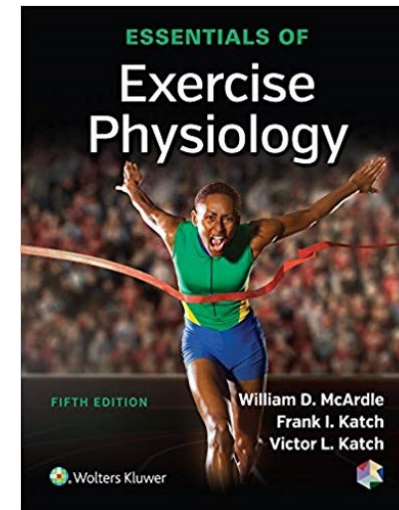
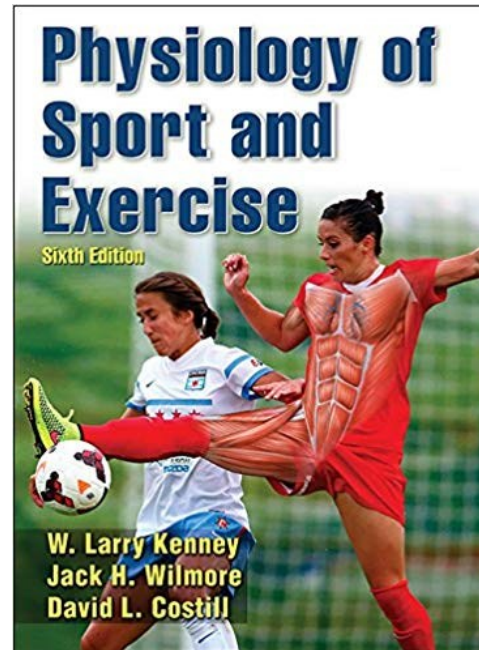
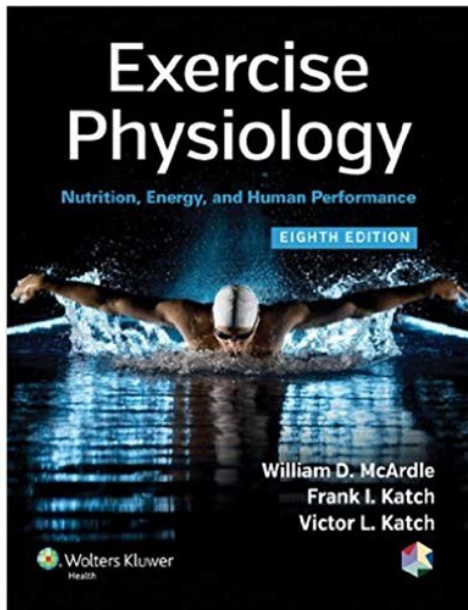


Unit 4: PHYSIOLOGY OF EXERCISE

Lecture# 02



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AN INTRODUCTION TO EXERCISE AND SPORTS PHYSIOLOGY

What is Exercise Physiology..?

Is it..?

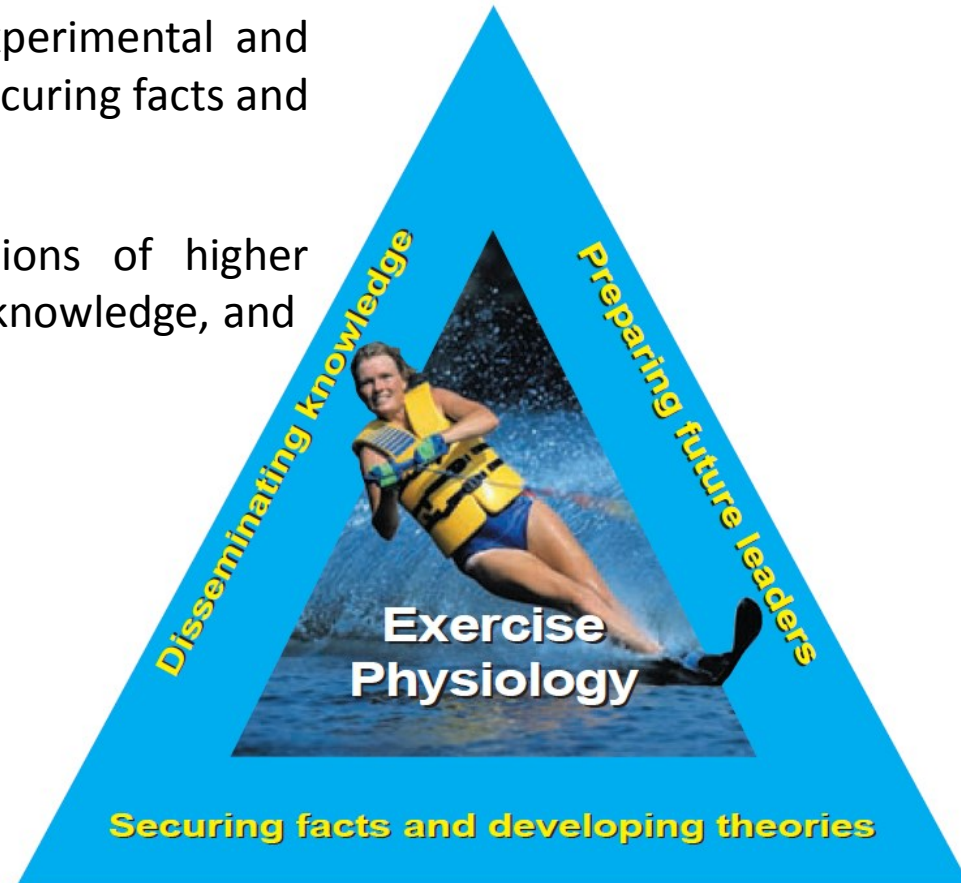
1. An Academic Program of Study, and a Course in Exercise or Sports Sciences..?
2. A Profession..?
3. Research or Areas of investigation..?

Think and Answer.....what is Exercise Physiology?

- Exercise Physiology is now a separate academic field of study within the biological sciences.
- Exercise physiology as an academic discipline consists of three distinct components:

The Science triangle :Three parts of the field of study for exercise physiology:

- (1) the body of knowledge evidenced by experimental and field research engaged in the enterprise securing facts and developing theories,
- (2) the formal course of study in institutions of higher learning for the purpose of disseminating knowledge, and
- (3) preparation of future leaders in the field.



(Adapted from Tipton, C.M.: Contemporary exercise physiology: Fifty years after the closure of the Harvard Fatigue Laboratory. Exerc. Sport Sci. Rev., 26:315, 1998.)

The current academic discipline of exercise physiology emerged from the influences of several traditional fields primarily of :

- anatomy,
- physiology, and
- medicine.

What they do?

Each of these disciplines uniquely contributes to our understanding of human structure and function in health and disease.

Human physiology integrates aspects of;

- chemistry,
- biology,
- nutrition, and
- physics

to explain biological events and their sites of occurrence.

Physiologists grapple with questions such as;

1. “What factors regulate body functions?” and
2. “What sequence of events occurs between the stimulus and the response in the regulatory process?”

The discipline of physiology compartmentalizes into sub-disciplines;

- **a systems approach** (e.g., pulmonary, cardiovascular, renal, endocrine, neuromuscular)
- **a broad area of study** (e.g., cell, invertebrate, vertebrate, comparative, human).

Introduction to Exercise Physiology

Exercise Physiology is one of the major sub-disciplines of Sport and Exercise Science, and evolved from its parent discipline **physiology**.

What is Physiology..?

Physiology is the study of how living systems function.

(Or)

Physiology is the study of how the human body functions.

Then, What is Human Physiology..?

Human **physiology** is the science of the mechanical, physical, and biochemical functions of normal humans or human tissues or organs.

What is Physiology?

- Physiology is the study of life processes
- How living systems work at many levels
 - Molecular level
 - Organ and systems levels
 - Whole organism level
- How living systems respond to physical activity
- How living systems respond to environmental conditions
- How the genome translates into function at different levels

Q. What is Exercise Physiology and What is Sport Physiology..?

Sports Physiology and **Exercise Physiology** are often used interchangeably, but there are subtle differences between the two.

Wilmore and Costill (2004) clearly distinguish between these in the following definitions:

- **“Exercise Physiology** is the study of how our bodies' structures and functions are altered when we are exposed to acute and chronic bouts of exercise.”
- **“Sports Physiology** further applies the concepts of exercise physiology to training the athlete and enhancing the athlete’s sport performance.”

Note: *Exercise and Sports Physiology overlap significantly, and therefore are generally considered together. For the remainder; the term exercise physiology will be used to encompass the area of both exercise and sports physiology.*

Now again what Is Exercise Physiology and Why we Study It?

Exercise physiology as an academic field of study consists of three distinct components:

- (1) A body of knowledge built on facts and theories derived from research,
- (2) A formal course of study at institutions of higher learning, and
- (3) Professional preparation of practitioners and future leaders in the field.

Exercise physiology has developed as a field separate from physiology because of its unique focus on the study of the functional dynamics and adaptations to human movement and associated physiological responses.

- ✓ **Exercise physiology** can be defined as both a basic and an applied science that describes, explains, and uses the body's response to exercise and adaptation to exercise training to maximize human physical potential.
- ✓ **Exercise physiology** is an aspect of Sports Medicine that involves the study of how the body, from a functional standpoints, respond, adjust and adapt to exercise.

Why we Study It..?

1. Understand how the basic physiological functioning of the human body is modified by short- and long term exercise as well as the mechanisms causing these changes. Unless one knows what responses are normal, one cannot recognize an abnormal response or adjust to it.
2. Provide quality physical education programs in schools that stimulate children and adolescents both physically and intellectually. To become lifelong exercisers, students need to understand how physical activity can benefit them, why they take physical fitness tests, and what to do with fitness test results.
3. Apply the results of scientific research to maximize health, rehabilitation, and/or athletic performance in a variety of subpopulations.
4. Respond accurately to questions and advertising claims, as well as recognize myths and misconceptions regarding exercise. Good advice should be based on scientific evidence.

Focus of Exercise and Sport Physiology

Q. Exercise Physiology evolved from its parent discipline,?

The two cornerstones of exercise physiology are:

(1) how the body responds to the acute stress of exercise, or physical activity, and

(2) how it adapts to the chronic stress of repeated bouts of exercise, that is, exercise training.

- Some exercise physiologists use exercise or environmental conditions (heat, cold, altitude, etc.) to stress the body in ways that uncover basic physiological mechanisms.
- Others examine exercise training effects on health, disease, and well-being.
- Sport physiologists apply these concepts to athletes and sport performance.

Exercise physiology:

Current trends in enhancing athletic performance

Major Trends In Exercise Physiology: Recent Findings And Their Implications For Perfection Of The Human Organism

The great German poet and biologist, Goethe, wrote

“What you can do or dream you can, begin it, for boldness has genius, magic and power in it.”

"आप जो कर सकते हैं या सपना देख सकते हैं, आप उसे शुरू कर सकते हैं, क्योंकि साहस में प्रतिभा, जादू और शक्ति हैं।"

In actual performance, human capacities probably far exceed what an individual imagines or dreams his physical and/or mental powers to be.

And, while absolute limits to human potential are obvious (for example, those imposed by morphology of the species), cumulative evidence in the relatively **new field of exercise physiology suggests that the limits of performance are more psychological in nature than physiological.**

Traditionally exercise physiology has been an **intriguing and controversial area of research**, with recent application directed towards enhancing athletic performance.

Peak athletic performance is a multi-dimensional phenomenon,

- the product of **genetic endowment**,
- **extensive training** and, more recently,
- **a greater understanding of exercise physiology.**

In order **to enhance athletic performance, exercise physiologists** center on the fundamental principle of the ‘training response’, of which, **neuromuscular patterning is a key component.**

That is to say—the ability to monitor and/or manage neuromuscular stress determines the **athlete's stress/fatigue state**, which in-turn governs the athlete's training response.

Given that different types of training (**strength, conditioning, skill, tactical**) all have an accumulative impact on the athlete's stress/fatigue state (**day, week, phase, period and season**), significant emphasis is placed on the use of technologies to monitor this process.

- As such, **high levels of training that push an athlete** into an overreached state are considered a normal and necessary part of the training process.
- However, **if an athlete is not monitored closely**, then imbalance in the stress/fatigue state can often turn into long-term overtraining.
- If a large increase is observed in the stress/fatigue state, suggestive of reduced exercise tolerance after training or match play, the possibility of increased catabolic activity, insufficient recovery, and/or injury becomes much more likely.

Current trends in exercise physiology highlight the emergence of technological aids aimed at monitoring the athletes training response, and this has seen an increase in the use of devices including;

- *Heart rate monitors;*
- *Power measurement technologies;*
- *GPS technologies; and*
- *Coaching software systems.*

Exercise physiologists have demonstrated how the **use of such technology** can further promote understanding of the training response and this applied knowledge can lead to improved athletic performance via monitoring the stress/fatigue state.

Our tendency is to be interested in the workout, not the science that underlies the workout but if you want to run well, it is important to understand the Physiology underlying the workout.

---Shunryu Suzuki

General Adaptation Syndrome

Hans Selys:- defined **Stress** as the nonspecific responses of the body to any demand

Selys “General Adaptation Syndrome”

What is Stress ?

Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure. The energy expenditure can be measured in kilocalories. Physical activity in daily life can be categorized into occupational, sports, conditioning, household, or other activities³.

Exercise is a subset of physical activity that is planned, structured, and repetitive and has as a final or an intermediate objective the improvement or maintenance of physical fitness³.

Why we requires Exercise and Physical Activity?

To be Fit: *Fit _ for_ life..!*

Being fit for life means

Hardness in your body...

Sharpness in your mind....and,

Softness in your heart...!

Fitness is the measures of person's ability to perform the activities requiring specific work, exercises or functions, and is related to present and future health outcomes.

Physical Fitness is a characteristics relates to a person's ability to perform physical activity that requires:

- Aerobic capacity
- Endurance
- Strength
- Or, Flexibility

Physical fitness is a set of attributes that are either ***health- or skill-related***. The degree to which people have these attributes can be measured with specific tests.

1. Lab Based Test:

- a) **Aerobic Test:**
 - VO₂ Test,
 - Blood Lactate Threshold,
 - Oxygen Cost of Exercise

2. Field Based Test:

- a) **Anaerobic Test:**
 - Cycling Test,
 - Treadmill Test,
 - field basic fitness

Stress Responses:

- 1. Acute Responses***
- 2. Chronic Responses***

A.) Acute Adaptation to Exercise

1. Cardiovascular Responses

- a) Cardiac Output*
- b) Blood Pressure*
- c) Coronary Circulation*

2. Pulmonary System Adaptation

3. Musculoskeletal System

4. Hormonal Responses to Exercise

- a) Endocrine System*

5. Immunological Adjustment

B.) Chronic Adaptation to Exercise

1. Skeletal Muscle Adaptation

a) Endurance Training

b) Resistance Training

2. Ligament and Tendon Adaptation

3. Metabolic Adaptations of Prolonged Exercise

4. Long Term Cardiac Adaptation

5. Long Term Respiratory Adaptation

Assessment

1. *Type of Assessment*

- *PAR-R (Physical Activity Readiness Questionnaire)*
- *SCAT (Sports Competitive Anxiety Test)*
- *Strength*
- *Speed*
- *Power*
- *Flexibility*

2. *Treatment*

1. *Type*
2. *Process*
3. *Duration*

4. *Amount of Recovery*

- *Ability*
- *Inability*

5. *Rate of Recovery*

6. *Recovery Process*

1.) Morphological Component

- a) Body Mass for Height*
- b) Body Composition*
- c) Subcutaneous fat Distribution*
- d) Abdominal Visceral Fat*
- e) Bone Density*
- f) Flexibility*

2.) Muscular Component

- a) Power*
- b) Strength*
- c) Endurance*

3.) Motor Component

- a) Agility*
- b) Balance*
- c) Co-ordination*
- d) Speed of Movement (Reaction Time)*

4.) Cardiorespiratory Component

- a) Submaximal exercise Capacity*
- b) Maximal Aerobic power*
- c) Heart Function*
- d) Lung Function*
- e) Blood Pressure*

5.) Metabolic Component

- a) Glucose tolerance*
- b) Insulin sensitivity*
- c) Lipid and Lipoprotein Metabolism*
- d) Substrate Oxidation characteristics*

WHAT DO EXERCISE PHYSIOLOGISTS DO?

Exercise physiologists assume diverse careers.

Some use their research skills primarily in colleges, universities, and private industry settings. Others are employed in health, fitness, and rehabilitation centers, and others serve as educators, personal trainers, managers, and entrepreneurs in the health and fitness industry

Exercise physiologists also own health and fitness companies or are hands on practitioners who teach and service the community, including corporate, industrial, and governmental agencies.

Some specialize in other types of professional work such as massage therapy, and others go on to pursue professional degrees in physical therapy, occupational therapy, nursing, nutrition, medicine, and chiropractic.



Additional topics studied

- Nutrition for health and performance
- Body composition techniques
- Physiological response to environmental stress
- Exercise testing protocols
- Exercise prescription models
- Exercise responses in special populations
- Exercise and aging
- Pediatric exercise responses
- Exercise effects gravity
- Sports training & performance
- Metabolic disorders
- Bone health

Class Room Task...!

Q. Write 10 Organizations and Certifications Courses in each discipline ?

Professional Organizations and Certifications

Fitness Related Organizations and Certifications

Careers in Exercise Physiology



Many career options for different levels of study (select examples):

Personal trainer	Bachelors
Fitness instructor	Bachelors, Masters
Sports consultant	Bachelors, Masters, Doctorate
Exercise physiologist	Masters, Doctorate
Clinical exercise physiologist	Bachelors, Masters, Doctorate
Exercise technologist or stress testing technician	Bachelors, Masters
Exercise specialist	Bachelors, Masters
Wellness counselor	Bachelors, Masters
Professor	Doctorate
Physical therapist/Occupational therapist	Bachelors, Masters, Doctorate in Physical or Occupational Therapy
Medical doctor	Bachelors & Medical School
Chiropractor	Chiropractic School
Nursing	Bachelors plus degree in nursing

THANK YOU..!