



# Unit 4: Exercise Physiology

for Health, Fitness, and Performance

Lecture No. 5

## Research Areas and Basic Concepts Used in Exercise Physiology



# I. What is Exercise Physiology?

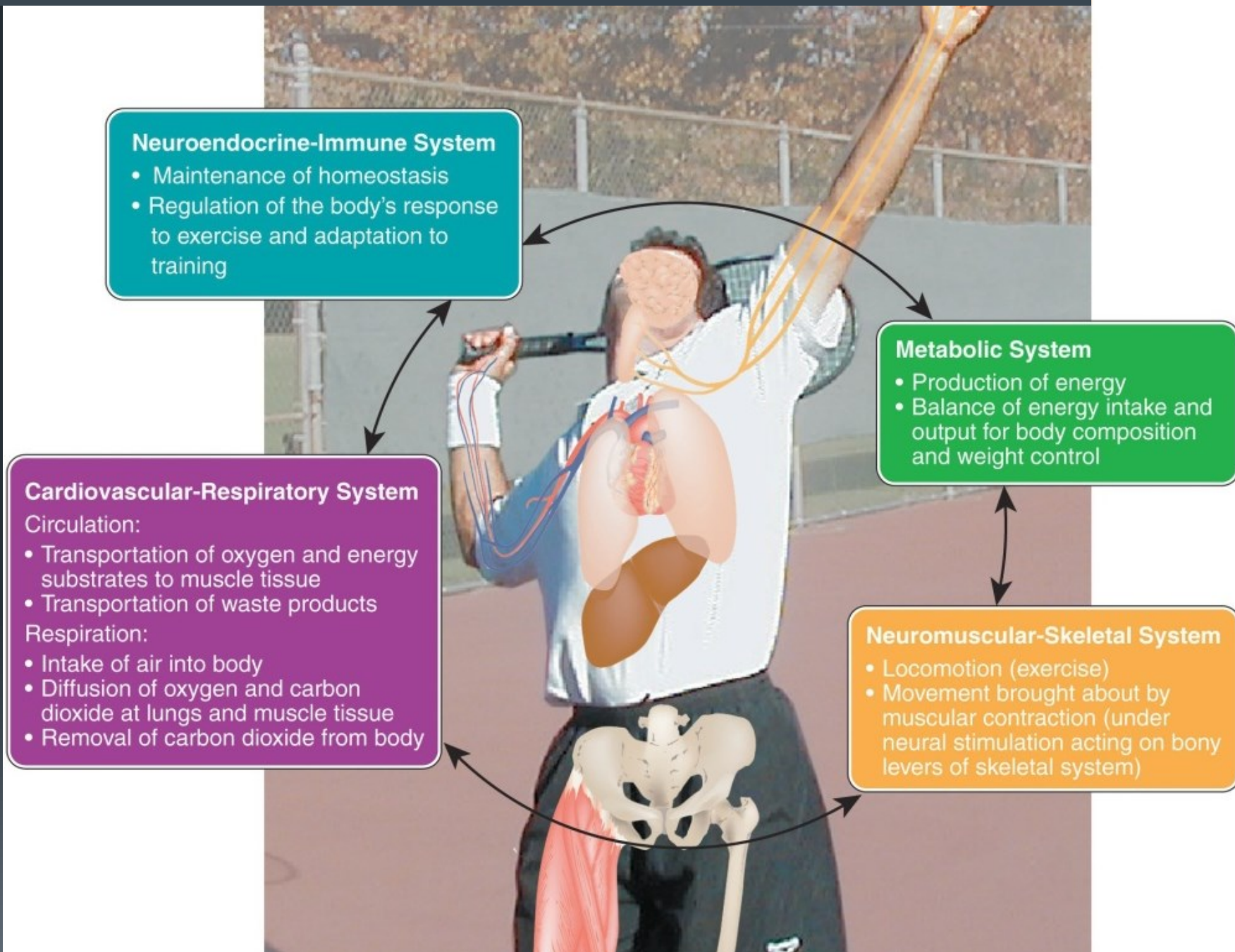
*Exercise Physiology* is both a basic and applied science that describes, explains, and uses the body's response to exercise and adaptation to exercise training to maximize human physical potential



# Overview of Lecture

- A. Consistent order of presentation
  - 1. Basic science
  - 2. Exercise response
  - 3. Application of training principles
  - 4. Training adaptations, and
  - 5. Special concerns (health-related)

## B. Organized according to body systems





### III. Exercise Response

*Exercise* - A single acute bout of bodily exertion or muscular activity that requires expenditure of energy above resting level and that in most cases results in voluntary movement

*Exercise Response* - The physiological responses which occur during or immediately following an acute bout of exercise



Can be described based on 3 factors

A. Exercise modality (mode) -  
type of activity or sport

- Energy demand  
(aerobic or anaerobic)
- Type of muscle action  
(continuous, rhythmical  
or resistance, or static)



## B. Exercise intensity

a. Maximal

b. Submaximal

- Absolute workload

- Relative workload

## C. Exercise duration

## IV. Exercise Categories

### A. Short-term, light to moderate submaximal aerobic exercise



10-15 min

~30-69% of maximal work capacity



B. Long-term, moderate to heavy submaximal aerobic exercise



30-240 min

~55-89% of maximal work capacity

## C. Incremental aerobic exercise to maximum



Progresses in stages from light to maximal

## D. Static exercise



Described as a percent of maximal voluntary contraction (%MVC)

## E. Dynamic resistance exercise















Described as a percent of maximal weight that can be lifted (1-RM) and number of times lifted.

## F. Very short-term, high intensity anaerobic exercise



Often supramaximal when compared to maximal aerobic capacity

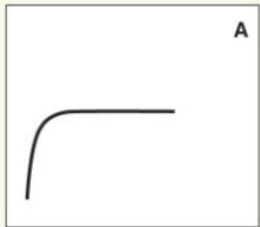
# Summary of Exercise Responses

<b>TABLE 1.2 Color and Icon Interpretation for Exercise Response Patterns</b>		
<b>Exercise Category</b>	<b>Color</b>	<b>Icon</b>
Short-term, light to moderate submaximal aerobic		
Long-term, moderate to heavy submaximal aerobic		
Incremental aerobic to maximum		
Static		
Dynamic resistance		
Very short-term, high-intensity anaerobic		

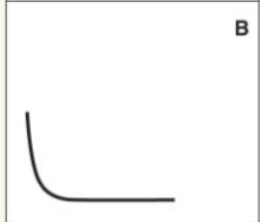


# V. Exercise Response Patterns

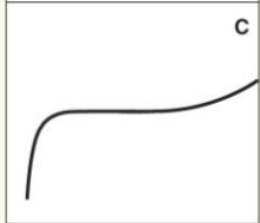
y axis = variable name and unit



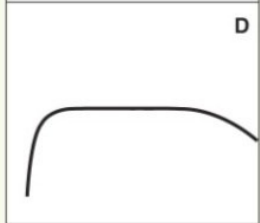
**A** Initial increase, plateau at steady state



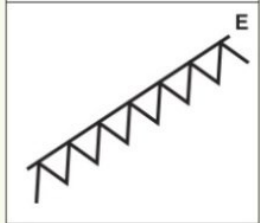
**B** Initial decrease, plateau at steady state



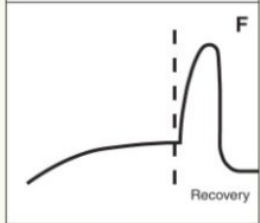
**C** Initial increase, plateau at steady state, positive drift



**D** Initial increase, plateau at steady state, negative drift



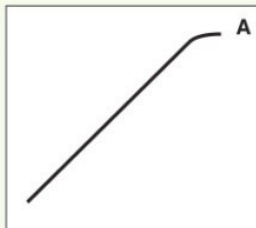
**E** Gradual increase



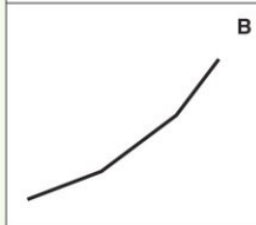
**F** Minimal increase during exercise; rebound rise in recovery

Constant workload/workrate

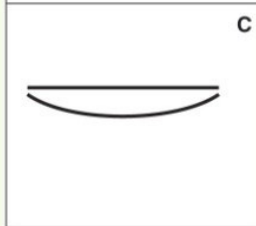
y axis = variable name and unit



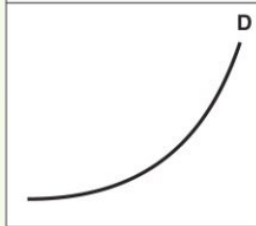
**A** Rectilinear rise with a plateau at maximum



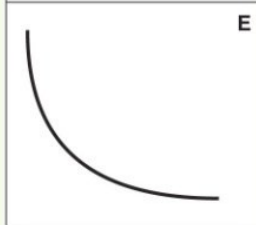
**B** Rectilinear rise with two breakpoints



**C** No change or a change so small it has no physiological significance



**D** Positive curvilinear rise



**E** Negative curvilinear change



**F** U-shaped curve; truncated inverted U

Incremental workload/workrate







## VI. Exercise Response Interpretations

Based on:

1. Characteristics of the exerciser
2. Appropriateness of the selected exercise
3. Accuracy of the selected exercise
4. Environmental and experimental conditions




## VII. Training

*Training* - A consistent or chronic progression of exercise sessions designed to improve physiological function for better health or sport performance



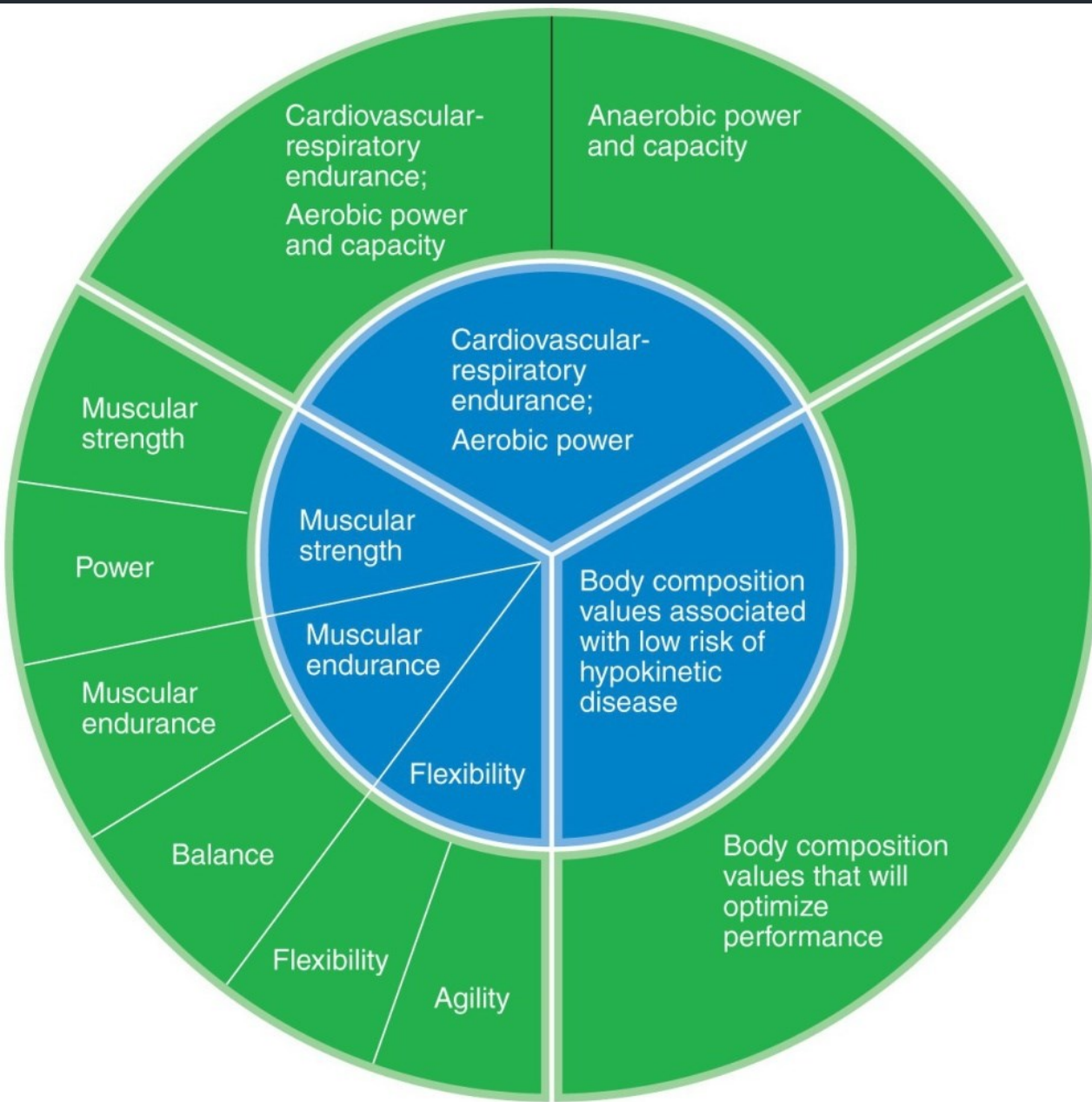
## **A. Health-Related vs. Sport-Specific Physical Fitness**

*Physical Fitness* - A physiological state of well-being that provides the foundation for the tasks of daily living, a degree of protection against hypokinetic disease, and a basis for participation in sport



*HRPF*- That portion of physical fitness directed toward the prevention of, or rehabilitation from, disease as well as the development of a high level of functional capacity for the necessary and discretionary tasks of life

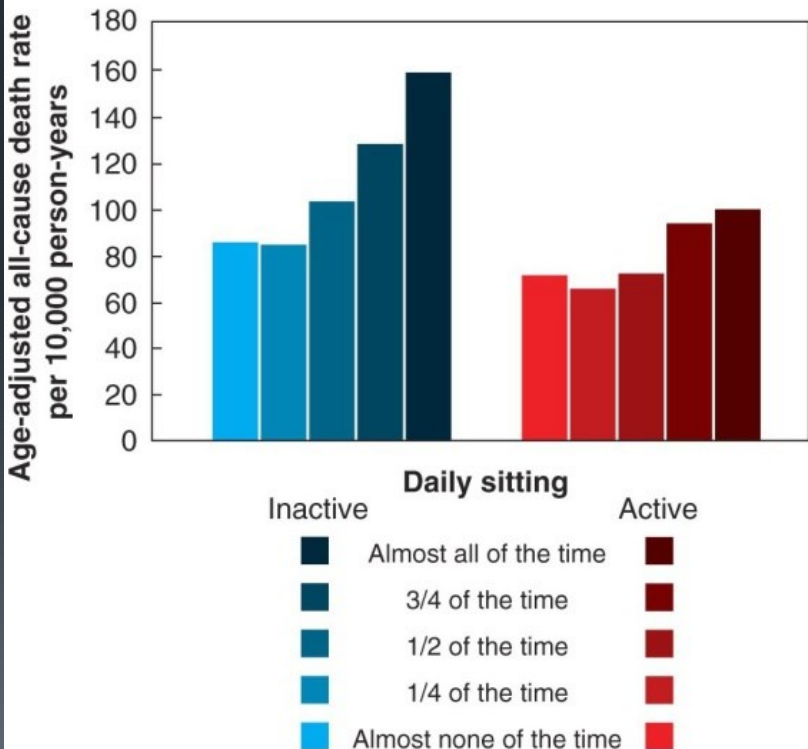
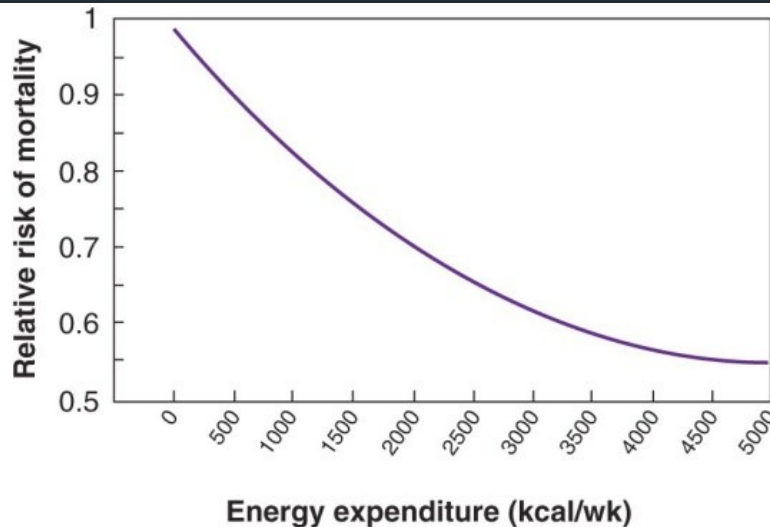
*SSPF*- That portion of physical fitness directed toward optimizing athletic performance



- Sport-specific physical fitness
- Health-related physical fitness

# B. Dose-Response Relationships

What are the health benefits (or performance benefits) of varying amounts of exercise?





## C. Training Principles

1. Specificity
2. Overload
3. Rest/Recovery/Adaptation
4. Progression
5. Retrogression/Plateau/Reversibility
6. Maintenance
7. Individualization
8. Warm-Up/Cool-Down



## D. Periodization

- A plan for training based on a manipulation of the fitness components with the intent of peaking the athlete for the competitive season or varying health-related fitness training in cycles of harder or easier training.

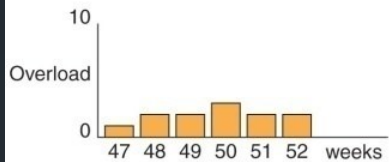




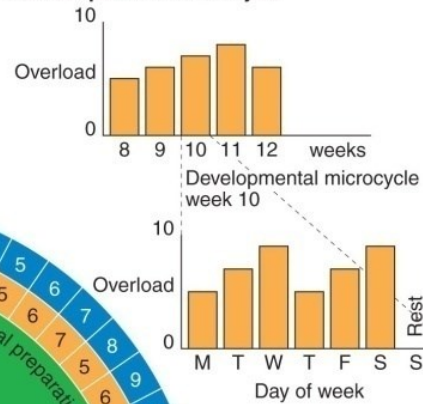
## Periodization Phases

1. General Preparatory phase (off-season)
2. Specific Preparatory phase (preseason)
3. Competitive phase (in-season)
4. Transition phase (active rest)

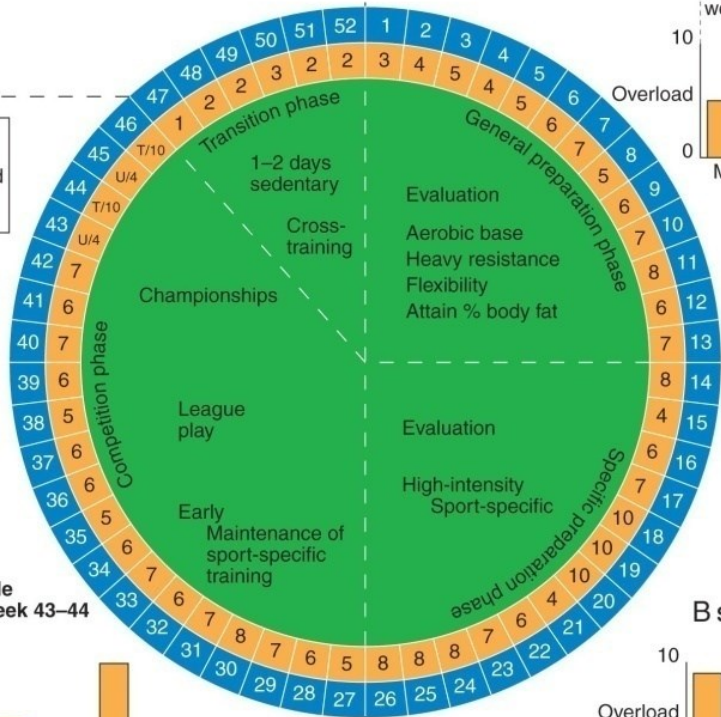
### E Transition macrocycle



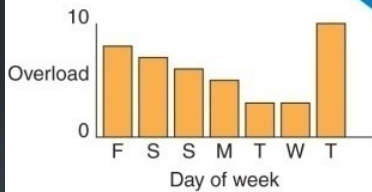
### A Developmental macrocycle



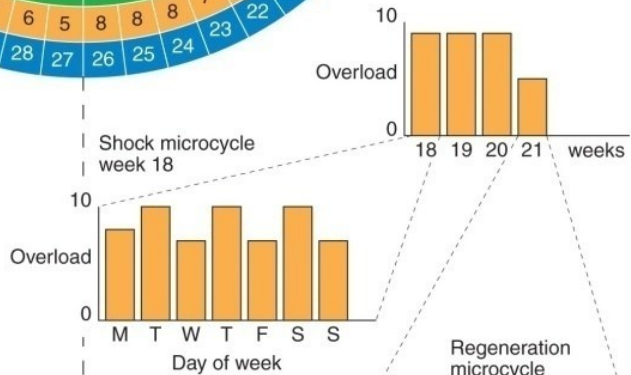
**Key:**  
 Outer circle = weeks  
 Inner circle = overload  
 U = unloading  
 T = tournaments



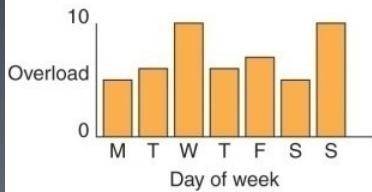
### D Tapering microcycle Thursday game week 43-44



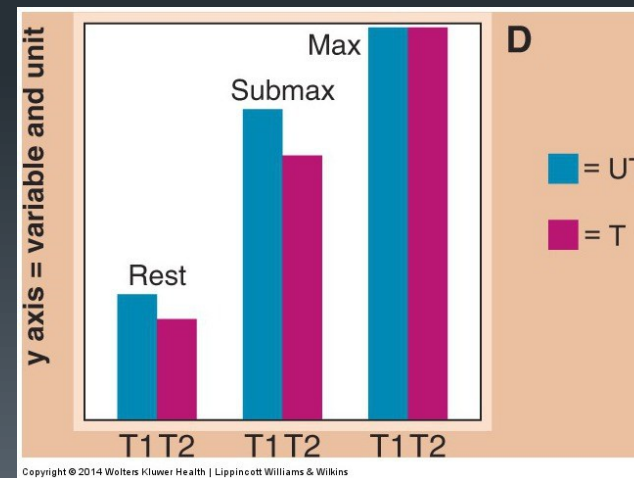
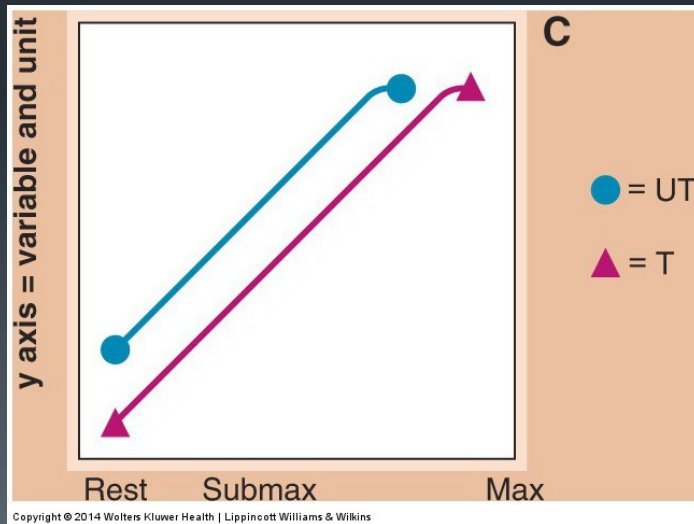
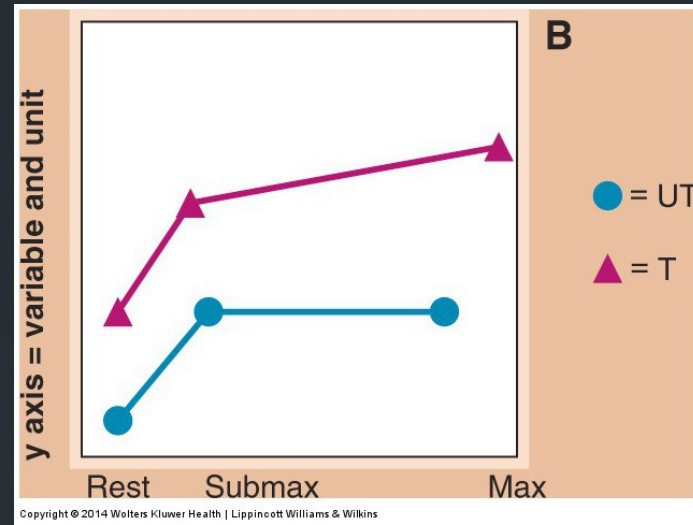
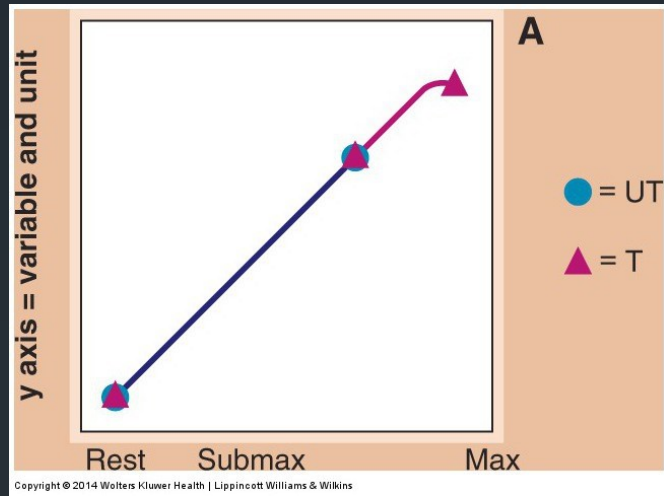
### B Shock macrocycle



### C Competition microcycle 2 games per week (W and S)




# E. Training Adaptations





## VIII. Detraining

- *Detraining* is the partial or complete loss of training-induced adaptations as a result of a training reduction or cessation



# IX. Exercise & Training as Stressors

## A. Selye's Theory of Stress Stages

1. Alarm-Reaction: Shock and Countershock
2. Stage of Resistance
3. Stage of Exhaustion

## B. Selye's Theory Applied to Exercise and Training

TABLE 1.3 Selye's Theory of Stress Applied to Exercise Physiology			
Stage	Exercise Response	Training Principle	Training Adaptation/Maladaptation
I. Alarm-Reaction	Neuroendocrine system stimulated	Warm-up/Cooldown	
a. Shock	a. Homeostasis disrupted	Overload	Dampened response to equal acute exercise stimulus
b. Countershock	b. Begin to attain elevated steady state	Progression*	
II. State of Resistance	Elevated homeostatic steady state maintained if exercise intensity is unchanged	Adaptation Maintenance Specificity (SAID) Individualization	Enhanced function/physical fitness/health; increased maximal exercise depending on imposed demand and individual neuroendocrine physiology Adaptation is reversible with detraining
III. Stage of Exhaustion	Fatigue, a temporary state, reversed by proper rest and nutrition	Retgression/ plateau reversibility	Overreaching <sup>†</sup> Overreaching Overtraining syndrome Maladaptation changes in neuroendocrine systems

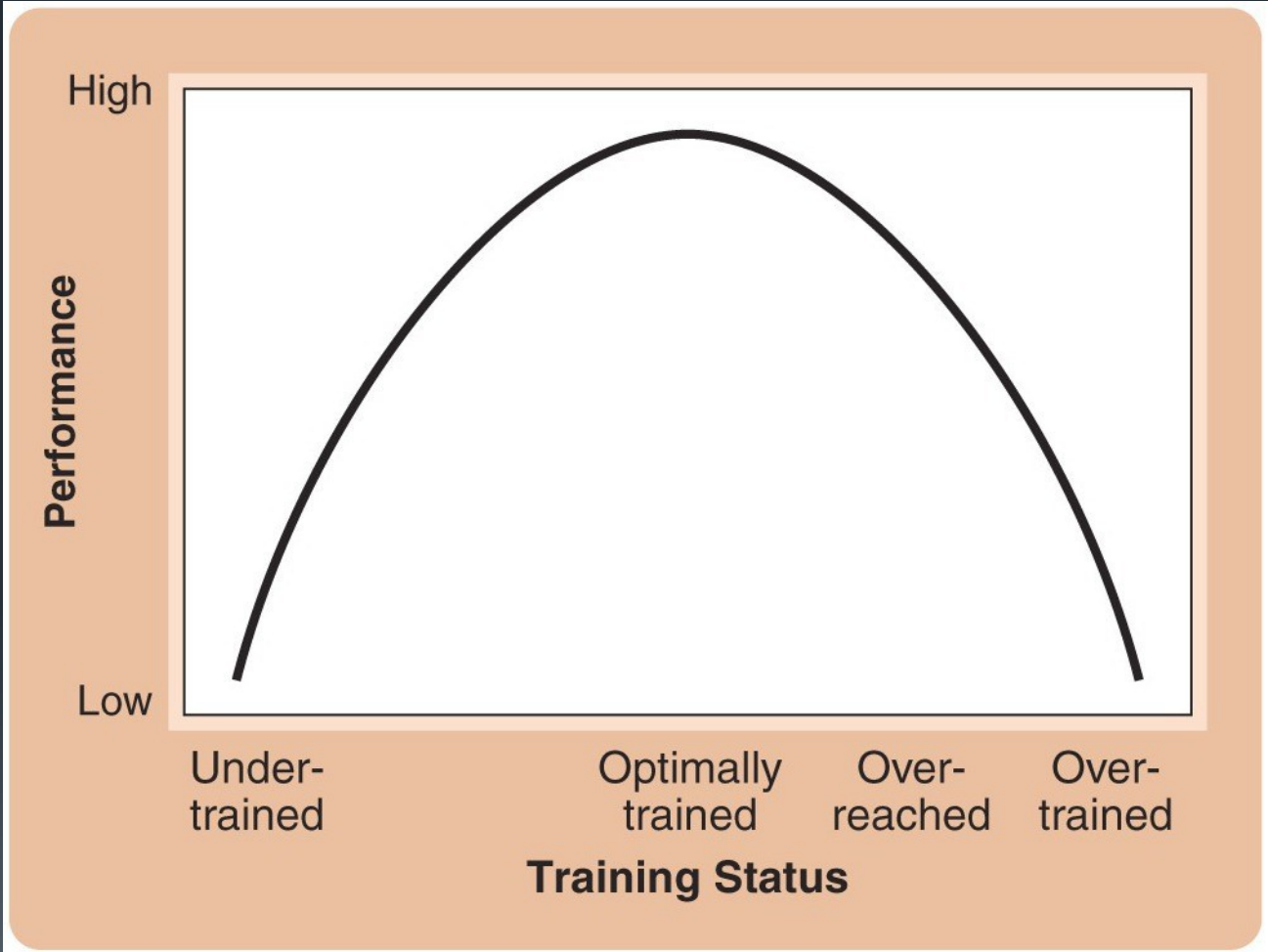
\*The cycle of adaptation and progression occurs repeatedly during a training program.

†If overreaching is planned and recovery is sufficient, positive adaptation results; if overreaching is accompanied by insufficient recovery and additional overload, overtraining will result.



## C. Training Adaptations & Maladaptations

- **Overreaching:** a short-term decrement in performance capacity that is easily recovered from and generally lasts only a few days to 2 weeks.
- **Overtraining syndrome (OTS):** state of chronic decrement in performance and ability to train, in which restoration may take several weeks, months, or even years.







Thank You...!