

Kinesiology and Yoga Body Knowledge

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This article will be written in three parts. Part I is an overview of Kinesiology, its' definition as well as concise information to outline the components in the study of movement that can be integrated into practice and teaching of Yoga. Part II is a brief overview of Yoga and Yogic body knowledge. Part III will be the support that Kinesiology can provide for the study of Yoga.

Part I Kinesiology

Kinesiology is the study of the science of human movement and as such an important foundation for individuals teaching a movement discipline. Through this science coaches and movement teachers can instruct their students or athletes in the best way to perform physical movements. Through this knowledge and its application it is also possible to assist in the rehabilitation process if injury occurs as well as guiding towards a better pathway to perform the movement required for whatever discipline. The standard investigation and emphasis in kinesiology includes the movement parts of the body by knowing the planes of

action, as well as the skeletal, muscular and nervous system—the building blocks of movement. The following four are part of the foundation of kinesiology:

Planes of Action

In order to facilitate the description and analysis of movements, kinesiologists have adopted the use of three anatomical 'cardinal' reference planes. When the three cardinal planes are visualized as passing through the body simultaneously, it will be noted that there is a common point of intersection which is taken to be the center of gravity of the total body.

These three planes are:

1. The cardinal sagittal plane progresses from the front to the back of the body, dividing it into right and left halves.
2. The cardinal frontal plane passes through the body from side to side, dividing it into front and back halves.
3. The cardinal horizontal or transverse plane divides the body into a top and a bottom half.

Planes of action set boundaries to describe range of motion in an intelligible way. This gives movement scientists a foundation to analyze movement and to determine its efficiency. Most movement skills occur in more than one plane simultaneously. The center of gravity that the planes define as they come together at right angles or plumb line of gravity becomes a focal point to further organize and describe movement as well as to clarify body movement when teaching.

The Skeletal System

The tissue of the skeleton is a conglomeration of structures made of bones. Bones are dynamic, living tissues and are the stabilizing framework of the body. They give shape and form to the body and are the foundation for movement.

There is an axial skeleton comprised of the trunk, pelvis and head and the appendicular skeleton which are the arms and legs. The adult human skeleton has 199 bones. These bones come in many shapes and sizes. The shape and size of the bone gives information about what its function might be with regard to movement.

Body Joints

A joint is one of the most highly specialized and perfectly formed structures in the body. It is an articulation or connection between two bones or between bones and cartilage. The bones are usually attached to each other by connective tissue (such as ligaments and tendons) but this is not always the case. Joints vary considerably in the amount of movement they allow.

The structure of each joint is best for the function of that joint. The structure determines the actions and range of motion of which the joint is capable. Immovable joints amount to two bones fused together with a thin layer of fibrous tissue between them which serves a protective function. Slightly movable joints are either ligamentous (held together by ligaments) or cartilaginous (bound together by ligaments and separated by a cartilage-type disc as in the spinal column).

Muscular System

Muscle is malleable, noticeably changeable tissue that brings movement to the skeleton. All movements in the body involve muscular contractions of one kind or another. The muscles generate the forces which move the human body and its parts. All movements of the body and its segments

are the result of muscle force and/or the application of some external force. The most common form of external force that acts upon the body is gravity. However, the majority of bodily movements can be attributed to the contraction of muscles. Muscle contraction is the source of energy for all movements in which the body and its extremities are raised or held in position against the pull of gravity.

There are more than 600 muscles in the human body. Ordinary skeletal muscles are voluntarily controlled by nerve impulses transmitted from the Central Nervous system. As a result of their contractions made in correct sequence with sufficient force, we are able to walk, run, swim, throw, breathe and perform numerous other movements.

Nervous System

All body activity, both obvious external movement and unseen internal movement is controlled by nerve impulses, chemical stimuli or both. Without nerve impulses, the muscles are unable to contract and consequently the organism is unable to function. Physiologically the establishment of coordinated movement patterns by the nervous system is a highly complicated process.

The nervous system is conveniently divided into two parts according to function:

Autonomic (automatic): There is no conscious control over autonomic functions. Mostly this system governs vegetative or unconscious responses which sustain life.

Voluntary: This is the system over which we can exercise conscious control but which often operates below conscious level. The nerve impulses which control the functions of the skeletal muscles originate and travel in the voluntary system.

Structurally the voluntary system is divided into the:

Central Nervous system which includes the brain and the spinal cord.

And the

Peripheral Nervous system which refers to the remainder of the voluntary system in the trunk and limbs

Functionally the voluntary system may be subdivided into the:

Afferent System: It conducts impulses which originate in the sensory organs and travel towards the CNS. It supplies information about both the internal and external environments.

Efferent System: It carries impulses which move away from the CNS and terminate in the muscles

The nervous system is important in discussion of asana practice because there would not be movement of the body without it and also because it plays such an integral role in the subtle body anatomy taught in Yoga science.

The Spinal Column

The spinal column is part of the skeletal system but it can also be considered part of the nervous system in that it houses the central information highway and significant in Yoga practice as the seat of our consciousness. No movement can take place that is not governed by the spinal column and the spinal column is affected either positively or negatively by all movements taking place the body. *The spinal column becomes the bridge between matter and esoteric*

The spinal cord is actually an extension of the brain encased within the vertebral column extending from the brain up to the first lumbar vertebrae. The cord is the link between the brain and the rest of the body. There are both ascending and descending pathways in the cord to receive and conduct impulses. At certain times messages from the cord supersede those of the brain.

The principal functions of the spinal cord are both motor and sensory. It transmits sensations of touch, pain, temperature and proprioception. It coordinates muscle movement using afferent and efferent pathways.

As mentioned previously Kinesiologists observe how movement is done based on the above information but with an application towards movement efficiency which is based in large part on proper body alignment. Movement efficiency is the movement or movements which accomplish the purpose with the least expenditure of energy. (p. 21; Broer; Efficiency of Human Movement) The concept of “good form” or functional alignment is necessary for efficient movement.

Functional alignment is not based solely on outward appearance as the skeletal framework is the foundation of good alignment. Good alignment is also based on the plumb line of gravity and how the parts of the skeleton align with that.

Much of this is based on observation with the application of scientific principles. Two positions are universally accepted (Hinson) as reference positions for efficient alignment as well as reference positions for joint movement.

1. The Fundamental Position

The person stands in an upright posture with feet parallel and close, with arms at the side and the palms of the hands facing the body.

2. Anatomical position

Varies slightly from the fundamental position in that the palms face forward and the legs slightly turn out.

The purpose of a reference position is to supply a starting point from which movement in any direction can be described. (p.5)

Part II Yoga

Yoga, one of 6 important philosophies, of India is an ancient art and science which aims to unite the body, mind and soul. The beginnings of Yogic thought was thousands of years ago in the Vedic civilization that had sprung up around the Saraswati River in India. In that civilization were men that had attained a degree of spiritual wisdom and they were known as rishis or seers. The rishis were the authors of a collection of works known as the Vedas, four in number: the Rig Veda, the Yajur-Veda, the Sama-Veda and Atharva-Veda. The Rig Veda is dated back to the third millennium B.C.E. and is considered one of the oldest literary documents in existence. Within it, as well as the other 3 Vedic hymns, is a collection of visionary experiences, ecstasies and mystical insights that are considered to be revealed wisdom as well as the beginning of Yogic thought. Within these texts is what could be considered a way of looking at the anatomy of the human body, from a different point of view than what we normally consider.

Anatomy is explained in the Yogic system through the concept of subtle or esoteric anatomy. During the time of these first practitioners MRI's, X/ rays and dissection of bodies was not happening. Discoveries were made through experimentation, observation and self study. Much is felt as the pulse of life as breath flows in and out, as the force that beats the heart and the energy that moves within.

In Yogic thought the body exists at two levels: on the physical plane and at a more esoteric level. Yoga philosophy introduces the concept of the "subtle" body that can be somewhat correlated with the nervous, glandular and venous systems but actually reaches beyond the mechanics of the body's physiology. Therefore, Yoga expands the view of the physical body through the awareness of the subtle body. The subtle body is composed of the vital life force (prana), mind (manas), intellect (buddhi), ego (ahamkara), and the feeling of self (chitta).

To increase understanding of yogic thought following is an exploration of the elements of the subtle anatomy focusing on prana, the life force, and the connections it makes within. The descriptions can be difficult to grasp, as much of this must be experienced or taken on faith to begin to be understood.

Prana: Modern exercise science describes energy production in the body that is created by chemical reactions. Psycho physical energy described in yoga philosophy is electrochemical in nature and it works with the help of prana. Prana is the energy that creates life, matter and mind. The word prana means "vital life force". Although prana is drawn in through breathing, dynamic pranic energy is not based on the physiochemical system of the body; it operates super-physically through a "wireless" system rather than through the nervous system. Prana is the means by which the subtle and the gross in the human organism are connected. It activates all of the systems in the body, including the nervous system, and helps them work together as they should.

Nadis: Prana is distributed throughout the body by Nadis, the "wireless" system described above. The word nadi comes from the Sanskrit root "nadi" meaning "movement". In the Rig-Veda, the most ancient Hindu scripture, the word nadi is used to mean stream. Nadis are not only nerves or vessels for blood and lymph but channels in the human body through which nervous energy passes. These belong to the subtle body. There are two types of nadis:

1. Subtle, non-material channels of subtle energy called Yoga Nadis. The subtle nadis are of two kinds.

- A. The channels of manas or the mind
 - B. The channels of chitta, the feeling self or being.
2. Gross channels of subtle energy, visible as chords, vessels or tubes. Included in this are acupuncture meridians (not actually visible), nerves, muscles and the vessels of the cardiovascular and lymphatic system, to including the arteries and veins.

There are 72,000 nadis in the human body. From the viewpoint of the yogic practice only three pathways are crucial. The first is the central pathway called Susumna nadi (“most gracious channel”), which runs along the axis of the body from the base of the spine to the crown. Along it are situated the major chakras. Twisting around it in helical fashion and crossing over at each chakra are the Ida.-nadi and the Pingala-nadi, which also originate at the base of the spine, to the left and the right of the Susumna, the central conduit, respectively. When the life force flows predominantly through the Ida pathway, the result is an overall cooling or calming effect. The Pingala pathway, on the other hand, is associated with activity. The functions of these two channels are clearly related to the parasympathetic and the sympathetic nervous systems on the physical level and in the latter case stimulate metabolic processes. In esoteric symbolism, Ida. and Pingala are fittingly represented by the moon and the sun respectively.

In the ordinary person, the life force ascends and descends along these two channels causing flux in the pranic field and, correspondingly, the ebb and tide of the psychosomatic states. The principal task of the yogin is to regulate the rhythmic flux of the life force in such a way that it gathers at the lower opening of the central channel and then rushes up toward the head. The susumna nadi is centrally situated and it is the only Nadi that passes through the spinal column.

When the dormant kundalini is stimulated and begins its ascent it is through the susumna that it passes. The whole process of spiritual growth is made possible by prana and its carriers the Nadis.

“The whole Vedic system is very comprehensive. It begins with the sound current or word of God as the first emanation. This forms the central core and axis of the Universe and the cerebrospinal nervous system of the human body and distributes the energy impulses upon the central axis as the motive power of the finer energies in man, from within outward, as the Life flows. First it is the psychic wireless energy and then precipitates into the physical life energy and currents.” (Chakras)

Chakras: Chakras are perhaps the best known aspect of the esoteric anatomy system. Chakras do not belong to the material body and are difficult to fully describe. Chakra is a Sanskrit word that means “a wheel, a disc or any arrangement in a circular form or organization.” The word can also indicate movement. Chakras introduce movement because they transform psycho physical energy into spiritual energy. The chakras, located throughout the body, are connected to the main Nadi of the subtle body system, the Susumna, which operates in proximity to the spinal column.

The chakras are subtle and not easily cognizable. Though they are compared to the various nerve plexi, it should not be taken for granted the plexi alone are the chakras. Chakras are most simply defined as psychic centers of transformation that enable one to move toward an enlightened state of being. Chakras are active at all times, whether we are conscious of them or not. Energy influenced by the elements moves through the chakras, producing different psychic states. These elements are constantly moving with the breath inside the body and influencing one’s temperament. These changes are understood by neurobiologists as chemical changes produced by the endocrine glands whose secretions mix into the body’s blood stream directly and instantaneously.

Kundalini

“Suddenly, with a roar like that of a waterfall, I felt a stream of liquid light entering my brain through the spinal cord... The illumination grew brighter and brighter, the roaring louder, I experienced a rocking sensation and then felt myself slipping out of my body, entirely enveloped in a halo of light.”
Gopi Krishna’s Kundalini Awakening
The Shambhala Guide to Yoga

The above is a description of a kundalini awakening best described as a spiritual emergence. Many of the practices in Yoga are designed to

encourage this awakening. Because of the power of this emergence, it is necessary for the practitioner to prepare themselves mentally, emotionally and physically.

Kundalini is latent psychic energy or can be considered latent potential energy. There are a tangle of nerves that emanate from the sacrum. In yogic thought, these are symbolized by a coiled and sleeping serpent that rests in the muladhara chakra at the base of the spinal column. This latent energy has to be awakened and made to go up the spine to the brain through the Susumna Nadi.

The Sanskrit noun kundalini is the feminine form of kundala meaning “ring” or “coil.” It thus means “she who is coiled”. This enigmatic name is an apt description of the essential quality of the kundalini, which, at its most abstract, is psycho spiritual potential. It is power (Shakti), conceived as the feminine or goddess counterpart of the god Shiva, who is pure Consciousness. In choosing the name kundalini, the Tantric authorities clearly thought of a serpent—perhaps a cobra—that, before it strikes with lightning speed, lies in tightly wound coils. Indeed, the scriptures speak of the kundalini serpent sleeping in the lowest psycho energetic center, the first chakra, at the base of the spine wound into three and a half coils.

A more contemporary metaphor that might be helpful in explaining the kundalini is that of an electric generator. Most of the time, the generator is running at minimum capacity, supplying only a trickle of barely measurable energy. But when switched on full, it releases a high-voltage current with sufficient energy to cater to the needs of an entire city. Similarly, at least according to some traditions, the dormant kundalini is not entirely inactive either, releasing enough energy into the human body-mind to maintain the life processes.

A forceful method is required to mobilize the static energy and convert it into dynamic energy. The underlying process is to focus the life force (prana) by means of mental concentration and controlled breathing in such a way that psychosomatic heat (called agni) is created. This process has occasionally been likened to the release of nuclear energy by means of continuous bombardment. This continuous bombardment translates as the practices outlined in the Astanga path of Patanjali.

Another important text, The Yoga Sutras of Patanjali, was written around 3 B.C.E. and can be considered a compilation of the definition and description of Yoga Philosophy as developed up to the moment in time. The Yoga Sutras are organized into 4 chapters covering the practice of Yoga and what a dedicated student can expect to experience as they progress in this discipline. Much is on the stilling of consciousness and what keeps that from happening as well as what can support this change. Meditation, like so many of the ancient books on Yoga, is also in the forefront of the Yoga Sutras. Throughout Patanjali’s Yoga Sutras are also descriptions of physical processes that occur during the practice of Yoga as well as how ill health can impact the ability to move forward.

Part III Kinesiology and Yoga

“Any science, art or philosophy has its own depth. But in order to understand them one has to study and build from the base. In the same way if one has to know the body’s depth, its structure, anatomy; he has to have the knowledge of how the various systems function....The science of Yoga begins from the body; it leads one to study and penetrate further the inner layers and sheaths with the journey ending in the realization of the soul (jivatma) and surrender to the Universal Soul (Paramatma). This requires study, culture, purity and sanctity in the body,... (p. 18; Iyengar; Yoga Rahasya Volume 22, No. 2. 2015)

Practically speaking, when teaching movement a competent teacher or coach has to understand at the very least the mechanics of human movement. They have to know joint action, range of motion as well as how to communicate this information in a meaningful way to their students or athletes to improve performance as well as in a way that does not add stress to the physical body. That is one of the goals of application of principles of Kinesiology. In order to apply the science of kinesiology in a meaningful way three things need to be implemented: 1) observation; 2) correction/redirection; 3) implementation of corrections/feedback will lead to transformation. Since Yoga Asana is a physical aspect of the overall practice this can easily be applied. Observation, correction and implementation of change is based on functional alignment which can lead to movement efficiency. A teacher of Yoga needs to know all of this as well as the view held in Yoga about the body. However, the knowledge of kinesiology gives a teacher another way to communicate the depth of thought and development existing in the discipline of Yoga.

One thing observed in movement performance is the physical alignment of the skeletal body. The word alignment is best defined as “to bring components or working parts into adjustment” as in “to line up”. What is being brought into adjustment initially is the skeletal body. The basics of alignment begin with an understanding of this, coupled with the concept that movement is caused by flows of energy.

Very few people possess what is known as “optimal” alignment. Everyone has postural deviations, some individuals more than others. Many of these postural deviations can be improved on and specifically so with the application of alignment principles applied in yoga asana..

As said implementing at even a very basic physical level principles of alignment is one way that the science of kinesiology works with that of Yoga. This also supports what can occur at a deeper level. Asana is mentioned only four times in the Yoga Sutras. Sutra II.29, which outlines ethical and daily practices as the first and second lists asana as the third piece of the “Astanga” or 8 limbed path. The implementation of this path involves action and dynamic effort to move forward. Asana, number of the 3 after ethical disciplines and daily practices that enhance these, is the most tangible and direct of the 8 limbs. The other three sutras where Asana is mentioned are as follows:

II.46 Shira Sukham Asanam

Asana is perfect firmness of body, steadiness of intelligence and benevolence of spirit

II.47 Prayatna saithalya Ananta sanapattibhyam

Perfection in an asana is achieved when the effort to perform it becomes effortless and the infinite being within is reached

II.48 Tatah Dvandvah Anabhighatah

From then on the sadhaka is undisturbed by dualities

(pgs. 157-160, Iyengar, Light on the Yoga Sutras of Patanjali)

Iyengar speaks of perfection that relates to how an Asana is done at every level physically, mentally and intentionally. Iyengar Yoga teaches actions in Asana that bring focus to the mind and align the physical body, working at the level of the skeletal body to achieve balance. Working this way Iyengar Yoga practitioners develop a practice that brings an efficiency of movement, mental clarity and progress in other areas outlined in Yoga. This is in line with principles of kinesiology most certainly at the physical level in terms of working with the physical body to improve posture in such a way that other areas of life are improved.

Of course B.K.S. Iyengar’s commentary on the Yoga Sutras is not the only one that speaks of ‘right’ or ‘optimal’ alignment with regard to physical posture. In his translation of the Yoga Sutras Dr. Ravi Ravindra in reference to Sutras II 46-48 uses the term “right alignment” to “permit the harmonious flow of energies inside.” (p. 147; Ravindra). And Edwin F. Bryant comments on Sutra II-46 “asanas relevance and function for the classical Yoga tradition are to train the body so that it does not disturb or distract the mind of the Yogi in any way in meditation when sitting.” (p. 284, Bryant).

“The best things can’t be told” Joseph Campbell

The esoteric is difficult to prove which is what the above quote speaks to. The teaching of the rise of consciousness through the Sushumna Nadi is an inspiring description of how an aspirant comes to that moment of union with the divine.

“Long before the art of dissection was practiced the ancient yogis were able to deduce certain subtle aspects of human anatomy through close observation of their own bodies.” (pg. 100, Robin). Interestingly enough the yogis were able to follow the flow of “energy” in their bodies via action and reaction then were able to describe in accurate detail the desired result—enlightenment or what others might term an altered state of consciousness. That this corresponds to details outlined in the science of kinesiology is quite astounding.

To line up the ‘topography’ of nadis, chakras and pranas into corresponding with modern anatomical understanding one might associate each of these with the following pieces of the nervous system as outlined in kinesiological studies:

- *Nadis associate with nerves
- *Chakras associate with nerve plexi
- *Prana associates with nerve impulses
- *Merudanda associates with the spinal cord

*Ida and Pingala associate with the two branches of the autonomic nervous system as well as the sympathetic and parasympathetic nervous system.

Iyengar further identifies the efferent nerves as the karma—nadi (nerves of action) and the afferent nerves as the jnana—nadi (nerves of knowledge) and states “perfect understanding between nerves of action and nerves of knowledge working together in concord is Yoga.” (p. 104, Robin)

Kinesiology can affirm then the results of steady and consistent Yoga Practice that includes all the eight limbs and as described in the yoga Sutras of Patanjali. Through the aspects of movement science it can be part of the foundation that proves the existence in some way of what the Yogis were describing and manipulating for their spiritual pursuits. The Yogis discovered this through field research and that is also shared in movement science. Much of what is known about movement is from observation as well as participation.

Kinesiology is a science that can provide a language to communicate the esoteric aspects of Yoga body knowledge because of the parallels between the two. It would be another way to communicate this information of how to connect with a higher level of consciousness as described in Yoga.

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