, 4, 5, 6, 7, 8, one count to each step, making the inhalation extend over the eight steps.
3. Exhale slowly through the nostrils, counting as before – 1, 2, 3, 4, 5, 6, 7, 8, -- one count to a step.
4. Rest between breaths, continuing walking, counting 1, 2, 3, 4, 5, 6, 7, 8, one count to a step.
5. Repeat until you begin to feel tired. Then rest for a while, and resume, at pleasure. Repeat several times a day.
6. The exercises may be varied to retain the breath during a 1, 2, 3, 4, count and then exhale to an eight-step count.

6. Morning exercise

1. Stand erect in a military attitude, head up, eyes front, shoulders back, knees stiff, and hands at the sides.
2. Raise body slowly on toes, inhaling a Complete Breath, steadily and slowly.
3. Retain the breath for a few seconds, maintaining the same position.
4. Slowly sink to first position, at the same time slowly exhaling the air through the nostrils.
5. Practise the Cleansing Breath.
6. Repeat several times, varying by using right leg alone then left leg alone.

7. Stimulating Circulation

1. Stand erect.
2. Inhale a Complete Breath and retain.
3. Bend forward slightly and grasp a stick or cane steadily and firmly, and gradually exerting your entire strength upon the grasp.
4. Relax the grasp, return to first position, and slowly exhale.
5. Repeat several times.
6. Finish with the Cleansing Breath.

A complete program of pranayama can be found in the book "The yoga of Breath" and its sequel, "Pranayama; beyond the fundamentals" by Richard Rosen. These books take

the Lions, elephants and tigers²¹⁵ approach to training; slow and deliberate training. The first book should take about a year to complete. The classic text for pranayama, "Light on Pranayama", would complement the Rosen books very well.

Similar to the exercises for yoga, minus the mystical content, are those taught by **William Knowles**. Knowles²¹⁶ was born in 1891 and, during his youth lived in Manchester. He contracted a lung disorder after time spent in the merchant marine as a cadet officer. He moved to Montreal when his local doctor advised that a move to a drier climate will be beneficial to his health. In Montreal he was treated by Dr. O. Z. Ha-nish, an unconventional healer of Eastern descent. Ha-nish taught him the exercises that follow. Knowles went on to teach these exercises, first in the Royal Army and later in private practice. His book contains many "case studies", these, however are letters of appreciation rather than scientific case studies.

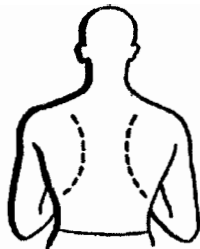
Some principles

The method requires steady rhythm, whether it the exercises require slow or fast breathing. A metronome is a useful tool to keep the rhythm.

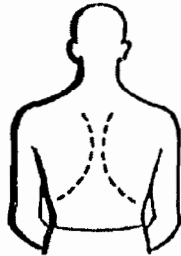
The posture for the exercises is shown in the figure below.

²¹⁵ Trying to force the development could result in death (Iyengar, 1976 :43)

²¹⁶ 1966

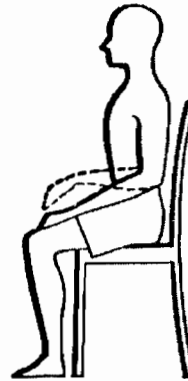


INCORRECT



CORRECT

How the student should keep the shoulder blades together to balance the weight of the chest.



The correct posture for the Knowles' Breathing Technique to be applied with full effect.

Fig 10; Knowles Method Posture²¹⁷

The Cleansing Breath

This exercise would be performed before any of the other exercises.

Breathe in gently but deeply and then exhale. Repeat until you feel strain, at the end of an exhalation purse the lips and blow, trying to clear the lungs of as much air as possible. Repeat the exercise two or three times.

²¹⁷ Morgan, 1966: 106

Deep breathing exercises

Exercise 1

Do the following exercise slowly taking deep breaths, fill the lungs to capacity but do not strain. Breathe in for four seconds, pause for one second then breathe out for four seconds. Continue using the rhythm below:

Breathe in...

to a count of 4 seconds
to a count of 5 seconds
to a count of 6 seconds
to a count of 7 seconds
to a count of 6 seconds
to a count of 5 seconds
to a count of 4 seconds

pause 1 second

Breathe out ...

to a count of 4 seconds
to a count of 5 seconds
to a count of 6 seconds
to a count of 7 seconds
to a count of 6 seconds
to a count of 5 seconds
to a count of 4 seconds

pause 1 second

Exercise 2: the seven-second round

Breathe in for seven seconds, pause a second, breathe out for seven seconds, pause for one second. Repeat 12 times.

Exercise 3

This exercise aims to improve exhalation.

Breathe in...

to a count of 4 seconds

to a count of 5 seconds

to a count of 6 seconds

to a count of 7 seconds

pause 1 second

Breathe out ...

to a count of 12
seconds
to a count of 15
seconds
to a count of 18
seconds
to a count of 20
seconds

pause 1 second

Exercise 4

This exercise should be done after the seven-second round. It concentrates on inhalation.

1. Take a full breath.
2. Breath out but in short bursts
3. Once you cannot exhale any more without strain, pucker your lips and whistle. Some air should be left
4. Once the whistle dies away, do not inhale but keep the posture for 10 seconds
5. Repeat but hold back inhalation first for 15 seconds, then 20 seconds after another repeat.

Exercise 5

1. Breathe in for 15 seconds, pause, then breathe out fully
2. Breathe in for 20 seconds, pause, then breathe out fully
3. Breathe in for 15 seconds, pause for 25 seconds, then breathe out fully
4. Breathe in for 15 seconds, pause for 30 seconds, then breathe out fully

In contrast to the previous methods (Knowles and Pranayama), where the exercises are meant to be practised every day, the Adams²¹⁸ method has a progressive approach, once the basic exercises are mastered, the player will start on day 1, do the exercises as prescribed every day for the following 21 days and as a result your breath control will have increased. It is not stated whether the program should be repeated in a 21 day cycle or if the exercises of day 21 should be practised every day. It is conceivable that the basic exercises could be practised on a daily basis, and using the program again if the player feels that work on breathing will be appropriate.

There is no mystical or esoteric reasoning behind these exercises.

²¹⁸ Sandy Adams. No information is available on the author or the source of these exercises. The exercises have been circulating in the South African brass community for some time without acknowledging the source.

Below are the basic exercises, the full program is given as appendix B.

The basic exercises

BREATHING

1. All exercises must be done through the mouth.
2. When exhaling, pucker lips as if whistling. Do not allow lips to vibrate.
3. When inhaling, the body must be relaxed. When exhaling there must be diaphragm tension.
4. When inhaling, fill lungs from bottom to top.

FULL BREATH

1. Fill the lower part of your lungs by drawing in air directly down to your waistline. Feel your waistline expand pushing your belly button out.
2. Fill above this now, the middle portion of your lungs and raise chest slightly.
3. Now fill top portion of your lungs with chest fully expanded.

THE GENTLE BREATH

1. Take a full breath
2. Do not hold but immediately blow the air out as gently as possible.
3. Exhale for 30 seconds.
4. Expel the remaining breathing.
5. Repeat process 3 times.

THE HELD BREATH

1. Take a full breath
2. Do not relax but hold.

3. While still holding the breath try to relax without tension in the diaphragm.
4. Hold the breath for 30 seconds.
5. Release air forcefully and empty lungs
6. Resume normal breathing
7. Repeat process 3 times.

Forced held breath

1. Take a full breath
2. Do not release but hold
3. While holding place the palms of your hands just below the rib cage
4. Press your hands as hard as you can into your stomach and at the same time force the air in your lungs to the bottom of your lungs.
5. Hold this forced pressed position for a count of 10 seconds.
6. Blow the air out vigorously and expel all air.
7. Resume normal breathing
8. Repeat x3

Jacobs²¹⁹

These exercises are meant to be practised away from the instrument, in front of a mirror. Take frequent breaks to avoid hyperventilation. Reflect often on the amount of air in the lungs and the residual capacity.

To open the oral cavity

This exercise will lead to the experience of inhaling through a large oral cavity.

- In a regular pulse say “ah, oh, ooh, ah, oh, ooh” then inhale. The inhalation should be in time.

To eliminate pressurization

²¹⁹ Frederiksen, 1996: 132 - 134

- Take a full breath with the gesture of surprise, keep the throat open
- With a resonant voice say “one”, pause with the throat open, say “two” with the throat open, say “three” and continue in this manner.

Exercise of the slow full breath

- Slowly move an arm toward the body in a count of six while inhaling until a full breath is taken.
- In a count of six, move the arm away from the body while exhaling.
- Use the arm as a measure device, when half the breath is exhaled, the arm should be half way.

Study of slow breath in breath in thirds

- Use arm motion, moving an arm at the elbow toward the mouth in thirds to give a visual representation of inhaling and exhaling air while imagining the quantity of air moving in thirds. When ordering a breath, do not focus on air velocity as the primary factor, focus on quantity of air.
- Move air in one third of total capacity
- Pause for two or three seconds and reflect on how much air has been taken in and how much room is left for additional air.
- Move air in a second third, pause and reflect.
- Move air in the final third, pause and reflect.
- Move air out one third, pause and reflect.
- Move air two thirds.
- Move air in three thirds.
- Move air out two thirds.
- Move air in one third.
- Repeat using various combinations.

Study of the fast breath

- Establish a steady rather slow beat of about 60 beats per minute.

- In 5/4 time: blow out for counts 1 through 4, breathe on count 5
- In 4/4 time; blow out for 3½ counts, breathe in for ½ count.
- Repeat using various meters and tempi.

Study of the slow breath

- Stand with your arms at your sides, palms down.
- While inhaling raise your arms to encourage the rib cage to elevate and snap your fingers while counting to five.
- On beat 5, your hands should be above your head and your lungs should be absolutely full. When you hold your breath, do not close your throat. Keep the airways open.
- Drop your hands to your sides while continuing to hold your breath. Notice just how full of air you are and how expanded you are from the bottom of your lungs to the base of your neck.
- Exhale over five counts.
- Repeat several times.

Breathing Gym

A further development of the above exercises is the “Breathing Gym²²⁰” developed by Sam Pilafian and Patrick Sheridan, both former students of Jacobs. For a comparison between the Jacobs exercises and the Breathing Gym see the WindSong Press website²²¹. A DVD is available with the book.

They also use body movements to encourage more efficient breathing. The exercises for the dynamic intensity are a good example of their method. For a fortissimo breath, the student mimics the movements (including muscular effort) of an archer, for mezzo forte breathing s/he throws darts and for piano breathing s/he floats paper airplanes²²².

²²⁰ 2007

²²¹ www.windsongpress.com/books/focus%20on%20music/breathing%20gym.htm

²²² Pilafian and Sheridan, 2007: 9

Breathing tools

The Breath Builder

The Breath Builder (sold in South Africa as the WindSong) is a tube of around 15 cm, with a table tennis ball inside. The tube is sealed at the bottom end. The top end is covered with a cap that contains 3 holes to vary resistance. A piece of tubing, used for breathing, protrudes from the top end.

The breathing tube is placed between the top teeth and the tongue. The ball is then brought to the top by either inhaling or exhaling. The goal is to keep the ball at the top of the tube while slowly inhaling and exhaling. Some of the more experimental students at UCT have developed more exercises; however the basic exercises should be mastered first.

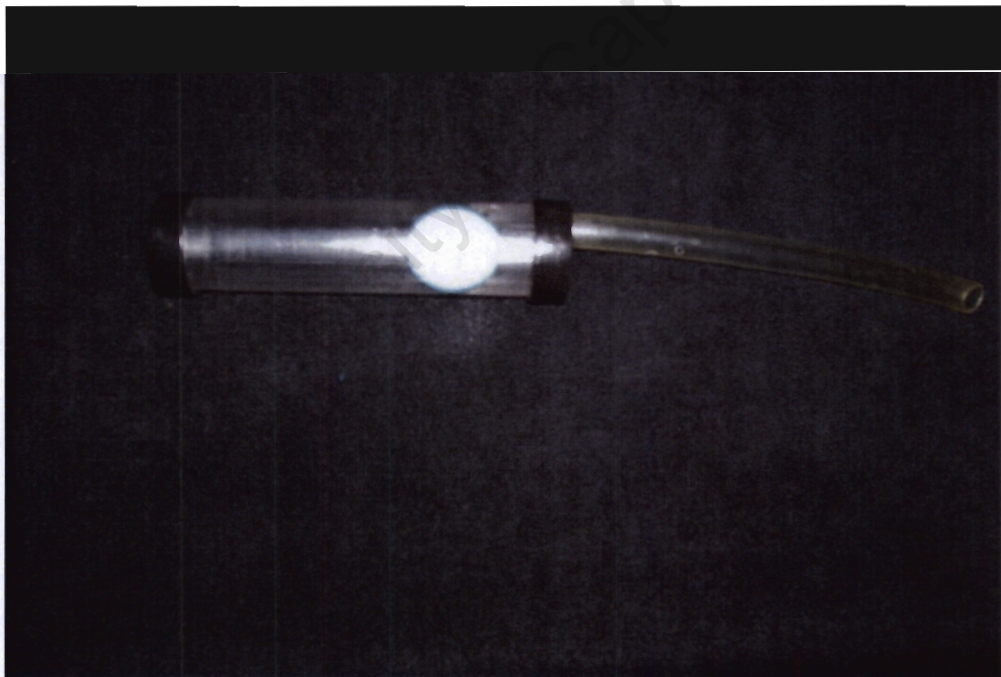


Fig 11

Air Bag

Almost any type of bag could be used as an air bag but five or six liter anesthesia bags are the most popular.

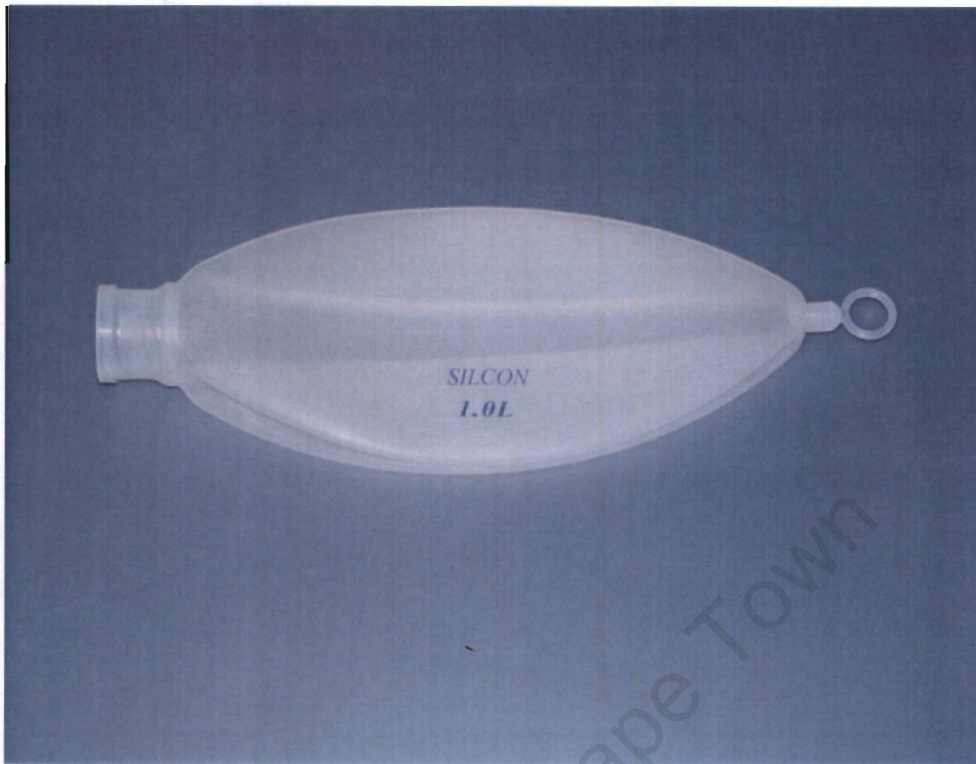


Fig 12²²³

1. The player breathes into the bag then inhales the air inside, fills it up again and keeps repeating this cycle²²⁴. This cycle should be repeated for 20 seconds²²⁵. The inhalation of carbon dioxide rather than oxygen will reduce the occurrence of hyperventilation. Success with this method is partly due to the visual aspect of watching the bag's movement²²⁶.
2. Fill the bag with air, rebreathe and then use the rebreathed air to start playing on the instrument.
3. A mouthpiece could be inserted into the bag for buzzing.

Voldyne

The Voldyne is used to measure the amount of air inhaled. Do no more than 3 or 4 repetitions to avoid hyperventilation.

²²³ http://img.alibaba.com/photo/10831602/Silicone_Breathing_Bag_0_5L_2_0L.jpg

²²⁴ Jacobs lecture notes

²²⁵ Frederiksen: 1996, 175

²²⁶ Jacobs lecture notes



Fig13. A Voldyne

Air pipe

The air pipe is about the length of a trumpet mouthpiece and the diameter should be that of the circumference of the mouthpiece's rim. The pipe is placed in the mouth but should pass through the teeth. Air is then breathed in and out²²⁷.

It would be interesting to be able to test the effectiveness of the breathing exercises and devices. There are however serious limitations in conducting a study of this nature. The first hurdle would be to find a large enough study group to be statistically significant. The second issue is eliminating variables. The study group would have to have exactly the same practise regimen; everyone should practice the same amount of hours, and the same amount of exercise. The only variable being the type of breathing method employed. This kind of study is not viable in the South African milieu.

²²⁷ Jacobs lecture notes

Chapter 4

Research methodology

Ethical permission was obtained from the Health Sciences Research Ethics Committee.

The Subjects

Brass Players

An ideal player is a player that is at the top of his/her profession. S/he does not present any signs of physical stress, even if the player will occasionally admit to feeling emotional stress/ discomfort (stage fright).

Four musicians who most embody the ideal brass player have been identified:

1. M Blake (trumpet)
2. D. Thompson (trumpet)
3. W Haubrich (trombone)
4. B Kierman (trumpet)

Other subjects have been selected from the brass playing community in the Western Cape. These players will be at the minimum standard of Grade 7 from one of the recognized examination bodies (Unisa, ABRSM or Trinity College). They are therefore students at one of the tertiary institutions, adult amateurs or professionals. They come from the following smaller communities:

1. The U.C.T. College of Music
2. The University of Stellenbosch Konservatorium²²⁸
3. The Senior Staff Band of the South African Navy²²⁹
4. South African Army Band Cape Town²³⁰, this group will also include students from various SADC countries.
5. The Cape Philharmonic Orchestra²³¹

²²⁸ Hereafter: US

²²⁹ Hereafter: The Navy Band

²³⁰ Hereafter: The Army Band

6. Freelance Players/ Teachers

The Control Group

The control group consisted of other string and percussion players that do not require breathing to produce music. Most of the control group were students from the South African College of Music. A questionnaire will account for variants in the group.²³²

The Tests

Lung Function

The lung function tests were done according to the methods used at the South African Sports Science Institute.

Intra Oral Experiment

Part 1

Equipment:

1 Sphygmomanometer
.02 mm tubing and connector

The testee is requested to standing a playing with a posture. The tube is to be inserted between the teeth and the cheek. A two-octave B flat major scale will be played at a dynamic level of *mezzo forte*. The scale will progress from each instruments low range to its high range as shown below²³³. The subject is given time to experiment with the placement of the tube before the commencement of the tests. The tests are repeated three times with a short rest between each try²³⁴. The best results of the three tests will be used. The tubes are sterilised between uses.

²³¹ Hereafter: CPO

²³² The questionnaire is attached as appendix C.

²³³ The scales are not notated as written and not in concert pitch.

²³⁴ Stephen et al.: **Spirometric testing**. Chest; 1979, 387.

Trumpet in B Flat



Horn in F



Trombone and Euphonium



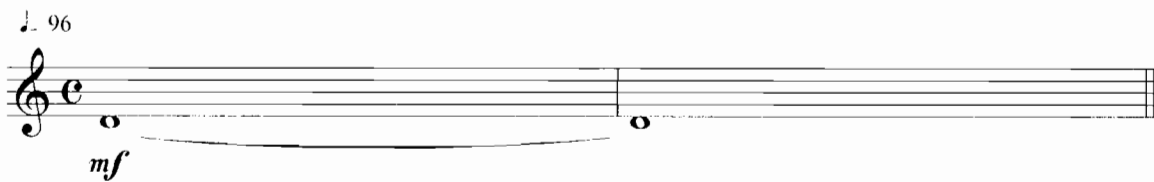
Tuba



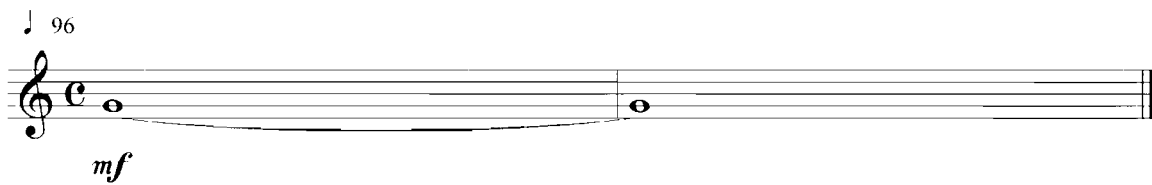
Part 2

All players are to play a *mezzo forte* concert Middle C held for two bars at mm = 96. The pressure measurement will be taken on the first beat of the second bar.

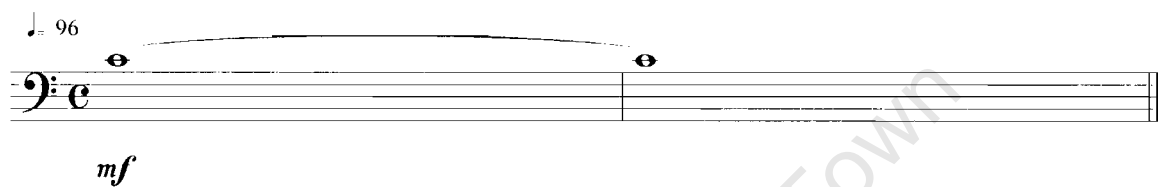
Trumpet in B –Flat



Horn in F



Trombone and Tuba



The subjects also took part in another study conducted concurrently by the Sports Science Institute. They tested Body iQ, handgrip strength and calculated Body Mass Index (BMI).

Results

Body Mass Index (BMI)

BMI was significantly greater in the brass players than in the string players. This could be due to the age difference in the two groups. The older brass players would be expected to be more sedentary, but two of the older ideal players are active runners.

Handgrip Strength (HS)

Handgrip strength was greater in the Brass Players than in the string players. This could be the result of the way in which brass players hold their instruments. Brass players tend to grip their instruments fairly tightly, resulting in isometric tension. This is despite teachers' efforts to minimize such tension, as it affects sound production and endurance,

and may cause injury. In personal conversation Mohiudeen²³⁵ told me that the left hand in trumpet players tends to be the strongest. Brass players are known to grip their instruments aggressively to increase pressure on the embouchure. This is not the recommended way to play, but it is not uncommon²³⁶.

If flexibility of the hand were measured, string players would probably score higher than the brass players.

Heart Rate (HR)

There was no significant difference for HR between brass and string players.

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²³⁵ Fellow student from the SA Sports Science Institute

²³⁶ Recent trumpet clinicians touring South Africa have emphasized the need to reduce pressure by keeping the small finger (pinkie) out of the finger hook. They include Sergei Nakariakov (internationally renowned soloist), Benni Wiame (Rotterdam Philharmonic) and Paul Voet (Ghent Conservatoire).

Chapter 5

Results and discussion

The study group

A total of 60 (100%) musicians took part in this study. There were 43 (72%) brass players and 17 (28%) non-brass players. In total there were 45 (75%) males and 15 (25%) females.

	Male	Female	Total
Brass Players	36	7	43
Non- Brass Players	9	8	17
Sub total			
Total	45	15	60

The control Group consisted of 9 (53%) males and 8 (47%) females while the brass group had 36 (84%) males and 7 (16%) females.

The brass group can further be divided by the instruments they play. The breakdown is as follows:

Brass Group per instrument	
Trumpet	9 (20%)
French Horn	11 (26%)
Trombone	14 (33%)
Euphonium	5 (12%)
Tuba	4 (9%)
Total	43 (100%)

Smoking:

17 (28%) of the subjects defined themselves as smokers²³⁷. There is a fear among some of the smoking brass players that a respected teacher may find out their smoking habit, as he strongly disapproves. Even some of the professional players do not want him to see them smoking. They still fear that he may see their questionnaires and have indicated that they are non-smokers on their questionnaires. I have added these subjects to the smokers.

Smoking habits is defined as follows:

Non Brass		
	Male	Female
Smokers	1 (6%)	2 (12%)
Passive/ Social Smoker		
Ex smoker	1 (6%)	
Non smoker	7 (41%)	6 (35%)

Brass		
	Male	Female
Smokers	6 (14%)	2 (12%)
Passive/ Social Smoker	3(6%)	
Ex smoker	2(5%)	
Non smoker	25 (58%)	5 (12%)

The Questionnaire

The subjects completed a questionnaire to account for any variables. The questionnaire was used to get biographical details, fitness levels and some medical history. A copy is attached as appendix B.

²³⁷ This number includes passive/social, and ex smokers.

Test 1: Brass Players have greater Vital Capacity and Forced Expiratory in one second than string players.

Results:

Vital Capacity

There was no difference in vital capacity between the two groups

FEV¹

The Brass players had greater FEV¹ than the string players (p<5).

Discussion:

This result is not surprising as brass players could be classed as “professional breathers”. They spend much of their time training the respiratory system.

This experiment should ideally be done where there is a large, homogenous group of musicians. One, or a combination, of the top colleges in the United States could take part in the study. At these colleges there is a large group of brass players within a well defined age range. The University of North Texas has an average of 250 brass students compared to the 23 at UCT. The study group should consist only of advanced players; the youngest could be in their third year of study, where one can assume that a high degree of training and sophistication has been reached. The upper age limit could be around 30. This age limit would limit many of variables that could influence the study. If one is more zealous, a height restriction could be put in place. This restriction, however, might eliminate too many candidates, and one would like to have a sample representative of the whole of the musical community.

Test 2: The ideal Brass Player has greater Vital Capacity than the Average Brass Players.

Results:

FVC	Higher	Lower	Similar
ID1	38 (97.44%)	1 (2.56%)	
ID2	21 (53.85%)	17 (43.59%)	1 (2.56%)
ID3	15 (38.46%)	24 (61.54%)	
ID4	8 (20.51%)	31 (79.49%)	

There is no difference in the VC between the Ideal Players and the Average Brass players. It should be noted that the Ideal Players may be more motivated to use their vital capacity to the full.

Test 3: The Ideal Brass player has a greater Forced Expiratory Volume in one second than the Average Brass Players.

Results:

FEV	Higher	Lower	Similar
ID1	30 (76.92%)	9 (23.08%)	
ID2	25 (64.10%)	14 (35.90%)	
ID3	29 (74.36%)	9 (23.08%)	1 (2.56%)
ID4	28 (71.79%)	11 (28.21%)	

The Average Brass Players had greater scores for FEV¹ than the Ideal Players

Discussion:

The result here is probably due to the average difference in age between the Ideal players and the Average players. Most of the average players were younger than the ideal players.

Test 4: Intra-oral pressure will be lower in the ideal players than in the other brass players.

Results:

Tonic

	ID1	ID2	ID3	ID4
Lower	21 (61.76%)	1 (2.94%)	5 (14.71%)	21 (61.76%)
Similar	11 (32.35%)	4 (11.76%)	26 (76.47%)	11 (32.35%)
Higher	0 (0%)	27 (79.41%)	1 (2.94%)	0 (0%)
No Result	2 (5.88%)	2 (5.88%)	2 (5.88%)	2 (5.88%)
Total	34	34	34	34

Octave

	ID1	ID2	ID3	ID4
Lower	28 (82.35%)	2 (5.88%)	19 (55.88%)	1 (2.94%)
Similar	4 (11.76%)	19 (55.88%)	9 (26.47%)	19 (55.88%)
Higher	0 (0%)	11 (32.35%)	4 (11.76%)	12 (35.29%)
No Result	2 (5.88%)	2 (5.88%)	2 (5.88%)	2 (5.88%)
Total	34	34	34	34

15th

	ID1	ID2	ID3	ID4
Lower	11 (32.35%)	1 (2.94%)	25 (73.53%)	11 (32.35%)
Similar	7 (20.59%)	10 (29.41%)	4 (11.76%)	7 (20.59%)
Higher	13 (38.24%)	20 (58.82%)	2 (5.88%)	13 (38.24%)
No Result	3 (8.82%)	3 (8.82%)	3 (8.82%)	3 (8.82%)
Total	34	34	34	34

The Average Brass Player scored lower or similar to the Ideal Players.

Discussion:

This result supports Faulkner and Sharpey-Schafer's results where advanced players recorded higher pressures than less experienced players.

Middle C

	ID1	ID2	ID3	ID4
Lower	4 (11.76%)	2 (5.88%)	2 (5.88%)	4 (11.76%)
Similar	13 (38.24%)	0 (0%)	14 (41.18%)	13 (38.24%)
Higher	12 (35.29%)	27 (79.41%)	13 (38.24%)	12 (35.29%)
No Result	5 (14.71%)	5 (14.71%)	5 (14.71%)	5 (14.71%)
Total	34	34	34	34

The expected result for this test was that all players should have had similar results. The Average players had higher or similar readings than the Ideal Players

Discussion:

This result supports Faulkner and Sharpey-Schafer's results where advanced players recorded higher pressures than less experienced players. This result may point out that

it is the efficient use of pressure, rather than a lower pressure, that gives a better quality of performance.

One variable not accurately accounted for is dynamics. The subjects were asked to play the exercises at a dynamic level of mezzo forte. While the subjects may have done this, dynamic levels are subjective. This is so for a variety of reasons. If we accept that a symphonic musician represents the benchmark for brass players, musicians in other genres of music will have a different concept of dynamics than they do. The mezzo forte of a military musician might be the forte of the symphonic musician. Jazz musicians often use electronic amplification and therefore will have a completely different concept of dynamics; they simply don't have to put in that much effort to produce a wide variety of dynamics. The experiment should be conducted with a sound pressure meter where a predetermined reading will be used for all players. It would also be beneficial to take readings at various dynamic levels.

The equipment for this experiment should be further refined. A gauge that could fit in the oral cavity, and transmits the data wirelessly would be the ideal. This would solve the discomfort many of the players experienced while the tests were performed. It would also not interfere with the embouchure of the subjects. The pipe protruding through the embouchure may have influenced the results negatively.

I would also like to point out that this experiment might be measuring the increase in intra-thoracic pressure associated with exhalation. The second part of this test should be the measurement of mouthpiece pressure on the embouchure. I think that the combination of these tests may yield some interesting results.

Suggestions for further study

The exact role of the facial muscles and the formation of a strong, flexible and efficient embouchure is a study of great importance to brass players. This topic is not well understood and the community will welcome accurate information.

The intra-oral experiments should be refined and further testing should be done, perhaps adding a measurement for mouthpiece pressure²³⁸.

²³⁸ The equipment to test mouthpiece pressure is under development at the Cape University of Technology. I hope to collaborate with them in this regard.

It is my hope that the research done for this study will provide information that is much needed in the South African Brass Community.

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Appendix A

- BREATHING -

Arnold Jacobs, Tuba
Chicago Symphony Orchestra

Breathing is not a matter of diaphragm pressure with brass playing. It is a matter of volume of air.

INHALATION: Keep lumbar arch straight. Keep backbone in a straight line, or curve as if in standing position. "Strength is my enemy, weakness is my friend!" The pushing out of the diaphragm is wrong; keep the diaphragm as loose and relaxed as possible. There should be no muscle tension in the diaphragm. Work for volume. With the back straight, breath so that the rib cage rises as air is taken in. Guide from the 10th rib, since #11 and #12 are floating and do not count. The whole rib cage should rise as air is taken in. Do not pull shoulders up, but shoulder should rise with rib cage assembly. Breast plate (center of chest) should expand and rise slightly. (This could be called modified chest breathing, but it is not.) It is the same type of breathing that one does after long and hard running. After strenuous running, one does not even think how he breathes. "strength is my enemy, weakness is my friend," refers to the diaphragm. It should remain flabby while breathing. If it expands, fine; but it should not be pushed out by muscles; rather, by air volume.

Always take in more, much more, than is needed. This will improve tone instantly. Have the most beautiful and buoyant sound in mind BEFORE the sound is produced.

EXHALATION: While playing, the breast plate and rib cage should start descending rapidly and immediately. This will vary with dynamics and register. The descending of breast plate and rib cage assembly serves two purposes: (1) They form a steady, fast stream of air. (2) They form a type of collapsed wind bellows that can expand and draw in air rapidly when needed.

Do not breathe in rhythm to begin with. Feel yawning sensation before first note is produced. Draw air in freely and fully, but not in one gasping fashion. This new type of breathing will not take place overnight!!! It should slowly be incorporated into one's playing, replacing bad habits.

When inhaling and exhaling, always think of "HO" syllable. This keeps throat open, and allows more air to pass quicker.

This type of breathing is the **ONLY WAY TO BREATHE** and since the potential of one's mind is so great, it can and **MUST** be done.

HOW TO PRACTICE

- A. Do it EVERY DAY.
- B. While you practice, rest as much as you play.
- C. In practicing, a balanced diet of musical exercises is preferred: i.e. both loud and soft playing; both legato and staccato playing; both flexibility and strength exercise.
- D. Don't go overboard on any one phase of study. **SOUND IS MOST IMPORTANT!!** Don't sacrifice your sound for anything. Keep your mind in your sound. Sing through your instrument.

Appendix B

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SUPER LUNG AND BREATH CONTROL

BY SANDY ADAMS

Begin your playing this way;

1. Hold your horn lightly yet firmly
2. Place your mouthpiece lightly but securely on your embouchure
3. Take full breath and blow through horn directly from diaphragm
4. Concentrate on free and maximum lip vibration
5. Think of air diaphragm doing all the work

BREATHING

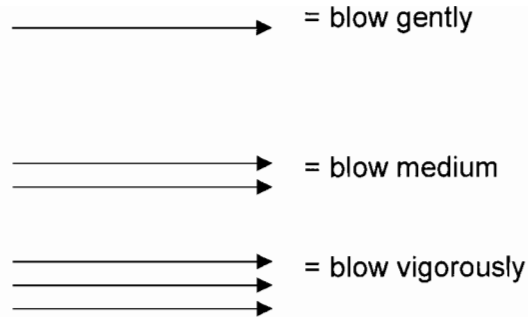
1. All exercises must be done through the mouth.
2. When exhaling, pucker lips as if whistling. Do not allow lips to vibrate.
3. When inhaling, the body must be relaxed. When exhaling there must be diaphragm tension.
4. When inhaling, fill lungs from bottom to top.

FULL BREATH

1. Fill the lower part of your lungs by drawing in air directly down to your waistline.
Feel your waistline expand pushing your belly button out.
2. Fill above this now, the middle portion of your lungs and raise chest slightly.
3. Now fill top portion of your lungs with chest fully expanded.

THE EXERCISES

1. 5 minutes a day.
2. 21 day course
3. 16 different exercises.
4. Start all exercises with full breath
5. Don't overdo things in the first few days.
6. After each days exercise try to use whatever learn in practicing.
Do this until it becomes automatic.



DAY 1

A. Deep panting breath

1. Take a full breath
2. Blow out immediately and immediately take another deep breath.
3. Breathe deeply in and out, in and out etc as vigorously as possible just as if you were panting for breath after you have been running.
4. Do 10 in – and exhalings and then stop.
5. Resume normal breathing
6. Repeat twice.

B. THE GENTLE BREATH.

1. Take a full breath
2. Do not hold but immediately blow the air out as gently as possible.
3. Exhale for 30 seconds.
4. Expel the remaining breathing.
5. Repeat process 3 times.

C. THE HELD BREATH

1. Take a full breath
2. Do not relax but hold.
3. While still holding the breath try to relax without tension in the diaphragm.

4. Hold the breath for 30 seconds.
5. Release air forcefully and empty lungs
6. Resume normal breathing
7. Repeat process 3 times.

When playing after this make sure you start each phrase with a full breath.

Be sure to relax the throat. Open mouth while holding the breath.

The two main characteristics of the air stream as it travels through your horn are;

1. The speed of the air
2. The amount of concentration of the air,
 - a) Applies to pitch
 - b) Applies to volume

When playing higher think of the air traveling faster than the horn. When playing louder there is a more concentrated volume of air.

When going higher think of notes in front of you rather than above you e.g. blowing out a candle one foot in front of you and then one two feet in front of you.

When descending, relax proportionately. Diaphragm tension must be keeping air flowing. Never have the feeling of holding back air flow- air must always be moving.

The same applies to pedal notes as to high notes i.e. notes in front of you. The only difference is, when playing higher notes you raise your lower jaw to bring lips closer together. For pedal notes you lower to relax embouchure.

NB: maintain diaphragm tension when exhaling.

All exercises must be done in upright sitting/standing position. Avoid droopy or slouched position.

DAY 2

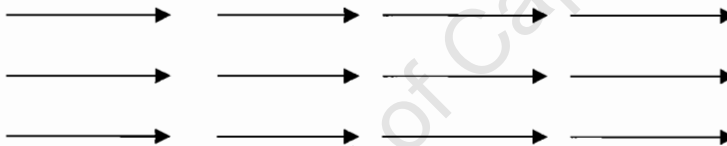
A. Deep panting breath x2

B. Gentle breath x3

Exhale for 35 seconds

C. Take vigorous breath.

1. Take a full breath
2. Do not hold but immediately exhale as forcefully as you can.
3. Empty the lungs completely
4. Resume normal breathing
5. Repeat process 3 x



8. The held breath x3

Hold breath for 35 seconds

DAY 3

A. Deep panting breath. 2x

B. Gentle breath 2x Exhale for 40 seconds

C. Vigorous breath 3x

D. Shallow breath (panting)

1. Take a very shallow breath filling only the top half of the lungs.
2. Blow out immediately and then another shallow breath.
3. Continue this shallow in- and exhaling as fast as possible, much the same as a dog pant when hot.

4. Do for ca. 10 seconds
5. Resume normal breathing.
6. Repeat 2x
7. Held breath x3
Hold for 40 seconds

DAY 4

- A. Deep panting breath x2
- B. Vigorous breath x3
- C. Shallow panting breath x2
- D. Held breath x2
Hold for 45 seconds
- E. Held breath x2
Hold 50 seconds.

DAY 5

- A. Deep panting breath 1x
- B. Shallow panting breath 1x
- C. Vigorous breath 2x
- D. Gentle breath 2x
Exhale for 50 seconds
- E. Held breath 2x
Hold 50 seconds.

DAY 6

- A. Deep panting breath 1x
- B. Shallow panting breath 1x
- C. Vigorous breath 3x
- D. Held breath 2x
Hold for 60 seconds
- E. Gentle breath 2x

Exhale 60 seconds.

DAY 7

- A. Deep panting breath 1x
- B. Power breath
 1. Take a single sheet of paper (8 1/2" x 11") and hold it against a flat wall with your face circa 6" away from it.
 2. Take a full breath
 3. Blow vigorously at the center of the paper. Try to keep the paper pinned to the wall for 6 seconds.
 4. Resume normal breathing
 5. Repeat 6 times
- C. Gentle breath 1x
Exhale for 60 seconds
- D. Held breath 1x
Hold for 60 seconds
- E. Vigorous breath. 3x

DAY 8

- A. Deep panting breath 1x
- B. Forced held breath.
 1. Take a full breath
 2. Do not release but hold
 3. While holding place the palms of your hands just below the rib cage
 4. Press your hands as hard as you can into your stomach and at the same time force the air in your lungs to the bottom of your lungs.
 5. Hold this forced, pressed position for a count of 10 seconds.
 6. Blow the air out vigorously and expel all air.
 7. Resume normal breathing
 8. Repeat 3x

- C. Vigorously breath 3x
- D. Held breath 1x
Hold 60 seconds
- E. gentle breath 1x
Exhale 60 seconds.

DAY 9

- A. Deep breath (panting) 1x
- B. Power breath 6x Increase distance 1 foot
- C. Held breath 1 60 seconds
- D. Vigorous breath 3 x

DAY 10

- A. Deep panting breath 1x
- B. Forced held breath: 3 x 15 seconds
- C. Vigorous breath x 3
- D. Held breath 1x 60 seconds
- E. Gentle breath 1x 60 seconds

DAY 11

- A. Deep panting breath 1x
- B. Power breath 6x 2 feet
- C. Gentle breath 1 x 60 seconds
- D. Held breath 1x 60 seconds
- E. Vigorous breath 3x

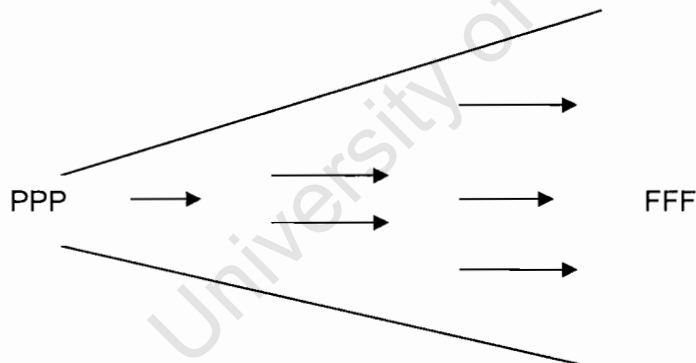
DAY 12

- A. Deep panting breath 1x
- B. Forced held breath 3x 20 seconds
- C. Vigorous breath 3x

- D. Held breath 1x 60 seconds
- E. Gentle breath 1 x 60 seconds

DAY 13

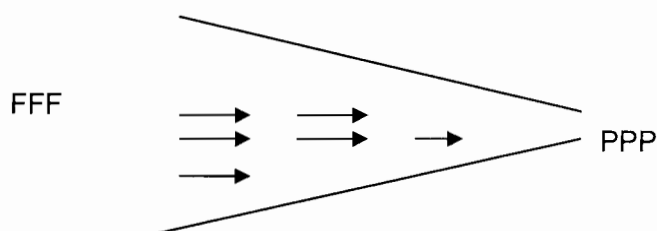
- A. Deep panting breath x2
- B. Power breath x3
- C. Crescendo breath
 1. Take a full breath
 2. Do not hold but blow out immediately as gently as possible.
 3. Gradually increase the speed of the air until blowing out as vigorously as possible.
 4. Expel all air.
 5. Resume normal breathing.
 6. Repeat process x3



D. The Decrescendo breath

1. Take a full breath
2. Do not hold but immediately blow out as vigorously as possible
3. Gradually decrease the speed of air until blowing as gently as possible.

4. Expel all air.
5. Resume normal breathing.
6. Repeat x3



E. Vigorous breath x3

Day 14

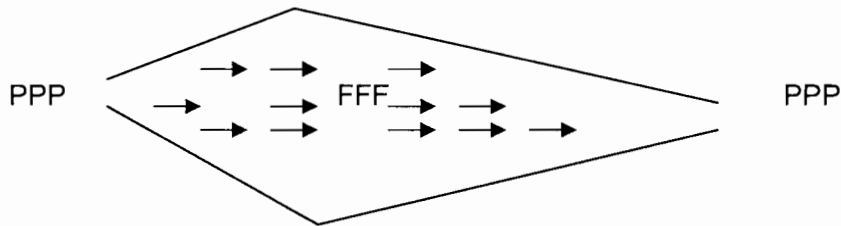
- A. **Deep panting breath. x1**
- B. Forced held breath x3
- C. Crescendo breath x3
- D. Decrescendo breath x3
- E. Gentle breath x2 60 seconds

Day 15

- A. **Forced held breath x3**
- B. Crescendo – Decrescendo breath
- C. Take a full breath
- D. Do not hold but blow out immediately as gently as possible
- E. Gradually increase the speed of the air until blowing as vigorously as possible, and then gradually decrease the speed, of the air until blowing as gently as possible.
- F. Expel all air

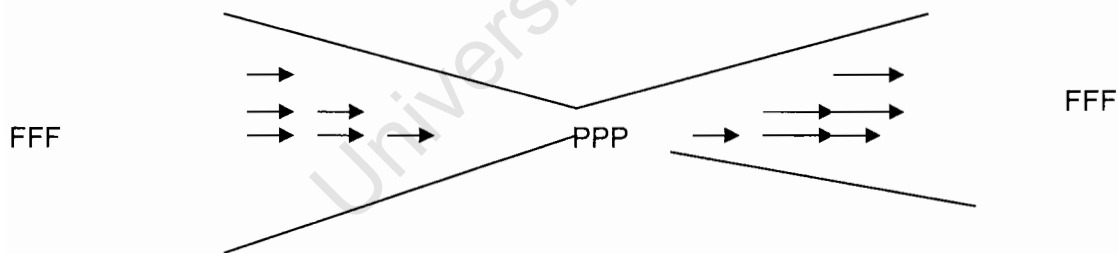
G. Resume normal breathing.

H. Repeat x3



Decrescendo – Crescendo breath.

1. Take a full breath.
2. Exhale as vigorously as possible.
3. Gradually decrease the speed of the air until blowing as possible, then gradually increase until blowing as vigorously as possible.
4. Expel all air.
5. Resume normal breathing
6. Repeat x3



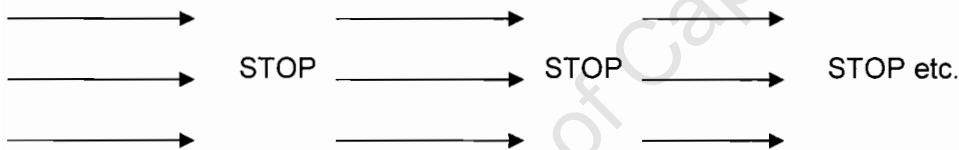
D. Held breath x1 for 60 seconds

DAY 16

- A. Power breath x3
- B. Cresc.-descerc. Breath x3
- C. Decres. – cresc. Breath x3
- D. Gentle breath x1 60 seconds.

DAY 17

- A. Forced held breath x3
- B. Vigorous stop-start breath
 1. Take a full breath
 2. Do not hold but blow out vigorously as possible for 1 second, then hold for 1 second.
 3. Do not take another breath
 4. Continue until all air is expelled.
 5. Resume normal breathing
 6. Repeat x3



- C. Gentle stop-start breath
 1. Take a full breath,
 2. As above, but blow gently and then stop.
 3. Resume normal breathing.
 4. Repeat x3
- D. Decrescendo-crescendo breath x3
- E. Crescendo – decrescendo breath x3

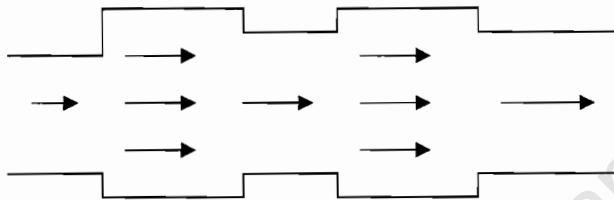
DAY 18

- A. Power stop – start breath 3x
- B. Vigorous stop – start breath. 3x
- C. Gentle stop- start breath. 3x

- D. Crescendo – decrescendo breath 3x
- E. Decresc. – cresc. Breath 3x

DAY 19

- A. Forced held breath 3x
- B. Soft – loud breath.
 - 1. Take a full breath.
 - 2. Blow out gently, then vigorously, then gentle etc
 - 3. Repeat x3
 - 4.



- C. Soft medium loud breath
 - 1. Take a full breath
 - 2. Blow gently, then medium, then loud and back again etc.
 - 3. Repeat 3x
- D. Cresc.-decresc. Breath x3
- E. Gentle breath x1 60 secs or longer

DAY 20

- A. Power breath x3
- B. Soft loud breath x3
- C. Soft medium loud breathx3
- D. Decresc – cresc breath x3 x1 60 seconds or longer

DAY 21

- A. Forced held breath x2
- B. Soft medium loud breath x1
- C. Cresc. – decrec. Breath x1
- D. Decrec. – Cresc breath x1
- E. Pumping breath
 1. Take a full breath
 2. Blow gently but periodically accentuating the flow, as if you were pumping air out your lungs.
 3. Repeat 3x
- F. Vigorous stop-start breath x1
- G. Gentle stop-start breath x1
- H. Power breath x3

Appendix C

University of Cape Town

Profile

Name: _____

Date of Birth: _____

Age: _____ Sex: _____ Height: _____

Weight: _____

Instrument(s): 1) _____ 2) _____

Profession: _____ (students should also mention their chosen future career)

Note any recent career changes:

1.1) Have you ever been told by a doctor or nurse that you have one of the following?

Yes

Asthma

Emphysema

Bronchitis

Other _____

No

1.2) Are you susceptible to colds? Yes No

1.3) Do you smoke? Yes

No

1.4) If yes, how many cigarettes do you smoke per day? _____

2.1) Fitness level: Very fit

Fit

Unfit

2.2) Do you play any sport or do any regular exercise: Yes

No

Elaborate

At which intensity level do you participate in sport/exercise: Low
Moderate
Intense
Very Intense

2.3) Do you dive? No
Skin
SCUBA

3.1) How much time do you spend playing your instrument per day (in hours): _____

3.2) Do you use a breath trainer? Wind/Song
Anaesthesia bag
Breath pipe
Special practice routine (Specify)

Other: _____

3.3) Do you sense pressure while playing? If so, where?

3.4) Does the pressure shift to another part of the body if you change ranges or at different dynamic levels?

3.5) Is there a change in pressure at different dynamic levels or depending on the time you play?

(Any additional remarks should be added on the back of this questionnaire)

Test results

Vital capacity: _____

Forced respiratory rate: _____

Oral pressure: _____

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