

Introduction to Exercise Science

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Key concepts, foundational principles, and practical applications

1. What Is Exercise Science?

Aspect	Description
Definition	The interdisciplinary study of how physical activity affects the human body, performance, health, and disease.
Core Disciplines	• Kinesiology
	• Physiology
	• Biomechanics
Core Disciplines	• Motor Control & Learning
	• Nutrition
	• Psychology
Goal	Apply scientific knowledge to design, implement, and evaluate safe and effective exercise programs for diverse populations.

2. Major Systems Affected by Exercise

System	Acute Response (single bout)	Chronic Adaptation (weeks?months)
Muscular	? motor unit recruitment, ? blood flow, ? glycolysis	? muscle fiber size (hypertrophy), ? mitochondrial density, ? oxidative enzymes
Cardiovascular	? heart rate, ? stroke volume, ? cardiac output	? resting HR, ? maximal cardiac output, ? capillary density
Respiratory	? tidal volume & breathing frequency	? VO?max, ? alveolar?capillary diffusion capacity
Skeletal	? bone strain, ? calcium release	? bone mineral density, ? trabecular thickness
Endocrine	? catecholamines, cortisol, growth hormone	? insulin sensitivity, altered resting hormone profiles
Nervous	? motor unit firing frequency, ? proprioceptive feedback	? neural drive, improved coordination, reduced reaction time

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3. Fundamental Concepts

3.1. Energy Systems

System	Primary Fuel	Duration	Typical Activities
Phosphagen (ATP?CP)	Creatine phosphate	0–10?s	Sprint, heavy lift
Anaerobic Glycolysis	Glucose ? lactate	10?s–2?min	400?m run, HIIT
Aerobic Oxidative	Carbohydrate & fat	>2?min	Distance running, cycling

3.2. Training Principles (SAID)

Principle	Meaning	Practical Example
Specificity	Adaptations follow the type of stress placed on the body.	Rowing improves rowing performance more than cycling.
Overload	To elicit adaptation, the stimulus must exceed current capacity.	Increase weight by 5?% each week.
Progression	Gradual increase in overload to avoid plateaus & injury.	Add 2?min to a cardio session every 2 weeks.
Individualization	Programs must match personal goals, fitness level, and health status.	Tailor intensity using heart?rate zones.
Periodization	Structured variation of volume & intensity over time.	4?week hypertrophy block ? 2? week strength block.

3.3. Exercise Intensity Metrics

Metric	How It's Measured	Typical Range
Heart Rate (HR)	Beats per minute (BPM) using monitor or pulse	50–85?% HRmax
Rating of Perceived Exertion (RPE)	Borg scale 6–20 or 0–10	3–7 (moderate)
VO?% or METs	Oxygen consumption (ml·kg? ¹ ·min	