

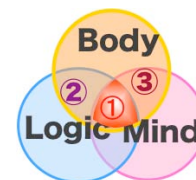
Education Program for "Gnothi Seauton" and Understanding of Own life System and Brain System.



“Gnothi Seauton – knowing yourself through your body”

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Abstract: [English] Analysis era begun from the middle of the 19th century to the end of the 20th century brought us enormous progress understanding humanities, both in the scientific and literature worlds. Previous methods of Humanities education of methods can be divided into two types. The first is the method of knowledge transfer, and the second is the one with only practice. By either type of education method we cannot know own possibility and mechanism of self-learning and self-recognition, which may be characteristic of human beings. This study shows new type of education system to “know thyself (gnothi seauton), which was introduced to 3000 first-year students of the University of Tokyo from the academic year of 2006. The program, which consists of five essential components to the understanding of our own body and existence, is as follows; we should know 1) the gaps of expectation and reality, 2) human standing and walking system, 3) running intensity to keep global homeostasis, 4) cell unity as an autonomous life system, and 5) resuscitation principle. In particular we focus on and discuss the importance of two new fields of recently developed life and brain sciences that had not been academically recognized in the physical education learning. Only human beings can learn and realize ourselves through scientific visualization of “own action” and representation of their own activities with words. This method is based on recent life and brain scientific knowledge of “activity (use-, output-)-dependent gene expression system”, epigenetic mechanism, cell theory, and protein homeostasis. This new management of oneself through action with scientific visualization of our body-mind system can be regarded as “human sustainability” and constitute one part of the area of “Alliance for Global Sustainability”.

I. Introduction: how to know me?

1. How to know me?

Although we have too much knowledge! But we don't know how to use them for our real life as human beings. What is human beings! Can we get the answer from science and technology?

I don't know what to do, if you tell me so. What I should do! Try directly by yourself! You should understand by knowledge and scientific experiment! Self identification is produced by Activity-dependent expression & good emotion. So we should set up the “field” where we human beings can be activated logically and emotionally. We should think about ourselves at least with three words; body, mind, and logic.

• *Rethink about action/activities/practice/exercise!?*

Regretfully Japan is the number one both in not only the longevity but also a number of suicides in the world

for these years. The top cause of suicide is related to health problems. The most important thing for peoples is to keep health, but the related education is not appropriately introduced through school education days. People are interested in athletic games, but don't know herself/himself through real activities and relating sciences. My researches are focusing on human biology since university days. Trying to think about our various activities or exercises from an aspect of human biology, they are explained as follows: Tai Ji is the best exercise to learn human motion and get awareness of our body system; running is human activity to progress evolution of Homo; stretching is “good work” for our cell systems. I feel the essence of life science will be useful for seeking the answer for “What is human beings?”

2. Life is realization, and genome information is not blue print of our real life.

Thanks to advanced scientific research, the

human-genome has been found. However we cannot see the real ability of human beings by genome research alone. Our life (cells) can adapt to real situations by receiving stress (stimuli). If we can use this stress well, our cells and body also can be strengthened (physically and mentally). As we have lived with our own cells and the environment/animals/human being surrounding us by communicating dynamically, I would like to talk about new symbiotic combination from the point of view of principles of life activity.

Life was born from space. Human-beings then evolved their huge brain. But how much we know about our life and brain?

Standing: how do we stand? In standing, we are swinging back and forth because of muscle soleus' stretch on foot.

If we stay in space for long time, both our muscle and bone will be weakened. Indeed, we can keep our mind and muscle healthy by movement (stretching, Tai Ji, jogging for example). Why standing on the earth can give us good stress? Why do our bedridden brains become weak? Physical exercise is often promoted only for its physical values -- but the impact of movement on the mind is far more important, a strong body gives us the foundation for a strong brain. I will emphasize the most recent research in the area of mind-body interconnection and highlight why this is so important in an increasingly globalized, complex and speedy world.

Life is realization of genetic information through protein expression! (Figure 1)

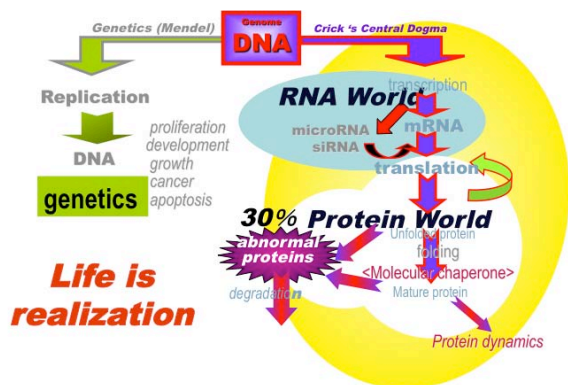


Figure 1 Life is realization

3. Let's imagine your cells which live in your body!

Constitution of "field to learn own body with logically and emotionally" guides us to create human creative action/activities. The action of seeing self activities or

observing beating heart cells just after counting own heart rate lets us understand that cell can live alone both on dish and also in our body (Figure 2). *Students want to know factors connecting individual beating cells in our heart in our body, and are going to think "real autonomy" of life system in own body.*



Figure 2. The scene of physical education class named by "Science course": Observation of "*beating heart cells on dishes*" through microscope in "gymnasium".

4. New science programs for "Self Discovery" in the University of Tokyo

Era of analysis science that begun from the middle of the 19th century and continued to the end of the 20th century brought us enormous progress understanding humanities, both in the scientific and literature worlds. However, we had missed the starting point and the goal of humanities educations. I would like to tell you about one possibility to solve this problem that unify body and mind resulting in occurrence of action/activity and realizing the process of creation of own abilities.

I feel sympathy for principle of human being who lived in ancient times. It seems that they know body more than us living now today. "**Self discovery**" called by "**Gnothi seauton**" has been in my mind for a long time, after the first discovery of an existence of life system working in my body and mind in student days of special course of physical education. I was impressed to read the book titled by "Human Biology ("Pre'cis de Biologie Humaine - Les Bases Organiques du Comportement et de la Pense'e -" written by Paul Chauchard, 1957, Presses Universitaires de France (translation into Japanese, 1959 「人間の生物学—行動と思考の生理学的基礎」, 岩波書店). The subtitle is "physiological basis of human action/behavior and thought". I imagine, he will publish a similar book from life science. if he were alive nowadays, he would like to write a book I will show you here some introduction, my hypothesis and the program of Gnothi seauton in KYOYO education in the University of Tokyo

introduced formally since 2006. All programs are performed in the special gymnasium equipped with various visualizing system.

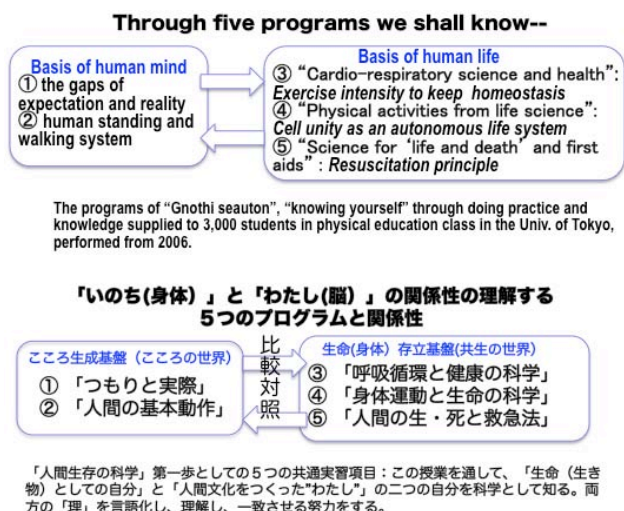


Figure 3. Inter-relation among five programs.

• Some principles of presetting

• The Scene is very important to learn something, because our recognition is afforded by environment. Therefore, I set the scene where students do, think and express with words. Beating heart cells under microscope in the science laboratory is for just scientific analysis, while beating rhythm under microscope set up in gymnasium observed after exercising and counting own heart pulse will connect to own rhythm of self heart.

• Five basic programs were selected from many contents produced by Trials of "Science Course", which are consisted of small classes (~30 students) for 5 years by several teachers. Five years of period as pre-trials named as "Science Course of physical education" have past since 2000. Volunteer teachers/researchers of specialists, such as brain-scientist, life-scientists, orthopedist, psychologist, and physiologists have developed each unique program to understand various aspects of human body, especially active/exercising state and performed for small numbers of students.

• Five programs

1. Basic rule for the gaps of expectation and reality, that is disagreement between recognition and output (performance)
2. Basic rules for human standing and walking system—Measurement of Center of foot at standing posture, and EMG during walking (Tai Ji is the best exercise for learning of human motion.)
3. "Cardio-respiratory science and health": running

intensity to keep global homeostasis. Reevaluation of exercise intensity of aerobics to keep homeostasis: Lactate Threshold (Stress Threshold)

4. "Physical activities from life science": cell unity as an autonomous life system. This produces basic rule of "adaptation" from life science (cell biology and molecular biology, that is "Mild stress is good stress")

5. "Science for 'life and death' and first aids": resuscitation principle. Practice of First-aids and understanding of the production of electric current for autonomy of heart cell: artificial respiration, taping, and icing.

• Relation among programs

First two programs are included in "Basis of human mind" and has effects on life system of body and action. Inversely, latter three programs directs from output via muscle activity to brain. Interestingly these programs are described by the Use of two striated muscles, skeletal muscle (①, ②) and heart muscle (③, ④, ⑤) for our understanding. Muscle contraction system makes us live and express all.

• Effects of Education Programs

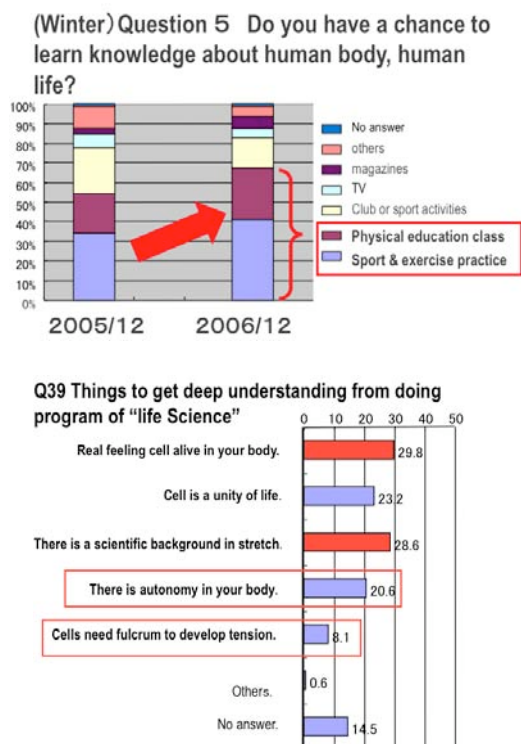


Figure 4. Effects of one program to understand own body related to life science by questionnaire to students.

Some results of a questionnaire for students participated in these programs of the first year will be presented in Figure 4. One examples: (Winter) Question 5: Do you have a chance to learn knowledge about human body, human life, and ? Question 39: Things to get deep understanding from doing program of “life science” (Figure 4).

II. Recent knowledge from life and brain sciences let us know intrinsic property of “action” and “dynamics”.

• Possible origin of our adaptability and educability.

On the process to elucidate molecular mechanism of muscle atrophy induced by unloading (special animal model for disuse-bone and muscle atrophy) I happed to meet a protein system named of “cytoskeleton”, which plays a role making frameworks of cell shape. This system is amazing because having fiber-like protein structure (Figure 5), but unstable being breaking down into small peaces of free form. Fibers are assembled form of free proteins. The assembly needs energy like ATP or GTP. Most cells in our body have basically three cytoskeleton, named actin, tubulin, and intermediate filament. Actin proteins assemble and making actin filament, and tubulins making microtubule, both of which has intrinsic dynamic property. The property of microtubue is called as “dynamic instability”. This means the unit of “a cell” has a dynamic structure. Plasticity is unique property on brain, and the base of our educability, that is based on these dynamic systems especially actin and tubulin protein system. In general, people think chemical reactions occur in solution like water, while the inside of cells are crowded in protein molecules organized by the cytoskeleton”, which produces the direction (“polarity”) and dynamics. I imagine unstable human mind, therefore always seeking something, borne from unstable body and activities because of bipedal landing, and also originally might be borne based on corresponding unstable cell system to be destined dynamic. Stabilization of life system is going to “death” at the cellular level, therefore we cannot realize myself through only thinking. Only image is only image. We cannot be healthy without “action”, “activities”, or “exercise”. Six hundreds thousand cells increased from

one egg and one sperm live in your body, whose system is working in the basically same discipline under Central Dogma, proposed by Francis Harry Compton Crick (1953). Doing, moving and explaining with words results in understanding and realizing myself. “Gnothi seauton” from cellular and individual levels, because life is working in an activity-dependent principle!

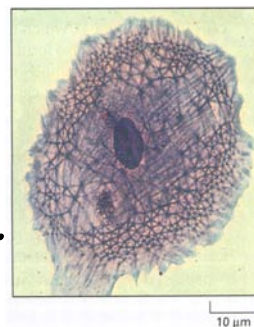


Figure 5 Cells make a shape with protein filaments named of the cytoskeleton.

Activity(Use/Output)-Dependent Manner

Recent evidences of brain and life sciences show that our life system including brain works on at the molecular and cellular levels in “activity-dependent way for almost biological phenomena. Brain produces both just images, most cases associating with perception from outer/inner environment and real creation with muscle and secretion systems. Human dream realizes only through activities with imagination resulting in creation (Figure 6). We need cyber world work but have to connect to real physical and biological world. Activity-dependent gene expression is a principle of survival of neuro-muscular cells as well as all cells in our body.

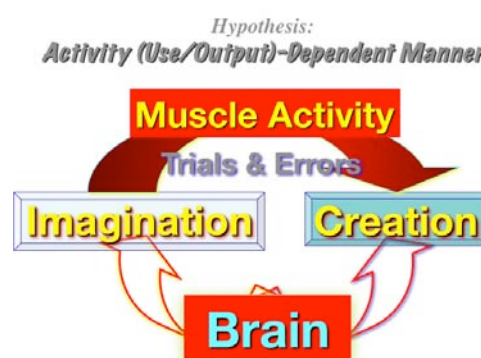


Figure 6 Relation of brain and muscle activities, realized in activity-dependent fashion.

II. Guidance of awareness by

visualization of invisible motion/activities processes, molecular and cellular phenomena.

• Three phases of our ordinary lives (Figure 7)

It seems to be three levels of ordinary life, phase I~III, depending on levels of consciousness; such as Phase I: Ordinary 24 hours: Daily Life to past 24 hours to plain live,; Phase II: Daily Life at present: Learning is considered as inevitable obligation; and Phase III: Understanding myself through monitoring of living conditions of daily life may bring us to get 24 hours to be active, alive and progressed.

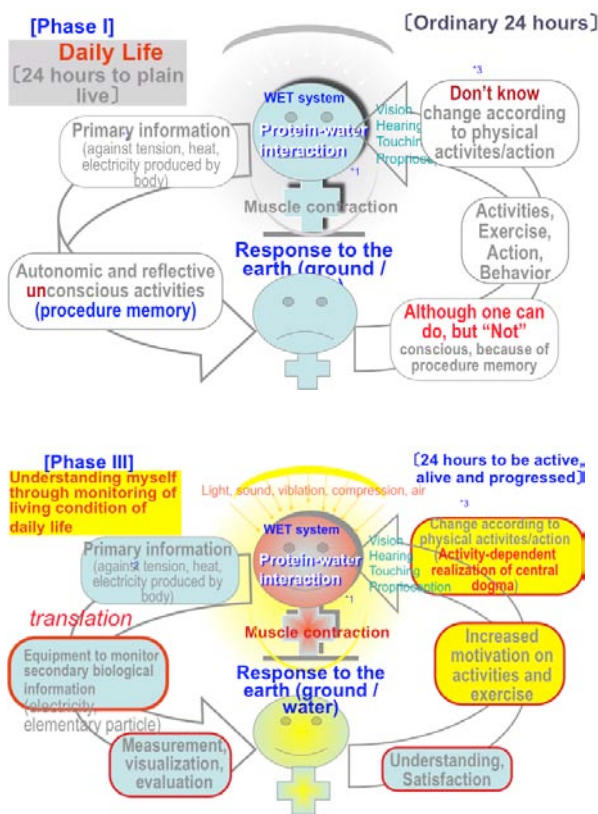


Figure 7. Three phases of our ordinary lives; plain life and active/alive life.

Most function of human body was produced by the interaction of proteins and surrounding water. Human communication with environment is produced by perception through vision, hearing, touching and proprioception to physical dry factors, such as light,

sound, vibration, compression, air. Most responses to various stimuli is tension/strength produced by muscle contractions. However, biological system is produced by wet chemical activities after perception of stimuli. Those responses are **autonomic and reflective, therefore unconscious activities because of procedure memory.**

Realization of learning, adaptation, and evolution is owing to just creative “activity-dependent system”.

III. Some examples of observations for “gnothi seauton” in body level; posture effects, physical exercise effects, and in cell and DNA levels

Some examples of programs will be listed as follows:

- 1) Gaps between subjectivity and objectivity
- 2) Heart rate change at different postures:
- 3) Heart rate changes during exercise: linearity
- 4) Direct observation of DNA extracted from cells

I explain a little some simple programs for students to realize and understand in the way of “Seeing is believing”.

1) Gaps between subjectivity and objectivity:

Using a hand dynamometer, two persons do together this program. One student tries to grip adjusting predetermined graded strength (output) without seeing the value. After performing grading grips of randomly assigned five grades (e.g. 20, 80, 60, 100, 40 %), she/he draws graphs of expected values relative to real measuring values. Usually the graph is almost linear with some threshold and showing plateau near 100%. Sometimes examples appeared no relation, meaning no grading or no controlling.

2) Heart rate change at different postures:

Heart Rate changes at 3 postures: standing, sitting and lying depending of body and heart works on the gravity. We can observe “heart’s autonomous response”, even under relatively milder changes of posture. Heart rate per minute is lower in lying position, becomes higher in sitting position, next in standing position.

3) Heart rate changes during exercise:

Although we know after the another program titled by “cardio-respiratory system and health”, another program of common basic practices, we can get a beautiful linear

line between exercise intensity (running speed) and heart rate. Comparing two different graphs of trials of grip strength relative to own ratings (grading) and heart rate levels relative to running speed, students understand differences of human expectation (grading of hand grip) and body (heart) works.

“Autonomy of heart” is regulated by corresponding changes of exercise quantity of whole body by dual autonomic nervous systems, sympathetic and parasympathetic nervous systems,

4) Direct observation of DNA extracted from cells:

We understand relation between our materials of our body and cells, and our will/consciousness, autonomy and observation & knowledge through this program.

VI. Conclusion

I contribute twice correspondences apart 5 years to “Japanese newspaper column in Asahi shinbun named by “the world of criticism” (2000“Human Body educates life and brain” (Asahi Shinbun, December 19, 2000)) and “My viewpoint” (2007.3.7: Thinking of my body - “Let us know the relation to myself!” (Asahi Shinbun, March 7, 2007). Strangely it is most far from our life system and our body and brain system, especially in Japan, despite recent progress of life sciences.

It is difficult to explain our programs from aspect of human understanding, especially in English. We human being should know what is human being. Body knows all. Do we know our body of nature itself? Now we have learned knowledge with association of physical activities, such as trials, mechanism of activity-dependent survival, and an existence of “shape to move.” We shall keep in mind to live as a man, whenever we could live through life. That is the human life.

“自分を知る”教育プログラム～我々自身の生命システムと脳システムからの理解と原理（その一）

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平成三年の大学設置基準の大綱化で、東大では長年必修だった保健体育講義は選択科目となり、体育実技のみが必修で残った。中高大学受験科目ではないので「保健体育」をほとんど学習していない新生が大学に入学してくる。身体や健康、身心の連携などについての知識は驚くほど少なく、受験のために学んだ生物学の知識さえ「自分が生きていること」と関連づいていない。その結果、学生にとって体育の授業は、「身体をリフレッシュする時間」との位置づけになっている。平成18年度から、一週間に一度の体育の授業を、身体の運動量を補償するだけの体育実技科目

から、「出力依存的に現れる自らの身体の動き」の観察・数値化を通して啓かれる「自己対象化」・「自己創発」を促す教育の場として捉え直し、授業題目を「身体運動・健康科学実習」と名付け開始した。「やる」ことだけを目的にせず、「やる」ことで分かる「からだの仕組み」や「身心連携の仕組み」の理解を目的としている。つまり、知識の習得と知識の活用を同時に実習し、授業後のレポート作成過程で自身の身体の内観を言語化することで学習効果を確実にする、自己認識の基礎実習と位置づけたのである。

スポーツ種目で応用される基礎実習

文理を問わず3千人の新生対象に、夏学期と冬学期の2期、90分間、計26コマ行われる授業では、従来のスポーツ種目を、身体運動・健康科学実習の応用モデルとして定義し、その基礎について学ぶ時間が5コマ分用意された。夏学期には、学習に取り組むための前提となる、①知っている「つもり」になっているが、やってみなければ分からないこと（第1の身心問題）、②姿勢維持と運動は脳神経と筋の連携で起こること（意思と運動）の2項目をまず学ぶ。これらは日常の視点から「からだ」を認識する第一歩である。それらを理解した上で、冬学期には、③「自分」でありながらも意思に依存しない「自律的な生命活動を営む生命体」としてのマクロな身体理解（呼吸循環と健康）と、④その身体のマクロな視点での理解と、意志や自発性のような「人間」としての側面を自然の法則に則って活動する身体にどう関わらせるか（身体運動と生命科学）、そして、⑤万が一のときの対処法（救急法）を学習する。

3千人という人数の制約から、これら5項目を選んだが、いずれも人間が120歳の人生を全うするために欠かせない、今まで見落とされがちだった人間の側面を見せる項目と自負している。

それぞれの内容について見ていく。

①認知と出力の一致度を探る できる“つもり”と“実際”は異なることを、自身の試行を通して気づかせる。全力を振り絞って握った最大握力の20～100%の5段階の「つもり」で握ってみても、思うように握り分けられない。そのことから“つもり”と“実際”は異なることを知り、実際にからだを動かして試してみることの大切さを実感させる。これは、大学での学習や研究に対する基本姿勢の醸成に大きく貢献する。

②立ち方、歩き方、からだの動かし方には基本がある 立位姿勢を中心に、人間は重力場中でどう立つか、立つためにどのような構造を持っているのかを理解させる。自分の姿勢や重心の位置を測定し、運動するとどうなるか実感でき、適切な運動によって姿勢や重心の適正化が起こることを知ることができる。若年化傾向にある腰痛の予防にも応用できる。

③自分に最適な走る速度を測る呼吸循環と健康の科学 運動の強度を高めるにつれて、心拍・呼吸数が変化するが、一様な線型変化ではなく、非線型応答を始める閾値がある。このことから運動負荷に対する身体の作動メカニズムを理解させる。二足歩行運動や走運動がヒト、そして人間への進化に強い関わりがあることと、人間としての健康のための運動の重要性を認識させ、脈拍や呼吸数などの心肺循環機能のチェックが確かな身体の健康指標であることを理解させる。

④身体運動と生命の科学 ストレッチ、呼吸、走歩、筋収縮による関節動作の発現など、基本的な身体出力（張力）が、細胞を活性化させる刺激になっていることを理解させる。刺激は細胞内のひも様タンパク質構造の張力で直接DNAに伝わり、DNAの読み出しが稼働する。細胞が活動するための「場」こそ身体であり、その場の保全つまり健康の維持は本人の責任であることを自覚させる。実際にストレッチを行い、姿勢による心拍数の変化を測り、その同じ実習室で生体から切り離されても拍動し続ける心筋細胞や細胞の核内DNAを観察し、生命の自律性と自分の意志に

ついて考察させる。

⑤救急法とからだのつくりの理解 市中に配備されつつある AED (自動体外式除細動器) のデモンストレーションを通し、個々の細胞がバラバラに活動するのではなく、統制がとれた運動をする心臓の動きを理解しながら、心肺蘇生法の実習、テーピング、アイシングなどを体験しながら、瀕死の負傷者を前にしたときの市民としてのたしなみを身につける。

5つのプログラムの選択と相互の関係：

コンピューターや他の機械と同様に、動かしてみないと機能や性能は分からない。また「知識」が単なる知識で終わってしまったのでは、役に立たない。身体知を本当に有効活用するための、戦略として、現場性を重要視する基本プログラムを創成し、試行錯誤し、導入した。

とくに「つもりと実際」、「運動強度と心拍数」を比較対照し、「自分の身体の生き物としてのシステム」の外界応答性を知る。自分自身の「つもり」よりも自身の身体の評価系が優れていることを学ぶ。このことから「身体には身体のルールがある」ことを知る。人間（の脳）で勝手に制御できないこと、対応性は、自分の反復繰り返しで学習できる！という確信を得る。

健康のためだけではなく、身体がもつ自己の可能性を活かすためにも、活き活きと活動的に生きることによって身体の 60 兆の細胞(自律的に生きている細胞)の機能を引き出し、活動性を維持上昇させる活動、適切な運動が必須である。「共通基礎実習(5コマ/年)の一つ「身体運動と生命科学」では、・主動、受動でのストレッチ運動、姿勢変化による心臓の仕事の変化を、人間動作や人体機能で評価するだけではなく、実際にそれらに回答している「からだ」を住処にしている細胞への刺激、細胞の応答として理解する。

・細胞の生存基盤(接着性・エネルギー産生/消費と運動した張力発揮)を維持する活動が、人間が為す動作により適切に引き出されることを理解する。

外界と自身の認知が、1対1対応することが当たり前か？、直線関係とはかなり人工的な系あるいは2~3因子が関与して直線性をもたらすことの方がむしろ多い、ということにはあまり気づかない。人間が環境とどのように対しているかについて、これらのプログラムは、若い学生に刺激的なものになっていることを期待したい。

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