

University of Wisconsin Stevens Point

The Alexander Technique and Body Mapping
A Strategy for Voice Teachers and Choral Directors

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by
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Introduction

The Alexander Technique and Body Mapping are invaluable additions to vocal studio and choral settings. Understanding the places of balance and the proper use of the body will allow the voice to sing with freedom, resonance and clarity.

Frank Pierce Jones explained the Alexander Technique during a lecture given at the Indiana University School of Music, Bloomington, Indiana on March 10, 1975 as follows:

The Alexander Technique is a method for getting rid of, (inhibiting) unwanted habit patterns that interfere with smooth performance – not just musical performance but any performance. For the performer it is a method for using kinesthetic cues – the sensations of tensions, effort, weight and the like – in order to organize his field of awareness in a systematic way, so as to take in the whole of what he is doing instead of just a part, and to accomplish what he aims to do without unwanted side effects. (Jones, 1975)

In her book, *Voice and the Alexander Technique*, Jane R Heirich delineates what the technique is and is not:

The Alexander Technique is not about release of tension *per se*, but about efficiency of muscle use (i.e. the appropriate use of the appropriate muscles for whatever is the task at the moment). It is not a relaxation technique, but about balanced strength, coordination, and ease of movement... It is not about learning deep-breathing exercises, but about relearning the elasticity of the entire thorax and of the muscles involved in breathing. It is not *posture* as

a static concept, but about dynamic *poise* in movement..." (Heirich, 2005)

Barbara Conable describes body awareness as essential to good singing. Body awareness comes through our kinesthetic sense. Kinesthetic sensations come from special sense organs in our muscles. Kinesthetic along with auditory and visual information comprise our inclusive awareness, which contains all the information needed. In her book *What Every Musician Needs to Know about the Body: The Practical Application of Body Mapping to Making Music*, she describes the Alexander Technique as:

...a simple and practical method for improving ease and freedom of movement, balance, support, flexibility and coordination. It provides a means whereby the use of a part – a voice, or an arm or a leg – is improved by improving the use of the whole body, indeed, the whole self. (Conable, 2000)

James McKinney has written about the Alexander Technique in his book, *The Diagnosis and Correction of Vocal Faults: A manual for teachers of singing and for choir directors*.

In recent years a system for establishing proper posture and freeing the body, mind and emotions to function as a unified whole has gained wide acceptance. It is known as the Alexander Principle... A practitioner who is trained in this system can solve many of the problems of alignment... (McKinney 1994)

This paper will provide voice instructors and choral directors with specific information on the use of the Alexander Technique and Body Mapping for private

studio instruction and choral rehearsals resulting in the attainment of optimum performance.

F.M. Alexander

Frederick Matthias Alexander was an Australian actor in the late 19th century. Although successful in many ways, he experienced failure of his voice frequently during performances. Since medical examinations revealed no cause, and the failures happened during performances, he deduced that something during performance was causing the problem. After prolonged self-evaluation and observation, he discovered that movements of his head and neck led to poor breathing and other physiological failures. He discovered that when he was on stage he would tilt his head back thinking this would help him project but it only served to shorten his neck which led to poor breathing. He found that with every movement he tended to pull his head back and down. This he believed was the key to his disability. (Maisel, 1990)

“The prevention of [the pulling down and back], he discovered lay in a technique of physical reeducation based upon a certain dynamic relationship of the head, neck and torso.” (Maisel, 1990) This basic scientific method of “watching and wondering” about behavior is what led to Alexander’s discovery.

He discovered that by removing habitual responses he could set about a change in the use of his body. His voice improved so much that other actors and singers sought him out to find out what he had discovered. He began teaching what he had learned from his body-mind investigation. During a six-month tour of recitals in Tasmania and New Zealand, he came to understand the meaning of

his work and what it could become. His pupils were primarily other voice students, but soon a number of them were patients sent to him by doctors.

He referred to his approach as the "Use of the Self", a natural process of breathing and vocal production. Eventually, local doctors sent patients to him who suffered from such maladies as pulmonary tuberculosis, adhesions of the lungs and spinal trouble. Some of the medical faculty members at the University of Melbourne studied with him. (Maisel, 1990)

He was so successful that he was encouraged to move to London so that his work could become well known. By 1910 he began to publish his work so that he would not be misrepresented. His first book *Man's Supreme Inheritance*, presented the principles of his work. The great actors and actresses of this time flocked to him to learn the technique, as they do today. Later on the film stars came.

As a consequence of World War I, students stopped coming. In 1914 Alexander visited the United States and from then on until 1924 he spent half the year there and half in other countries. (McCallion, 1988) "Besides John Dewey, other influential figures in America like Lewis Mumford, Waldo Frank, Leo Stein and James Harvey Robinson (not to mention J.B. Duke, the tobacco magnate), were all to become interested in the technique." (Maisel, 1990)

John Dewey was a student of F.M. Alexander and the Alexander Technique. In 1918, John Dewey, gave three lectures at Stanford University which were expanded for his book *Human Nature and Conduct*. He explained

that a habit cannot be changed without the intelligent control of an appropriate means or mechanism and that wishing for a behavior change would not bring the desired result. "Dewey says [that] is superstition....He introduces F.M. Alexander and devotes the next fifteen pages to an exposition of the Alexander Technique as a scientific and reliable means for changing behavior." (Jones, 1997)

In 1923, Alexander published his second book, *Constructive Conscious Control of the Individual*. He established a school for children between the ages of 3 to 8 in London in 1924. It was supported by two former students, the Earl of Lytton and the former viceroy of India. By 1930 he had established training courses so that his work could continue after his death. In 1932 *The Use of the Self* was published explaining what Alexander had done to develop his technique. It was reprinted in 1984. With the onset of World War II, the children's school was evacuated to America accompanied by Alexander and three teachers. The school was reestablished at the Whitney Homestead in Stowe, Massachusetts. American children joined the school. (Maisel, 1990) In 1943 he published his fourth book, *The Universal Constant in Living* and then returned to England. (McCallion, 1988)

Alexander continued to work with students until just days before his death in 1955 at age 86. Even a stroke in 1947 did not prevent him from assisting others with his technique." (Maisel, 1990) His work influenced such luminaries as Aldous Huxley, George Bernard Shaw, and William Temple, Archbishop of

Canterbury. There are many fully trained teachers in many countries continuing the work which he began. (McCallion, 1988)

The Alexander Technique

The Alexander Technique is a method for getting rid of unwanted habit patterns that interfere with smooth performance – not just musical performance, but *any* performance. It is a method for looking into a microscope or painting a ceiling or playing the violin, without getting a stiff-neck; for playing the piano or shoveling snow or working at a desk, without low back pain; for listening to a lecture, or playing a familiar piece of music without mind-wandering. (Jones, 1975)

The technique is a method of kinesthetic cues. It is a systematic way of organizing awareness of tension, effort, and weight to understand the entirety of what we are doing instead of only a part. It helps us accomplish optimum performance without unwanted side effects.

Sandra Head explains in her article *Singers, Singing Teachers and the Alexander Technique* the following;

I have been a professional singer of theater and classical music for over 25 years... About eight years ago I began to notice a significant rise in tension when I sang and taught, it began with my awareness that I was stiffening my neck and feeling increased nervousness about performing. Within a year, I had quickly escalated the stiffness into chronic pain in my neck, head and back... My stamina for singing or teaching waned dramatically. To my ear, my voice was becoming less resonant. Breathing to sing became laborious...

She continues by describing possible causes for the malfunction of her voice along with different remedies that were tried and failed.

She then encountered literature regarding the Alexander Technique

and chose to re-educate her understanding of dynamic and balanced body alignment. She began private Alexander lessons in the Spring of 1994.

In my first Alexander Technique lesson, I discovered that the teacher was going to communicate with me through touch, combined with verbal "directions" and verbal explanations and feedback. Although fascinated, I was quite disoriented...

I understand almost nothing about what the teacher is doing, nor what she wants me to do. Her hands are on me a great deal, but in such a subtle way that I can barely feel them. The changes she is making in the area of my head, neck and back seem so small as to be completely insignificant. She asks me not to try to help her make the movements nor to anticipate what she is doing. She begins by giving me directions regarding my head, neck and back with some explanation as to what they mean. She asks me to think the directions, not do them, while she touches my body. Thinking without doing is incredibly difficult. As I walked out of the teacher's studio I felt mentally buoyant and much lighter than usual, as if my legs were dangling out of my hips...

After three months of lessons, my pain seemed to disappear. Ease began creeping not only into my singing, but also into everything I did. By the time I had completed a year of lessons, bouts of stiffness became more infrequent. Breathing while singing became much easier. Jaw tension dramatically reduced and I noticed that my jaw was moving differently while I sang. (Head, 1996)

She concluded that the Alexander Technique had provided her voice with more resonance, stamina for performing, and improved teaching skills.

The benefits of the Alexander Technique are acquired by one's own experience of what F.M. Alexander called constructive conscious control. This is a process of self-observation and analysis where one becomes knowledgeable about their habits so that they can suspend habitual muscular tightening which he called "downward pull" and consciously replace it with constructive behavior. "Natural movement is discovered to be that movement which is most supported and sustained by the body's whole complex of postural reflexes, including the much prized "primary control", the natural lengthening and gathering of the spine in movement, which depends on a dynamic initiating relationship of the head to the spine." (Conable, 2000)

This conscious control is dependent on "inclusive awareness". John Dewey was attracted to the Alexander Technique because it provided a demonstration of the unity of mind and body. He had been physically awkward and said that he acted quickly and impulsively without thought. "Thought in this case was saved for 'mental' activity, which had always been easy for him. It was a revelation to discover that thought could be applied with equal advantage to everyday movements." (Jones 1997)

Habits are not "an untied bundle" of isolated acts. They interact with one another and together make up an integrated whole. Whether or not a particular habit is manifest, it is always operative and contributes to character and personality. Mechanization is an essential property of all habit. But it does not follow that habit must be mindless. "The real opposition," Dewey said, "is not between reason and habit, but between routine unintelligent habit and intelligent habit or art." It is the function of

intelligence to determine where changes should be made.

A habit cannot be changed, however, without the intelligent control of an appropriate means or mechanism. (Jones 1997)

Frank Jones in a lecture given at Indiana University in 1975 explains that between the thought of doing something and putting the thought into action there is a characteristic preparation or "set" ("ready, on your mark, get *set*, go") which strongly affects the character and quality of the response. You might say the set determines the response. Sets are difficult to change because they are unconscious. They are most evident when what you are getting set for doesn't happen – when the suitcase you thought was full turns out to be empty, when there is one more or one less step in a stairway. (Jones 1975)

Alexander discovered that using his hands he could instruct his students by giving them information directly through the kinesthetic sense. He was able to bring to their consciousness the maladaptive sets they had developed. This teaching approach allows the student to experience an awareness of the set so they can consciously release the tension before continuing.

Origin and Theory of Body Mapping

Alexander's discovery that 'use determines function' and his evolution of a technique which enables the use of the body to be reeducated and freed from unhelpful or damaging habitual patterns of response remains, in my view, one of the potentially most important innovations which our culture has produced. (McCallion, 1998)

Body mapping assists the teacher and student to communicate terms and an understanding of how the body is organized and the use and misuse of various parts which affect performance. "The first step then is to convince the pupil that his present misdirected activities are the result of incorrect conception and of imperfect sensory appreciation". (McCallion, 1998)

Body Mapping was discovered by William Conable, professor of cello at the Ohio State University School of Music. Conable inferred the Body Map from the congruence of student's movement in playing with their reports of their notions of their own structures. He observed that students move according to how they think they are structured rather than according to how they are actually structured. When the student's movement in playing becomes based on the student's direct perception of their actual structure, it becomes efficient, expressive, and appropriate for making music. Conable's observations are currently being confirmed by discoveries in neurophysiology concerning the locations, functions, and coordination of body maps in movement. Body mapping is the conscious correction and refining of one's Body Map to produce efficient, graceful, and coordinated movement. Body mapping, over time, with application, allows any musician to play and sing like a natural. (Conable 2000)

Alexander speaks of “inhibition” or non-doing which is an activity of the conscious self. “If we grant the unity of life and the tendency of its evolution, it follows that all the manifestations of what we have called the “subconscious self” are functions of the vital essence of life-force, and that these functions are passing from automatic or unconscious to reasoning or conscious control.”

(Maisel, 1990)

Jane Heirich, voice professor at University of Michigan, has put the Alexander Technique into practice for singers in her book *Voice and the Alexander Technique: Active Explorations for Speaking and Singing*. In the introduction, she relates her lessons with an Alexander Teacher by the name of Joan Murray. Joan had her mentally sing a song without phonating while she placed a hand on the back of Jane’s neck. Joan was able to recognize when there was tension during the song. She then proceeded to continue to touch while Jane sang the words. Jane was guided to produce a freer, effortless approach. Jane now incorporates the Italian *bel canto* tradition with the Alexander Technique. (Heirich 2005)

James Jordan is associate professor of conducting at Westminster Choir College in Princeton, NJ and directs the Westminster Chapel Choir. He has written the forward to Barbara Conable’s book, *The Structures and Movement of Breathing*.

Body Mapping allows conductors to give bits and pieces of anatomical truth to the choir each rehearsal, both during the choral warm-up and during the rehearsal. These bits accumulate over time into a

potent arsenal of information that will allow people to sing at their maximum potential...one's singers are constantly empowered to make incredible sounds within bodies that are aligned. Choirs sing with more rhythmic excitement because rhythmic impulses are not short circuited by rigid muscular holding. (Conable, 2000)

Jordan goes on to say that postural terms may be too rigid and lead to misuse of the body. Good alignment requires an understanding and correcting one's own Body Map. In understanding the structure of our joints and muscles we can enhance our breathing mechanism; the lengthening of the spine for singing and the gathering for inhalation process. He suggests some phrases to remind the singers during rehearsal:

- Sing with your whole body, please
- Are you aware of your breathing?
- How are your ribs moving as you sing?
- As you sustain the phrase, are your spines lengthening?
- Are you keeping your heads independent and mobile?
- Are you thinking Up and Over?
- How is the joint of your head to your spine? Is it free? Can you sense it? (Conable, 2000)

Barbara Conable, in her introduction to *The Structures and Movement of Breathing* explains;

Our Body Maps are our physical representations. We literally map our own bodies with our brains, that is, we conceive neurally what we're like (structure), what we do (function), and how big we are (size). We map our whole bodies in this regard, and we map their parts. If our Body Maps are accurate we move well. If our Body Maps are inconsistent with the reality of our structures we do not move well. Singing is movement, and its quality is as determined by our Body Maps as the quality of our walking is. Fortunately, inaccurate or inadequate Body Maps can be replaced with accurate and adequate Body Maps. All that is needed is information and attention to the information. Human beings are naturally self-correcting.....The many choral conductors who have helped their singers regain full body awareness as they sing are surprised and delighted by the terrific difference embodiment makes in the quality of the singing. (Conable 2000)

Barbara also explains that the reason the mapping work is so effective in speeding up the learning of the Alexander Technique is because they bring their faulty maps to the lesson and then attempt to learn the technique using the old map. As the student becomes aware and consciously corrects the map the use of the body is refined and improved. (Conable, 1995)

The Core of the Body and the Six Places of Balance (Allen, 2009) Body Mapping Applied

The most fundamental lesson for any instrumentalist is how to hold and operate the instrument. For the singer, this includes the entire body. The alignment of the body and tension in the muscles affects the tone, clarity, support and pitch of the voice. Poor alignment and unidentified tension can result in many performance problems. The student's untrained perception of the body's structure, function and size [body map] is often inaccurate. Understanding the truth about the body's structure, function and size will correct the body map thus giving accurate information to the teacher and the student so that optimum performance can occur and hopefully become a habit.

The challenge is how to help the student tune in and understand their inner kinesthetic awareness of what is going on in their body. Kinesthetic awareness of the body comes easily to some students and is difficult for others. Barbara Conable has developed the process of body mapping. She states, "If a singer has the body mismapped, the singer will use the body improperly." (Conable, 2000) This kinesthetic awareness enhances the understanding of what is happening in the body and how to make adjustments to free it while singing.

Conable has identified six checkpoints or places of balance. When they are aligned body tension is released. [Figure 2-8] When the body is supported by the skeletal structure it is light, buoyant, and energized because the weight is

evenly distributed. [Figure 2-1] The vocal tone is clear, full, resonant, supported and flexible. The body is able to gesture and move on stage seemingly without effort.

The term posture is a concern for the singer. Many teachers communicate their ideas about posture in such a way that students are stiff and rigid and their bodies are static rather than dynamic. "Singing is movement, and its quality is as determined by our Body Map as the quality of our walking is."(Conable, 2000) Teachers can use terms that better promote the desired body alignment, such as having a sense of being balanced, buoyant, springy, light or energized.

It is necessary to know and understand the physiology of the body in order to achieve this sense of balance, buoyancy and resilience. Visual diagrams are helpful when talking about things internal. Some very good sources for these diagrams are *Albinus on Anatomy* - Dover Publications, *What Every Singer Needs to Know About the Body* - Plural Publishing, *What Every Musician Needs to Know about the Body* - Andover Press and *The Body Moveable* – Ampersand Press. Figures from these books may be found in the appendix with permission.

The first of Conable's six places of balance is the joint located where the bottom of the skull (occiput) meets the top cervical vertebra (atlas), more commonly known as the A-O (atlanto-occipital) joint. [Figure 2-9] It is important to map this correctly because balance at this joint releases tension throughout the neck and body. The head is balanced and mobile, ready for gesturing and expression. The freedom in the neck allows for the gathering of the spine during

inhalation and lengthening during singing. "The head leads and the spine follows in sequence."(Conable, 1995) Alexander also speaks of "sets" as in ready – set – go. (Maisel, 1990) There are various sets that students have before singing. It is important to notice and correct those sets. Some examples of sets requiring correction are:

- pulling down and back of the arms (many students of dance do this)
- pulling up on the back of the head and the neck (many instrumentalists do this)
- rigidly setting the chin (violinists are prone to this)
- pulling the head back and looking up (many choral singers do this)

These sets place the body in a rigid position and inhibit the singing process.

The teacher needs to assist the student in understanding the set and finding balance of the head on the spine.

The next place of balance is the arm structure. This includes four joints, the sterno-clavicular, shoulder, elbow and wrist. [Figure 2-23] The release of the neck allows freedom in these joints. It is common for singers to pull down on the arms, which creates tension. Pulling shoulders back and down and holding them down is an example of poor use of the structure. It robs the arm structure of freedom of movement and reduces sensation and kinesthetic awareness.

Pressure in the arm structure interferes with breathing because the intercostal

muscles become set and rigid. The arm structure should balance freely over the ribs.

The thorax in relation to the lumbar spine is the next place of balance. "The [torso] is the portion of the body that excludes the head, arms and legs. It begins at the top vertebra (atlas) and continues down to the bottom of the pelvis." (Allen, 2009) [Figure 2-8] It includes the thoracic cavity, the abdominal cavity and pelvic cavity. The balance of the thorax on the lumbar spine releases the arms and legs. This area, although not a joint, has many kinesthetic receptors that give the singer feedback.

It is important for singers to know the size of the vertebrae. Many singers underestimate the size of the support structure. If you make a circle with the thumbs touching and the index fingers touching, this would be an approximate size of a lumbar vertebra from the outermost most spinous process to the vertebral body. [Figure 2-6] The vertebrae are smaller at the top of the spine and increase in size as they move down the spine and then taper slightly at the other end before the coccyx (tailbone). [Figure 2-4]

The vertebral bodies and the discs are the weight bearing portion of the spine. This is the front of the spine. The discs between the vertebrae are approximately 1 inch in diameter and ¼ inch thick. [Figure 2-7] These discs compress and release as the spine moves. Compression occurs during inhaling and release happens during exhaling and singing. The vertebral bodies and discs support and distribute the weight of the body. This gives a sense of strength and

support without misusing the muscles to hold the body up. Richard Miller, a renowned vocal pedagogue, refers to this as “noble posture”. (Miller, 1996) The spinous process protects the spinal cord and is not capable of bearing weight.

The fourth place of balance is the hip joint. [Figures 2-16, 2-17] Jane Heirich has students describe where they would divide their bodies in half horizontally. (Heirich 2005) Most say at the waist. She then asks them to bend at this point. It is then that they learn that half is at the hip joints. This increases the understanding that the singing torso extends from the atlas vertebra to the pelvic floor. “For singers, mapping the torso’s length is of tremendous importance for movement, including breathing, gesturing and bending forward.” (Malde, Allen & Zeller, 2009) The weight of the body goes through the hip joints and is equally distributed to the legs in standing. Many students plant their feet on the floor which tightens the legs and locks the hip movement. Having students walk lightly in place while singing will allow them to feel light and free in the legs and hip joints. Using the sit bones or rockers [Figure 2-18] allows the torso to stay up and free when sitting.

The fifth place of balance is the knee joint. The joint occurs where the thighbone meets the lower leg bone. The knee cap floats in front of the lower end of the thighbone, and the joint is below this point. There are three conditions of the knee when standing; locked, balanced and bent. [Figure 2-19] The knees often lock to protect the discs of the spine when the body weight is out of balance, such as when the thorax is not centered over the lumbar spine.

Learning to balance the head and then the torso should alleviate the locking of the knees.

The last point of balance is the ankle joint. [Figure 2-21] Many students map the ankle as the two protrusions of the lower leg. [Figure 2-20] These protrusions are part of the tibia and fibula where they meet the talus bone which sits on the top of the heel bone [calcaneus]. The ankle is located where the leg meets the foot. Lifting the leg off the floor and moving the foot will help students to understand where the ankle is. Here again balancing the A-O joint and torso allows the weight to be equally balanced down the legs and through the ankle.

Along with the ankle joint it is also necessary to understand the foot. There are three arches; medial longitudinal arch (heel to big toe), lateral arch (heel to little toe) and transverse arch (big toe to the little toe). [Figure 2-22] This creates a wonderful tripod. Balancing body weight in the center of this tripod will allow buoyancy and lightness and a sense of being taller. If body weight is balanced in the center of the foot, it is less likely that the toes will grab the floor.

“Do you hear a recurring theme? Places of balance and optimal support? Balance at the arch! Balance at the knee! Balance at the hip joint! Balance on the rockers! Balance on the lumbar spine! Balance of the head on the spine! The places of balance and optimal support are **not** the places we should go and stay (then it wouldn't be balance; it would be posture). The places of balance are where we begin, and where we may return again and again as we [perform].” (Conable, 2000)

Body mapping is where to begin. "It allows teachers to give bits of anatomical truth... which accumulate over time into a potent arsenal of information that will allow people to sing at their maximum potential." (Conable, 2000) Freedom of the body, which comes from having an accurate body map, allows the natural process of producing clear, resonant and supported sound. This is a valuable strategy for the voice studio and choral rehearsals.

Appendix

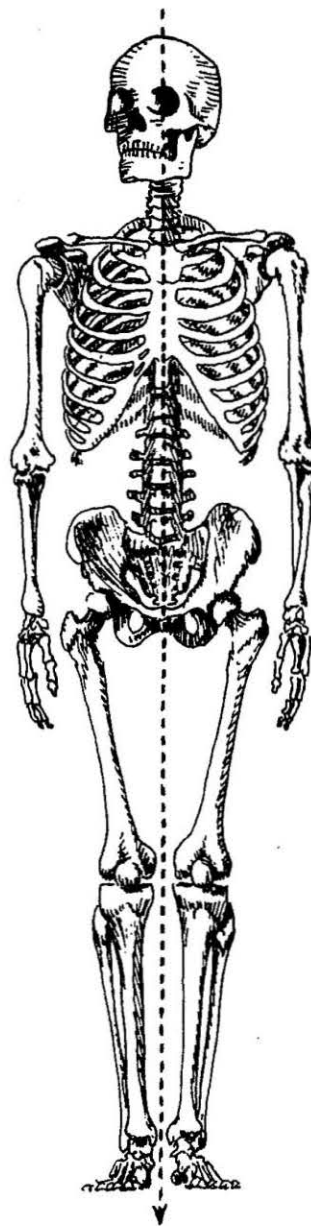


Figure 2-1. Full Skeleton, front view.
From *The Body Moveable* (4th ed.,
Section I, p. 28), by D. Gorman,
2002, Ontario, Canada: Ampersand
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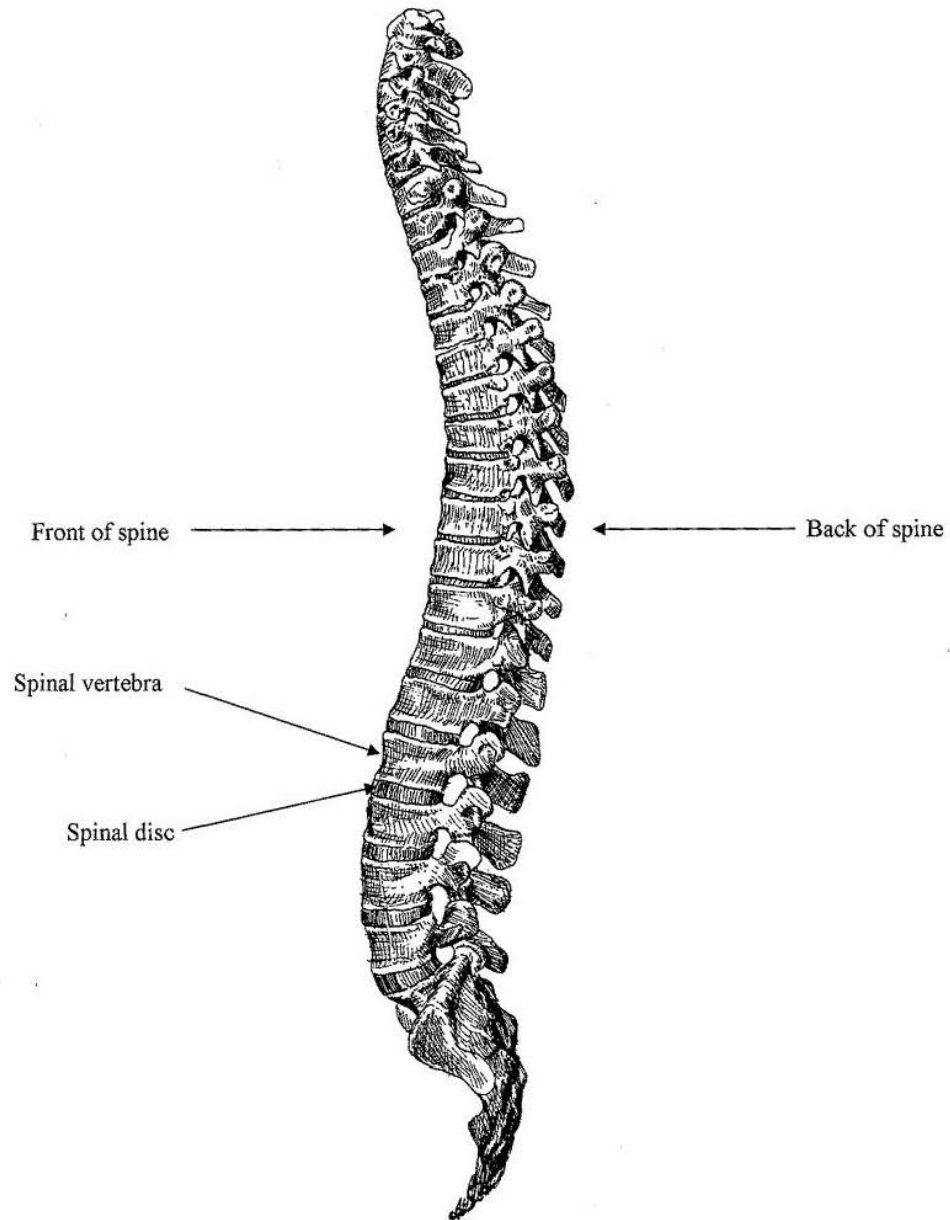


Figure 2-4. Side view, Spine with Discs. From the *Body Moveable*. (4th ed., Section 1, p. 46), by D. Gorman, 2002, Ontario, Canada: Ampersand Press. Copyright 2002. Reprinted with permission.

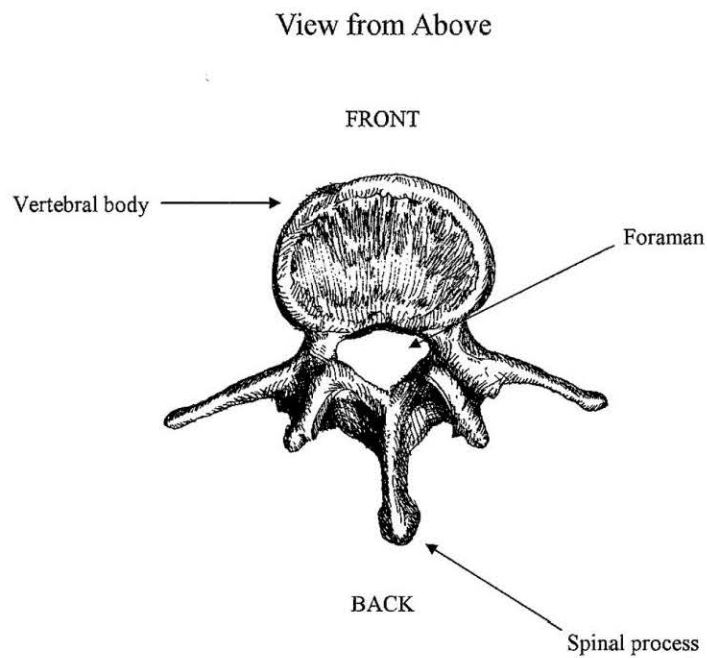


Figure 2-6. Vertebral Body. From *the Body Moveable*. (4th ed., Section I, p. 47), by D. Gorman, 2002, Ontario, Canada: Ampersand Press. Copyright 2002. Reprinted with permission.

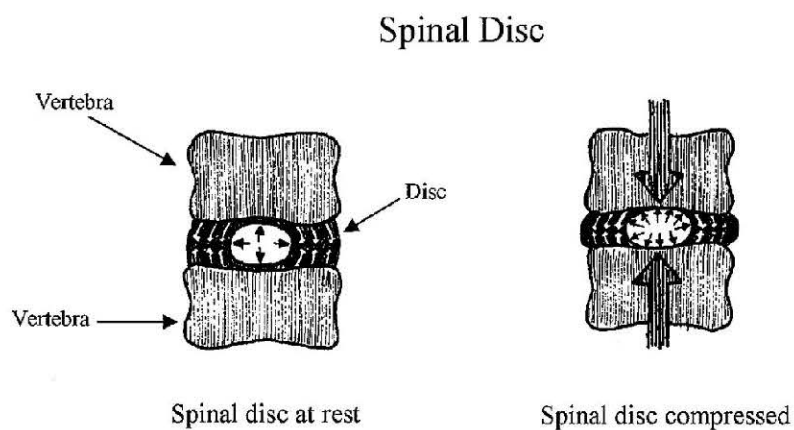


Figure 2-7. Spinal Disc at Rest and Compression. From *the Body Moveable*. (4th ed., Section I, p. 51), by D. Gorman, 2002, Ontario, Canada: Ampersand Press. Copyright 2002. Reprinted with permission.

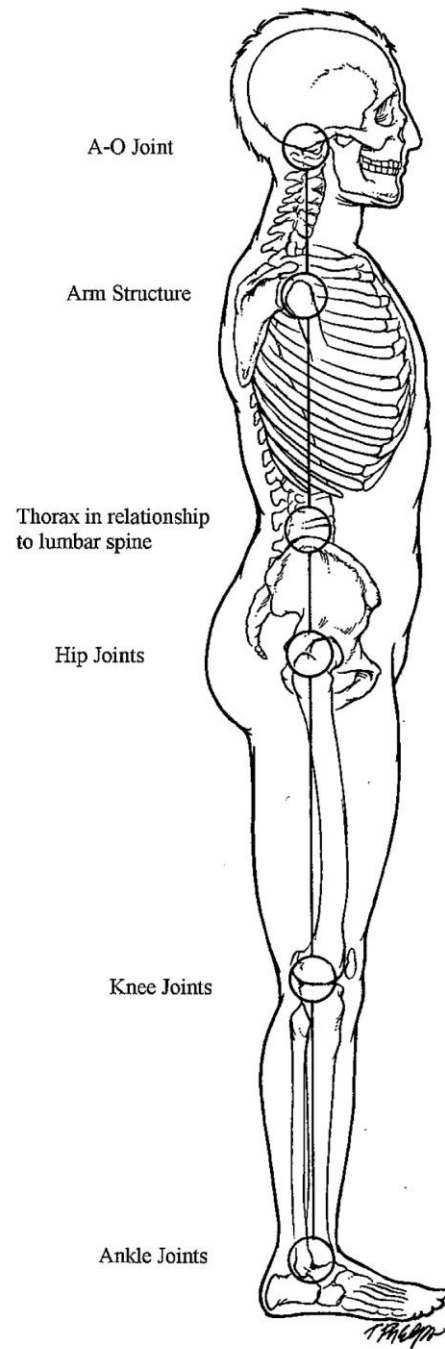


Figure 2-8. Places of Balance Skeleton, side view. By T. Phelps. Copyright 2008. Used by permission.

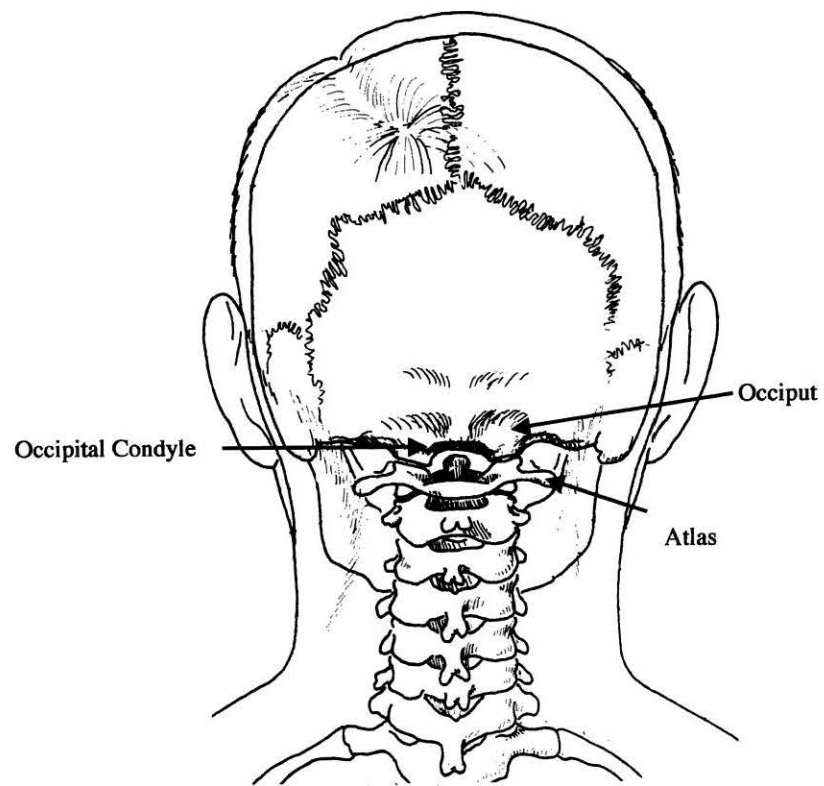


Figure 2-9. A-O joint, back view of Skull with Cervical Vertebrae. From *The Body Moveable* (4th ed., Section I, p. 153), by D. Gorman, 2002, Ontario, Canada: Ampersand Press. Copyright 2002. Reprinted with permission.



Figure 2-16. Hip Joints and Pelvis, front view, *Weight Delivery*. By B. Conable. Copyright 2001. Used by permission.

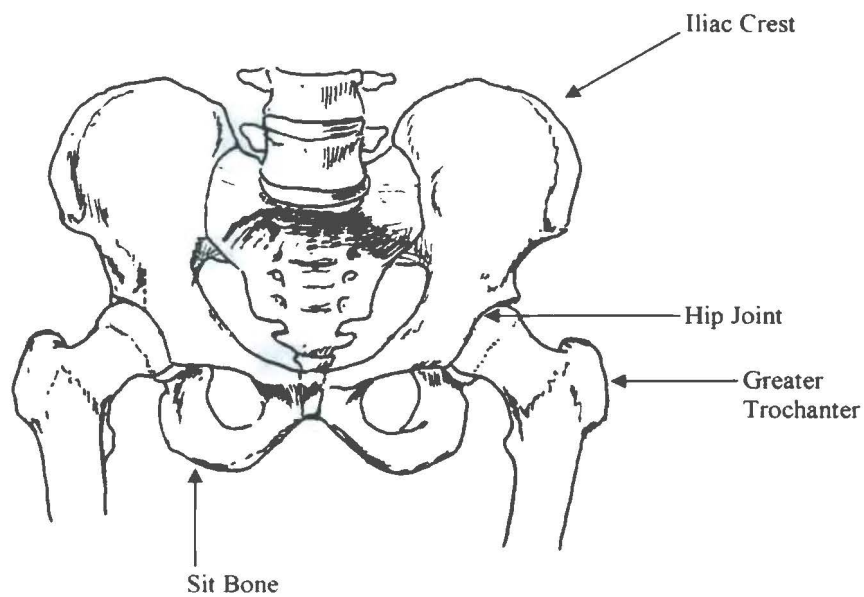
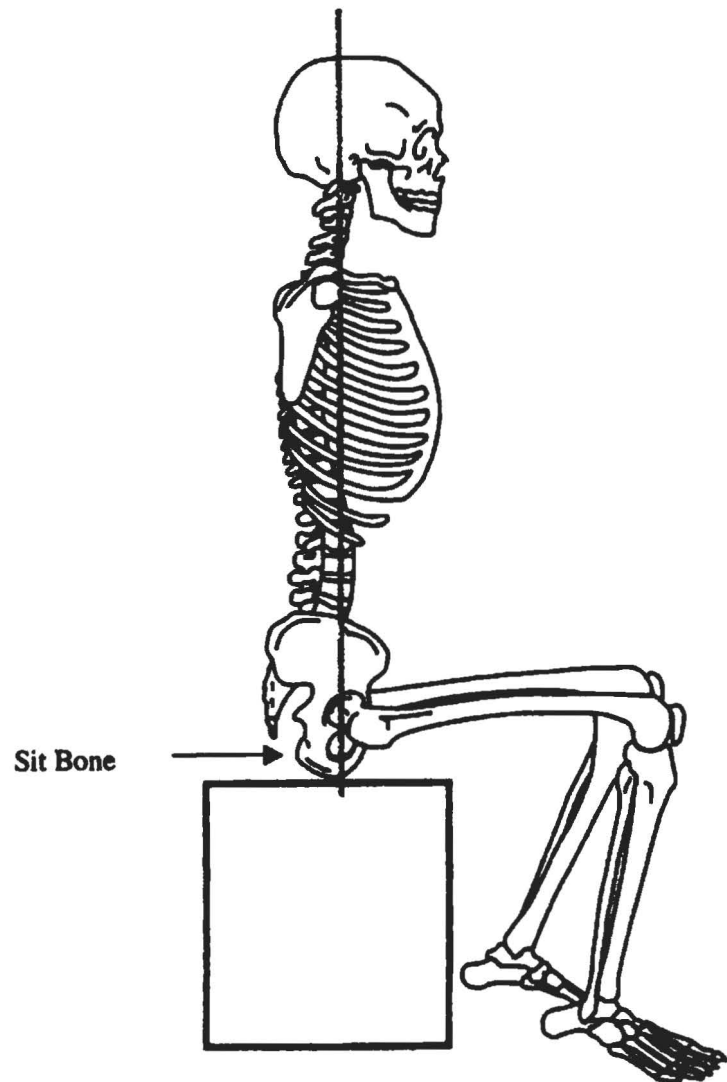


Figure 2-17. Hip Joints and Pelvis, front view. From *The Body Moveable* (4th ed., Section 3, p. 16), by D. Gorman, 2002. Ontario, Canada: Ampersand Press. Copyright 2002. Reprinted with permission.

Figure 2-18. You can sit easily on your sit bones, which simultaneously give you stability and mobility. By B. Conable. Copyright 2001. Used by permission.



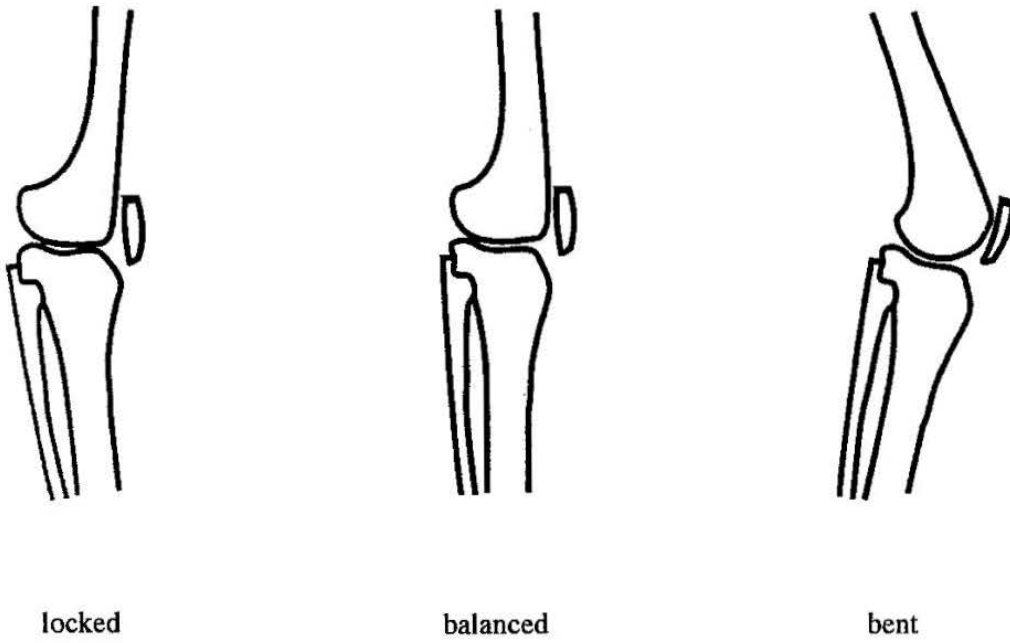


Figure 2-19. *Knee Joints. By B. Conable. Copyright 2001. Used by permission.*

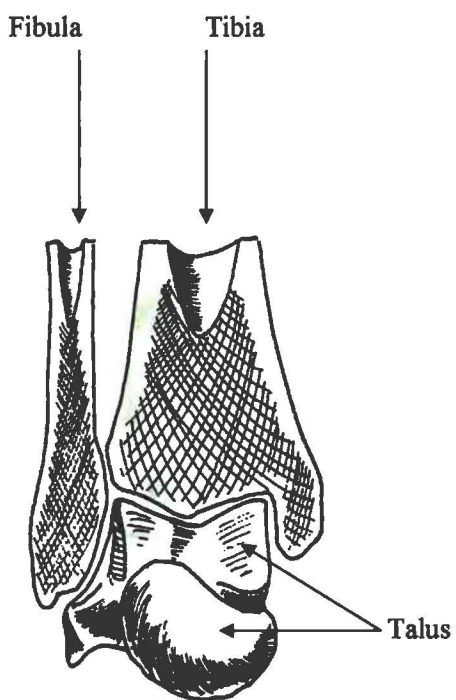


Figure 2-20. Ankle Joint, front view, Toes Excluded. From *The Body Moveable* (4th ed., Section 3, p. 103), by D. Gorman, 2002, Ontario, Canada: Ampersand Press. Copyright 2002. Reprinted with permission.

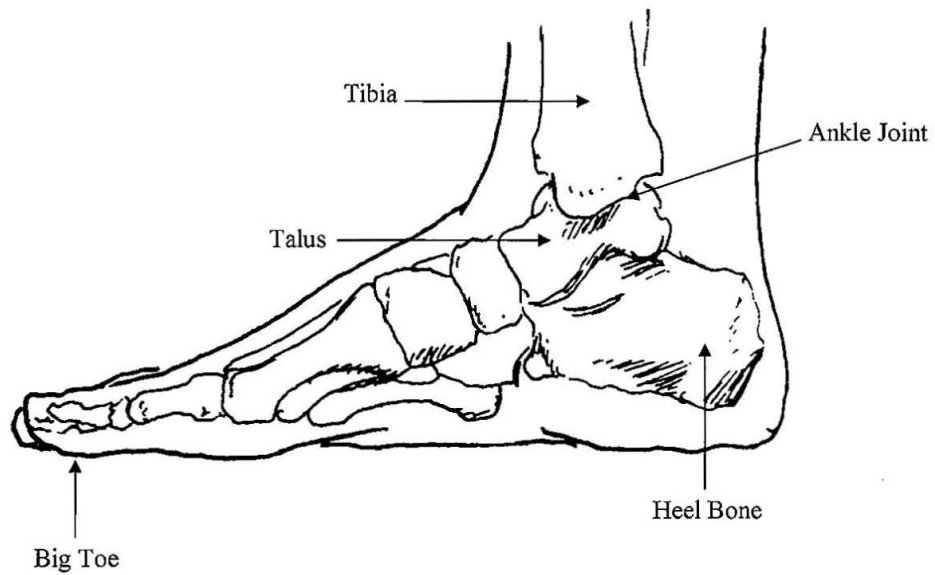


Figure 2-21. Foot, side view. From *The Body Moveable* (4th ed., Section 3, p. 100), by D. Gorman, 2002, Ontario, Canada: Ampersand Press. Copyright 2002. Reprinted with permission.

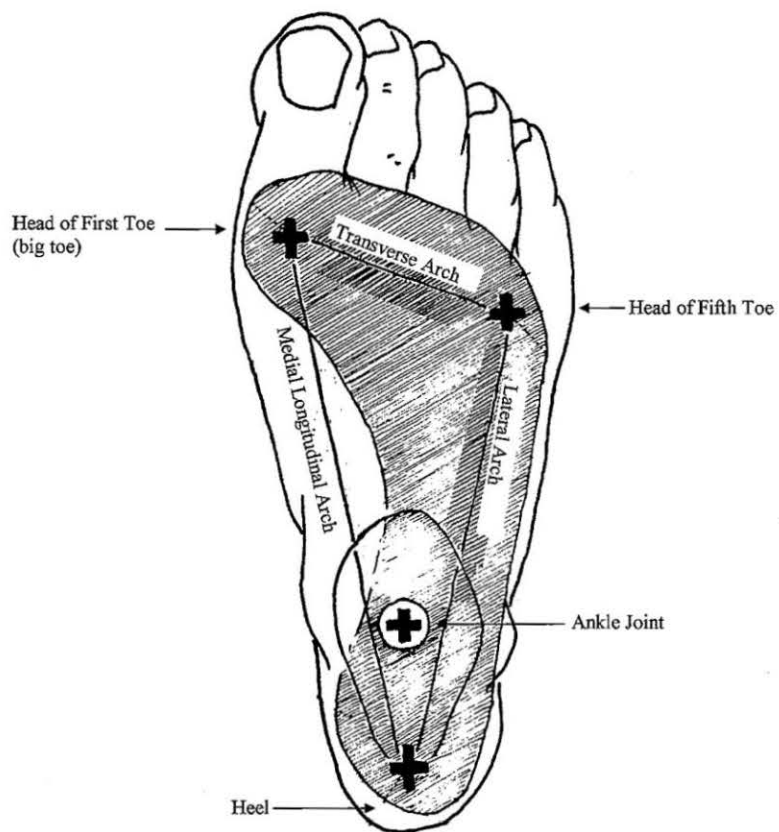


Figure 2-22. Foot Tripod. From *The Body Moveable* (4th ed., Section 3, p. 151), by D. Gorman, 2002. Ontario, Canada: Ampersand Press. Copyright 2002. Reprinted with permission.

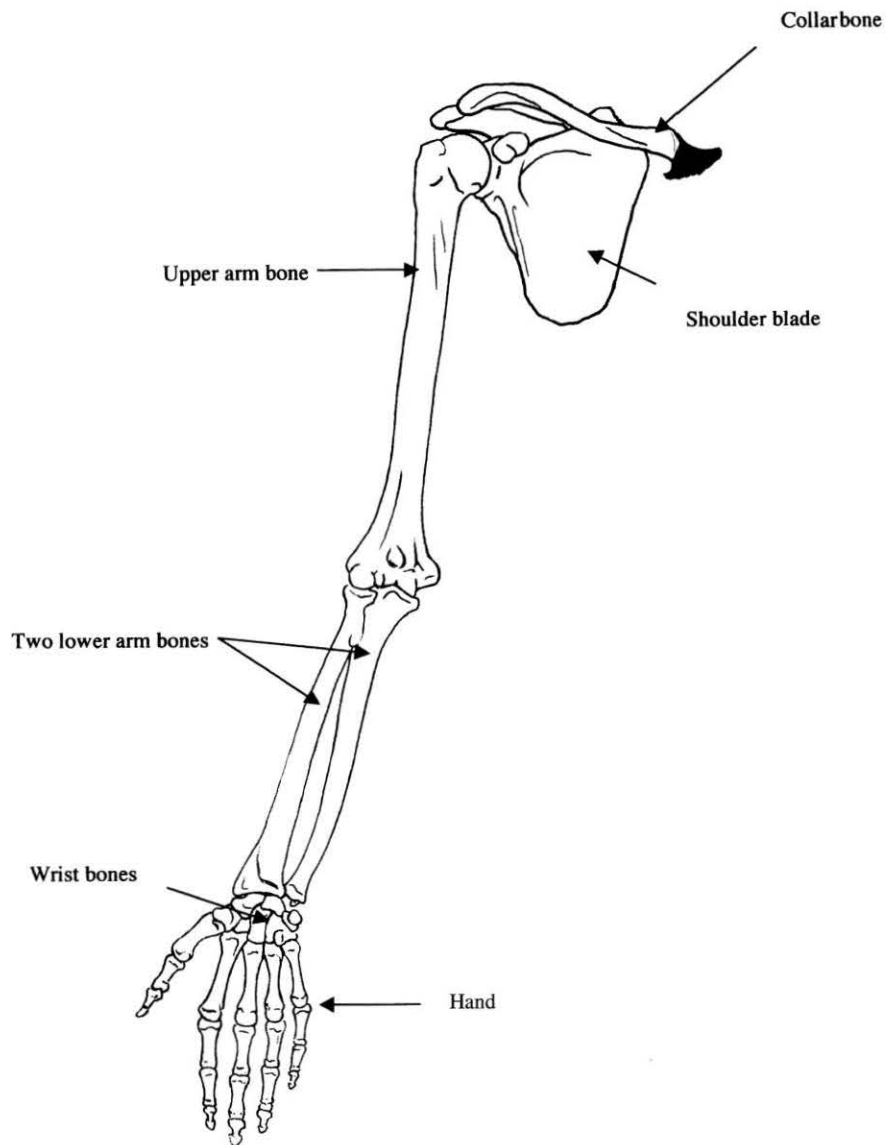


Figure 2-23. Arm Structure. By B. Conable. Copyright 2001. Used by permission.

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