THE CrossFit JOURNAL

Paradigm Lost

Dr. Lon Kilgore questions the modern foundations of the study of exercise physiology and suggests a new way forward.

By Dr. Lon Kilgore **November 2010**

S. Dy/CrossFit

"Into what abyss of fears and horrors hast thou driven me, out of which I find no way, from deep to deeper plunged."
— John Milton, *Paradise Lost*

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I don't know why no one has asked this before. I don't know why it has come down to me to ask a question central to the existence of an academic discipline. But someone needs to cowboy up and question the validity of a field of study fraught with data that informs but fails to illuminate—a discipline spawned of misunderstanding, misinterpretation, misapplication, misinformation, and misdirection in the path of science and discovery.

I could easily be referring to physical education, coaching, biomechanics, kinesiology or "exercise science" in general, but I am specifically questioning the theoretical and practical basis of the discipline known as exercise physiology.

The Body Under the Barbell

The study of the human body at work is very old. Anatomists, physiologists, physicians and surgeons throughout the centuries have been fascinated by how the body is built and how it functions. Each of these disciplines has specific domains in which its interests and experiences lie, but they have in common the need to master the understanding of form (anatomy) and function (physiology).

Throughout history there have been individuals who made contributions to all of these disciplines, blurring the boundaries between them. They studied the exercising human with the purpose of applying the knowledge obtained to the betterment of man's ability to work and live. Yet today, the effort to understand the body in motion, the anatomy and physiology of the exercising human with the desire and willpower to become physically fit and improve his physical lot in life, has been irreparably diminished—not by a lack of interest or manpower working in the field, but by the absence of a unifying scientific paradigm.

A paradigm can be thought of as a disciplinary road map representing the intellectual topography of a discipline.

A paradigm can be thought of as a disciplinary road map representing the intellectual topography of a discipline. Every new discovery fits on the map and allows a better understanding of the content and directions within a discipline. Like a map, a paradigm allows scientists to systematically and individually move en masse in the same direction in the performance of science.

"Form equals function" is a common observation in biology. University-level anatomy and physiology classes are the standard prep for many career fields, including those related to exercise. But part of this essential equation, the study of anatomy as it relates to exercise, has become rather ignored in favor of its more widely recognized cousin—the physiology of exercise—and anatomy is frequently grouped under the heading of "biomechanics."

To be clear: anatomy is important to biomechanics, but biomechanics is essentially physics applied to living systems, not the study of anatomy. Since Ono's 1969 work with mapping barbell movement in weightlifters, there have been hundreds of studies on the biomechanics of the sport of weightlifting (and of course the astoundingly important bench-press exercise as well) (1). The vast majority of these studies focus on bar trajectories, velocities, accelerations, displacements and generic arbitrarily defined "segments." None focus on what the body is doing in relation to the barbell. Is that not an important—if not the most important—thing to study?

By focusing only on what the barbell is doing, we fail to develop any understanding of what the body is doing. The human body is made of flesh, bone and sinew—plastic, moldable and dynamic. In failing to consider the body in the system, we also fail to develop a database that will enable us to improve the function of the human component in the barbell-human system. After all, the international standard Olympic barbell is an inanimate object that will behave only in a manner consistent with the physical forces applied to it by the human body lifting it.

The human race is genetically diverse, with a huge range of shapes and sizes. The failure to investigate the human component of this moving system diminishes the value of these studies as they apply to human movement. How can we effectively train a human for improved performance—in this case the lifting of a barbell—if we do not understand the anatomical principles of human movement under load? Furthermore, the "functional" anatomy classes common in exercise-related academic programs use an

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isolation/muscle-group approach that results in a failure to appreciate the integrative nature of human movement. It is apparent that researchers are asking the wrong questions and teachers are giving the wrong answers, the hallmarks of either having no operating paradigm or an ignorance of the existing paradigm.

The Study of Physiology

The term, title or job description "exercise physiologist" is a subject of importance to some and of scorn to others. Once upon a time it was enough to be merely a physiologist who studied the functioning of humans or animals in motion. Training as a biologist who investigates how the body works was the requirement, and no special disclaimer or qualifier was needed.

Was da Vinci an exercise physiologist? No, he was a genius, so perhaps not the best example. Was H.E. Huxley, who theorized the sliding filament theory of muscle contraction, an exercise physiologist? Nope. He was just a kid who wanted to be a nuclear physicist but ended up being one of the most influential biologists of modern times. A.V. Hill has been called the "pioneer of exercise physiology," but his training and practice were in "physiology," as was his Nobel Prize in 1922. Historically, any biologist or physiologist who studied exercising humans or animals was simply called a biologist or physiologist. For the classical physiologists, exercise was a tool, a means of elucidating the workings of the human body.

It was not until the term "exercise physiology" superseded the term "work physiology" in academic literature during the mid- and late 20th century that a distinction between physiology and exercise physiology was drawn, and the title "exercise physiologist" was born.

It remains that the physiology of exercise was researched very early on, usually because of some personal interest in the topic or because of a vested interest in enhancing human function for work or combat. The fun thing about Hill is that he liked sports and enjoyed trying to understand how his body and those of his research assistants worked during exercise (apparently there was quite a bit of experimentation done on himself and the laboratory staff on the track outside his lab). There are numerous similar instances of anatomists, biologists, physiologists, chemists and physicists who investigated exercise responses and adaptations due to their interests in sports, but none of them called themselves exercise (insert discipline).

It was not until the term "exercise physiology" superseded the term "work physiology" in academic literature during the mid- and late 20th century that a distinction between physiology and exercise physiology was drawn, and the title "exercise physiologist" was born. I am the bastard stepchild: a bachelor's degree from a traditional biology program, a master's degree from a PE-based exercise-physiology program, and a doctorate from a medical anatomy and physiology program.

I actually chose not to teach and do research in traditional biology programs in order to teach and do research in exercise physiology because I wanted to fix the problems I saw within the coaching system during my time as a halfway-decent athlete and as a moderately productive coach. I was intent on wading into the quagmire of teaching scientific applications to PE students while conducting viable research in a small state university to correct the coaching and performance problems of hearsay, misinformation, lack of information, ignorance of application and more. Believe it or not, I was once told in a job interview that I was scientifically overqualified to teach science to PE students! During that interview I discovered it was not going to be easy to bring science to PE because it was not just the students who needed a better appreciation of science as it applies to exercise.

It was becoming apparent to me that a drift had occurred in the nature of the science surrounding exercise. Something was different between the real world of my competitive athletic experience and the training of my adopted profession. It took years to understand this, but I was lucky with respect to my master's degree in exercise physiology; my mentor was a zoologist-turned-exercise-physiologist. In addition, my external thesis advisor worked in a biomedical science department and had penned

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one of the most influential papers on the mechanism of hypertrophy ever written (2). This advisor also taught me animal-surgery techniques.

As a result of this fortunate early academic exposure, I did not see the boundary between PE-based exercise-physiology programs and physiology programs that studied exercise. But now, when examining the research literature from the 1950s as compared to more recent work from the 1980s forward, it is easy to note that later exercise-physiology research departs from the classical norms in approach, topic and rigor. It is frequently pointed out by those in exercise physiology that the shift in "quality" of content noted here is due to the move from an emphasis on basic science (science for understanding) in physiology to an emphasis in applied science (science to solve a problem) in exercise physiology.

During this time there was another major change affecting the sciences and the study of exercise. American physical-education academia began developing their own exercise-science research and training materials in order to produce data and publishing output, and to secure their positions on campuses. In the 1960s, PE departments were on the verge of becoming regarded as "non-academic" by many administrations. The Fischer Bill of 1961 specifically required universities to prepare students in "academic" areas that provided the student with intellectual development, scholarship, research and a set of guiding theoretical principles. At the time of the bill, physical education as it was practiced at universities failed to deliver in any of these areas.

James Conant, an organic chemist and president of Harvard University from 1933 to 1953, added to the controversy in 1963 by writing that university PE programs were shallow in content and minimal in academic rigor. Not only did he suggest that undergraduate programs could easily be eliminated, but he also said that PE graduate programs should be eliminated.

So began the restructuring of physical education on a scale of magnitude and haste never before seen in any other university discipline. To keep PE on campuses, new courses had to be created, new information had to be put into those courses, and new "exercise science" faculty had to be developed to teach these new courses and to generate the new data. PE programs became subdivided into biomechanics (physics or engineering as taught by physical educators), exercise psychology (psychology as taught by physical educators), sport history (history as taught by physical educators), and most relevant to the topic at hand, exercise physiology (physiology as taught by physical educators). Such an undertaking led to fragmentation, dilution and a failure to do one of the most important things the Fischer Act required: develop a guiding set of theoretical principles.

The fact is that theoretical principles were developed, enough so that PE programs are still on campuses, but these principles are not cohesive. They are not widely applicable to all aspects of PE or exercise science. Many have no scientific basis at all. PE, in its effort to become the authoritative discipline of exercise, had become the jack of all trades and master of none. Newly trained exercise physiologists and other exercise scientists were primarily being produced in physical-education programs, not in biology or physiology programs as had previously been the norm. This provides a degree of disconnection from the intended applied nature of exercise-physiology research, the exploration of improving work capacity. This began changing the approach to science as it was applied to exercise, and in my opinion this is due to the absence of a valid paradigm framing the science carried out under the guise of exercise physiology.

Courtesy of Lon Kilgore

It is not enough to study exercise physiology. One must aggressively be a participant. Research conducted, or an opinion expressed, in the vacuum of inexperience is frequently wrong or useless.

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Define Your Terms

Most exercise-physiology curricula in colleges of education, and in some instances colleges of health sciences, were not forged in the fires of classic biological science. Further, given the 1960s contention that exercise academic fields were actually non-academic, there was a tremendous need to produce a volume of novel information quickly to retain the place of such programs on campus. So any question about exercise, useful or irrelevant, was just fine for study. But how can one perform applied research into fitness with random questions or do so if there is no paradigm to guide the development of useful questions? Further, how can one perform research into exercise and fitness if there is no measurable and agreeable definition of what fitness is?

How can an exercise physiologist provide any useful insight into his own discipline without knowing how to measure fitness, the basic entity he is studying?

If you examine the history of the definition of physical fitness, you will find virtually nothing meaningful in the exercise-physiological literature or the authoritative professional publications beyond a few vague statements. The National Strength and Conditioning Association (NSCA) has never included a definition of fitness in the texts it produces. And the widely accepted authority organization the American College of Sports Medicine (ACSM) did not produce any substantive definition in its publications until issuing, in 2006, a quite verbose definition consisting of a laundry list of scientific, clinical but ultimately arbitrary "attributes" of fitness:

A multidimensional concept that has been defined as a set of attributes that people possess or achieve that relates to the ability to perform physical activity and is comprised of skill-related, health related, and physiologic components. Skill related components of physical fitness includes agility, balance, coordination, speed, power, and reaction time, and are mostly associated with sport and motor skills performance. Health related physical fitness is associated with the ability to perform daily activities with vigor, and the possession of traits and capacities that are associated with a low risk of premature development of hypokinetic diseases. Health related components of fitness include cardiovascular endurance, muscular strength and endurance, flexibility, and body composition. Physiologic fitness differs from health-related fitness in that it includes nonperformance components that relate to biological systems influenced *by habitual activity. Physiologic fitness includes—(a) Metabolic fitness: The status of metabolic systems and variables predictive of the risk for diabetes and cardiovascular disease. (b) Morphologic fitness: The status of body compositional factors such as body circumference, body fat content, and regional body fat distribution. (c) Bone integrity: The status of bone mineral density.*

When you examine it closely, the "everything and the kitchen sink" approach to a definition fails the litmus test of useful application. It is not really any more precise or testable than the many-decades-old previous definition:

"Physical fitness is the ability to carry out daily tasks with vigor and alertness without undue fatigue and ample energy to enjoy leisure time pursuits and meet unforeseen emergencies."

Ambiguous, unquantifiable and not terribly useful.

Physics, biology and chemistry all deal with precise quantitative parameters measured in newtons, picograms, joules, kilodaltons, watts and a wide spectrum of other defined units of measure. How can an exercise physiologist provide any useful insight into his own discipline without knowing how to measure fitness, the basic entity he is studying?

The application of exercise physiology was, is and should be the improvement of fitness. The term "exercise" means the methods by which fitness is improved, so when we use the term "exercise physiology," we mean the study of the methods by which fitness is improved. Or do we?

Perhaps many, if not the vast majority, of exercise physiologists feel as though their primary field of concern is merely physical activity as it relates to health. Or does exercise physiology actually consist of two sub-disciplines: health physiology and fitness physiology, each named after their functional end product? If it does, the need for a viable definition of the term "fitness" becomes even more pressing.

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The definition of fitness should be meaningful and tangible, something understandable and measurable. To that end, in 2004 Mark Rippetoe and I began a conversation on the definition of fitness. After months of discussion, argument, evaluation and semantic wrangling, we arrived at a simple and straightforward definition meeting the criteria of precision, simplicity and quantifiability:

Possession of adequate levels of strength, endurance and mobility to provide for successful participation in occupational effort, recreational pursuits and familial obligations, and that is consistent with a functional phenotypic expression of the human genotype.

In 2007, we published the definition in an article titled "Redefining fitness for health and fitness professionals" in the *Journal of Exercise Physiology* (3). It took more than two years in the review and publication process to get it published in the journal of the most liberal and progressive-thinking of the exercise-science professional organizations. Apparently even exercise scientists who disagree with the conventional wisdom have a hard time abandoning and replacing it. To the credit of the reviewers, once they looked past their preconceived notions and their "aerobics = exercise" attitudes, they accepted the paper, in virtually unchanged form, as a valuable contribution and approved publication.

(For those who don't know, scientific papers are "peer reviewed," meaning, at least theoretically, that one's peers read the paper, offer comment and criticism, and eventually deem it either fit or unfit for publication. It is frequently the case in the exercise sciences that papers which do not conform to the conventional wisdom are not published.)

We were not the only ones who were dissatisfied with the sad academic definition of fitness. In 1998 Greg Glassman, fully aware of the inadequacies of the ACSM definition, put his definition of fitness into operation, and then in 2002 he put the definition online.

The first CrossFit fitness standard elaborates the specific abilities or elements of "physical fitness": cardiopulmonary endurance, stamina, strength, flexibility, power, speed, coordination, agility, balance, accuracy. The second CrossFit fitness standard referring to the ability to cope with any external physical challenge provides a much clearer presentation of the "unforeseen emergencies" clause of the 1970s ACSM definition. CrossFit's third fitness standard goes beyond the traditional definition and links development of all three metabolic pathways (phosphagenic, glycolytic and oxidative) to general fitness. Although there was much data in the literature about exercise and all three pathways, virtually all exercise prescriptions for fitness centered around the oxidative; i.e., let's go jogging. A field definition of fitness superior to that espoused by the world's major exercise-science academic and professional organization had been articulated.

Courtesy of Lon Kilgore

Greg Glassman and Nobel Prize-winning biochemist Dr. Kary Mullis. Science and exercise must not be estranged from each other. Effective exercise physiological science and the practice of teaching exercise depend on the flow of fact-based information between laboratories and the field, and vice versa. At every level within the exercise professions, academic and practitioner, we must consistently and objectively engage in relevant discussions.

A Discipline Without Foundations

Why is it that it took until the 21st century to develop a useful academic definition when it was clearly needed more than 50 years ago? Why did a corporate fitness entity feel compelled to create a definition for a concept central to any academic exercise discipline?

There are several reasons, but one is likely most relevant here. It is a common practice among graduate PE programs that students are prepared as "generalists," meaning that the curriculum is constructed to produce faculty who are supposed to be able to teach exercise psychology, biomechanics, motor control, PE pedagogy, exercise anatomy

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and exercise physiology. Generalists working in small-college and university PE programs reduce the cost of operation; because they feel capable of teaching a variety of courses, there is no need to hire trained experts in the specialties, and the program remains viable.

But by the very nature of his preparation, a generalist is not in a position to be an expert in any field. Someone prepared in this way cannot create from previous research an overarching paradigm for exercise physiology. A generalist may not know what a nephron is and does, may think that knowing only 72 out of 636 muscles is mastery of anatomy, or may believe that "research" and mastery of a subject can consist of reading a single review article in a clinical journal. Indeed, a generalist may think that such limited knowledge is of high academic standard and encompasses all that is needed to teach exercise-physiology courses and prepare students for practice. I have heard these things from faculty with my own ears. This limitation in disciplinary understanding, however, is exactly what has occurred in exercise physiology, setting the stage for our present dilemma.

Can exercise physiologists produced outside the traditional science track be good scientists? Yes. There are many exceptions, and not all the exercise physiologists produced over the past 50 years have wasted their time and effort. But it remains that they have not produced a unified body of knowledge that can be usefully applied to the production of physically fit individuals, from the very first day of training to the peak of physical function and then to the end of life. The lack of a guiding premise or even a good idea of what needs to be investigated has yielded a disconnected and conflicting mass of data that perplexes some of us and seems a waste of time to everyone else.

Questions abound. Will they be answered—or even investigated properly? Not in the current environment of exercise-physiological research.

When examining exercise-physiology research papers from the 1970s forward, every paper that "proves" a point is quite likely balanced by another paper "proving" the opposite. This occurs in the traditional sciences too—remember cold fusion?—but in biology, chemistry and physics, conflicts are generally settled over time by the accumulation of data supporting a piece of the presently accepted paradigm. Without that paradigm, how are we to settle conflicts?

The most contentious issues in exercise physiology are no more settled today than they were before 1970. What drives VO_2max improvement? Which is more useful in improving strength, 1 set or 5 sets? How much flexibility is required to be fit? And as discussed before, what is fitness? All are simple questions with no universally recognized, data-driven answer. There are lots of opinion pieces, though.

Similar unanswered questions abound. Will they be answered—or even investigated properly? Not in the current environment of exercise-physiological research. There must first be a unifying understanding of the facts that encompasses what we know, and this understanding must be articulated as a viable paradigm that guides logical thought and subsequent investigation.

During a series of discussions about science and training with Russell Hadley, a computer scientist who trains at CrossFit Eastside, it was suggested that modern exercise science was experiencing a paradigm shift, a part of the normal progression in the development of a new science into a mature science. Russell had inferred from my comments that the exercise sciences were demonstrating characteristics similar to those described by Thomas Kuhn in his 1962 masterwork *The Structure of Scientific Revolutions*.

But what is a paradigm? Lots of people use this term to describe a new training method or just a new idea. A paradigm is the thinking pattern or model distilled from the accumulation of prior scientific achievement that serves as the foundation for a discipline's further practice. It must be simultaneously rigid enough to serve as a logical framework and yet open-ended enough to encourage and accommodate the solution of further problems within the discipline. It is the study of the paradigm that we engage in during our time at university. We learn what went before so that we might participate in solutions to present and future problems. Occasionally an extant paradigm turns out to be wrong and must be replaced with a better, more tenable way of thinking.

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Many athletes who asked the question, "What is fitness?" were drawn to the CrossFit program, which is based on defining fitness, measuring it, and improving it over the course of a lifetime.

In Kuhn's text there are numerous famous examples of paradigm shifts: heliocentric local astronomy replacing the geocentric; the acceptance of Newton's work as a replacement for earlier physical theory; the later acceptance of special relativity over simple Newtonian mechanics. A paradigm amounts to an accepted set of beliefs about the nature of a discipline—what it is, what is known about it, and what needs to be known.

Russell's observations were astute and wise, as is he. But I question whether a paradigm shift is occurring. Do the exercise sciences and the inhabitants thereof actually have a developed and unifying paradigm? Read the literature: can you find a major theoretical framework that can serve as an operating paradigm which collectively engages the entirety of exercise physiology? If there is a model that can be said to function as the paradigm adopted by the exercise-physiology establishment, it can be summarized like this: there exists a minimum amount of physical activity that is needed to maintain health.

Most current research in exercise physiology centers upon this issue. The doctrines espoused by all major sports-medicine and exercise-professional organizations as well as government health agencies can be summarized by that statement. The federal funds devoted to exercise research focus on precisely this issue—how physical activity, defined as unplanned and spontaneous human movement, affects health, defined as absence of disease. Although the mass of data that has been generated by the investigation of this idea is considerable, I would argue that it does not constitute the breadth and depth of exercise physiology.

Where and what is the exercise in this unstated but obvious paradigm?

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A New Paradigm

Exercise, by definition, is programmed human movement intended to improve fitness. A paradigm of exercise must also address at its core the question of how the body adapts to an escalating physical load intended to improve human performance. It must be centered on the quest for more optimal human function. Most importantly, it must be derived from the same paradigm that governs the overarching science of biology. Without such a focus, exercise is just a little side issue of medicine, and fitness is merely an interesting permutation of physical therapy.

If I was to summarize a more valid exercise-physiological paradigm, it would be that exercise induces changes in DNA expression that lead to changes in RNA translation that lead to changes in protein synthesis that lead to changes in structure and then to changes in fitness. Assuming this paradigm, exercise physiology is the physiology of the processes of change and adaptation. Nothing elaborate, nothing earth shattering—just a simple framework on which to build a discipline.

This simple model was derived by following the lead of Francis Crick, who discussed the "dogma" of biology in a 1970 paper in *Nature* (4). The context of his use of the term parallels Kuhn's 1962 concept of a paradigm. In that paper Crick suggests the dogma of biology was: DNA makes RNA makes protein. If we take that central paradigm and extend it to include structure, we have then extended the root paradigm of biology to the biological sub-discipline known as anatomy:

DNA → RNA → Protein → Structure

If we then take a further step and add a functional stem, we get an extension of the paradigm descriptive of another biological sub-discipline, physiology:

DNA → RNA → Protein → Structure → Function

Hopefully the steps here seem logical, deriving the sub-discipline's operational paradigm from its parent discipline's paradigm. And here is where we adapt the biological paradigm to exercise physiology. Because we are interested in exercise and how it pertains to fitness, a functional outcome, we need to add "exercise" to the front end of the physiological paradigm because exercise initiates the events of interest. We also strike the word "function" and replace it with "fitness" because fitness is a major parameter of interest in exercise physiology:

Exercise → DNA → RNA → Protein → Structure → Fitness

We can create a better paradigm for the existing operational paradigm—there exists a minimum amount of physical activity that is needed to maintain health—by simply placing physical activity *and* exercise as inputs and health as the final output:

Physical Activity/Exercise → DNA → RNA → Protein → Structure → Health

I do not know if the entrenched conventional wisdom of exercise physiology—an approach that does not work in the real world—can be supplanted to allow for such a large-scale change in scientific thought and approach. A "folklore" of ideas about exercise has grown to be accepted as fact. Promulgated by academia, corporate fitness, medicine and the media, it is dug in deep and resists efforts to modify it. The only perturbations allowed deal with the amount and type of activity needed for "health" (again, used here as simple absence of disease).

As I suggested earlier, modern exercise physiology is actually practiced as "health" physiology. This is actually not a conceptual stretch at all. The Chronicle of Higher Education lists faculty jobs for exercise physiology and physical education under the heading "Health/Medicine." Also included under this heading are dentistry, medicine and nursing—all disciplines focusing on disease states.

If I were to suggest a fix for the problems facing exercise physiology, I would first suggest producing a consensus disciplinary definition for exercise physiology based on a valid paradigm.

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If I were to suggest a fix for the problems facing exercise physiology, I would first suggest producing a consensus disciplinary definition for exercise physiology based on a valid paradigm. A starting point for definitions might be:

Exercise physiology is the study of the causative relationships between human movement, physical function and disease state. It comprises of two distinct sub-disciplines, fitness physiology and health physiology.

Fitness physiology is the study of the effects of exercise stress on human physical function or the application of exercise stress in order to produce specific fitness adaptations and improve performance.

Health physiology is the study of the effects of chemical, physical and biological influences (to include exercise and physical activity) on human disease states or their application to humans specifically to control pathology or restore the absence of pathology.

Exercise is planned movement that is intended to produce an improvement in one or more components of fitness.

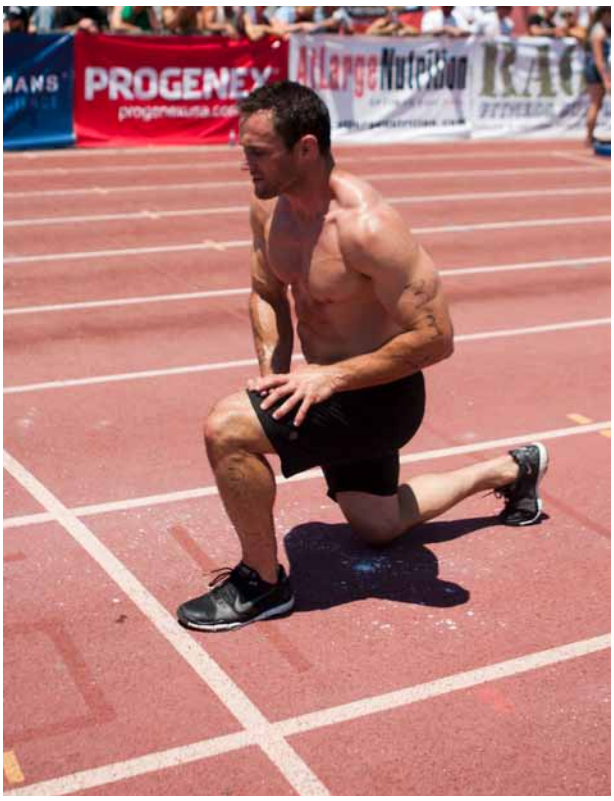
Physical activity is unplanned and spontaneous movement that has no specific intent other than recreation or as an occupational requirement.

I would then suggest immediate separation from colleges or divisions of education. The scholarly philosophies of educational research and teaching, in most instances, are not compatible with the classical biological approach to scholarship, and this places a considerable limitation on the rigor and resources with which science must be pursued. It is hard to make biological inferences from questionnaire research methods.

University education departments seem to place an emphasis on pedagogy over content mastery. I hear over and over again, "If you know how to teach, you can teach anything." This is utter foolishness. Teaching depends on both an understanding of the material and an ability to communicate. If you have not mastered the subject matter you are attempting to teach, it is very difficult to answer even the simplest of questions regarding that subject, no matter how talented a communicator you may be. It's hard to teach someone how to drive out of an empty garage.

With this in mind, my second recommendation would be to have experts in anatomy teach exercise anatomy and experts in physiology teach exercise physiology. This means that after leaving the college of education, exercise physiology should go back home to biology and physiology departments. However, the Moody Blues may have been right when they penned *You Can Never Go Home*, because biology and physiology programs will likely be less than receptive to welcoming back folks they might perceive as less than qualified academically. Because neither of these recommendations will ever be heeded by the academy at large, it falls upon exercise physiologists to change the discipline themselves.

Terminally degreed individuals must make the science of exercise physiology exactly that: a systematic inquiry pertaining not specifically to health but to another very important end product—fitness. If there is indeed a causative relationship between fitness and health, would not the study of how to become more fit be the essential element? Our work, our writings and our teachings should aid exercise practitioners in the execution of their jobs, not be irrelevant to them, or worse, provide them with conventional misinformation, as is currently and frequently the case.



D. Re/CrossFit

Is there a relationship between fitness and health? Many CrossFitters think so.

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D. Smith/CrossFit

Forward-thinking CrossFit trainers might help in creating a new paradigm by demanding more from the academics who study health and fitness.

Exercise physiologists should not be teaching and advising the subject of fitness if they are trained in health, medicine or rehabilitation. Terminally degreed individuals ascribing to the principles detailed in the ACSM materials can teach about health and longevity issues nicely, and this is perfectly OK. Doctors of medicine are equipped to make recommendations about disease issues as they relate to exercise and health. And a perfectly good group of professionals—doctors of physical therapy—can teach about exercise as it affects rehabilitation issues. But fitness is outside each group's expertise unless they receive additional training and experience beyond the realms of health and disease, although many with those degrees will argue this.

A great deal of criticism has been leveled at exercise physiologists from the field for being disconnected from the *practice* of fitness. It is well warranted, and the major professional organizations, recognizing this, have come up with cleverly titled "bridging the gap" papers and lectures that have still failed to solve the problem. They failed because they lacked direction; the organizations, authors and lecturers did not or could not discern between issues of health and issues of fitness because of the absence of a disciplinary paradigm and relevant definitions.

Exercise physiologists must assemble their collective thoughts about a viable paradigm for exercise physiology. We must publish and adopt better—and measurable—definitions. We must extend the theories of human biological adaptation to all exercising populations and realize that the way populations adapt varies, and that this variation itself is worthy of study. We must do research that is driven by the paradigm of physiological adaptation. We must develop new ways, on campus and off, to provide factual and useful physiological information to students, trainers, coaches and the general public.

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These tasks may be quixotic, because the tasks are large and varied, available funds are low, and allies are few. But in spite of the resistance from established academia, the health and wellness camps, medicine, popular practice and the fitness industry, in spite of the entrenched dogma, and perhaps in the face of the threat to our livelihoods, we must to be certain that we do not lose sight of what may be the most important but academically ignored aspect of exercise physiology: finding better ways of improving human fitness.

✦

Footnotes

1. Ono M, Kubota M, Kato K. The analysis of weight-lifting movement at three kinds of events for weight-lifting participants of the Tokyo Olympic Games. *Journal of Sports Medicine* 9(4): 263-281, 1969.
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3. Kilgore JL, Rippetoe MC. Redefining fitness for health and fitness professionals. *Journal of Exercise Physiology*10(2): 34-39, 2007.
4. Crick F. Central dogma of molecular biology. *Nature* 227(5258): 561-3, 1970.

Editor's Note

Dr. Kilgore realizes this article may seem minimally relevant to the CrossFit community, but there are two purposes here: (1) to suggest that the established exercise authorities may have less practical experience and a lesser theoretical underpinning for their ideas about fitness than the best-educated and forward-thinking CrossFit trainers, and (2) provoke at least a discussion amongst exercise academics regarding disciplinary reform. Change in higher education is difficult. However, it is becoming consumer responsive. You can and should demand more from your educational institution than an ad hominem education.

About the Author

Image courtesy of Lon Kilgore

Lon Kilgore is a professor in the Department of Athletic Training and Exercise Physiology at Midwestern State University. There, he teaches fitness physiology and exercise anatomy in an undergraduate pre-physical therapy curriculum and a graduate exercise-physiology program. He has also held faculty appointments at Kansas State University, Warnborough University, and Central Texas College. He graduated from Lincoln University with a bachelor of science in biology, earned a master's in kinesiology, and a Ph.D. in anatomy and physiology from Kansas State University. He has competed in weightlifting to the national level since 1972 and coached his first athletes to national championship event medals in 1974.

He has also competed and competes in powerlifting, wrestling, rowing and golf. Thirty-nine years after he started training, he still sets lifetime PRs at least once each year. He has worked in the trenches as a coach or sports science consultant, with athletes from rank novices to professionals and the Olympic elite, and as a head university strength coach. His interest in developing better weightlifting coaches, strength coaches and fitness professionals has driven much of his academic and professional efforts. He spent a decade as a certifying instructor for USA Weightlifting and was a frequent lecturer and researcher at the U.S. Olympic Training Center in Colorado Springs. His authorship efforts include books, magazine columns and research journal publications. His illustration efforts have appeared in many books and journals and online.

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