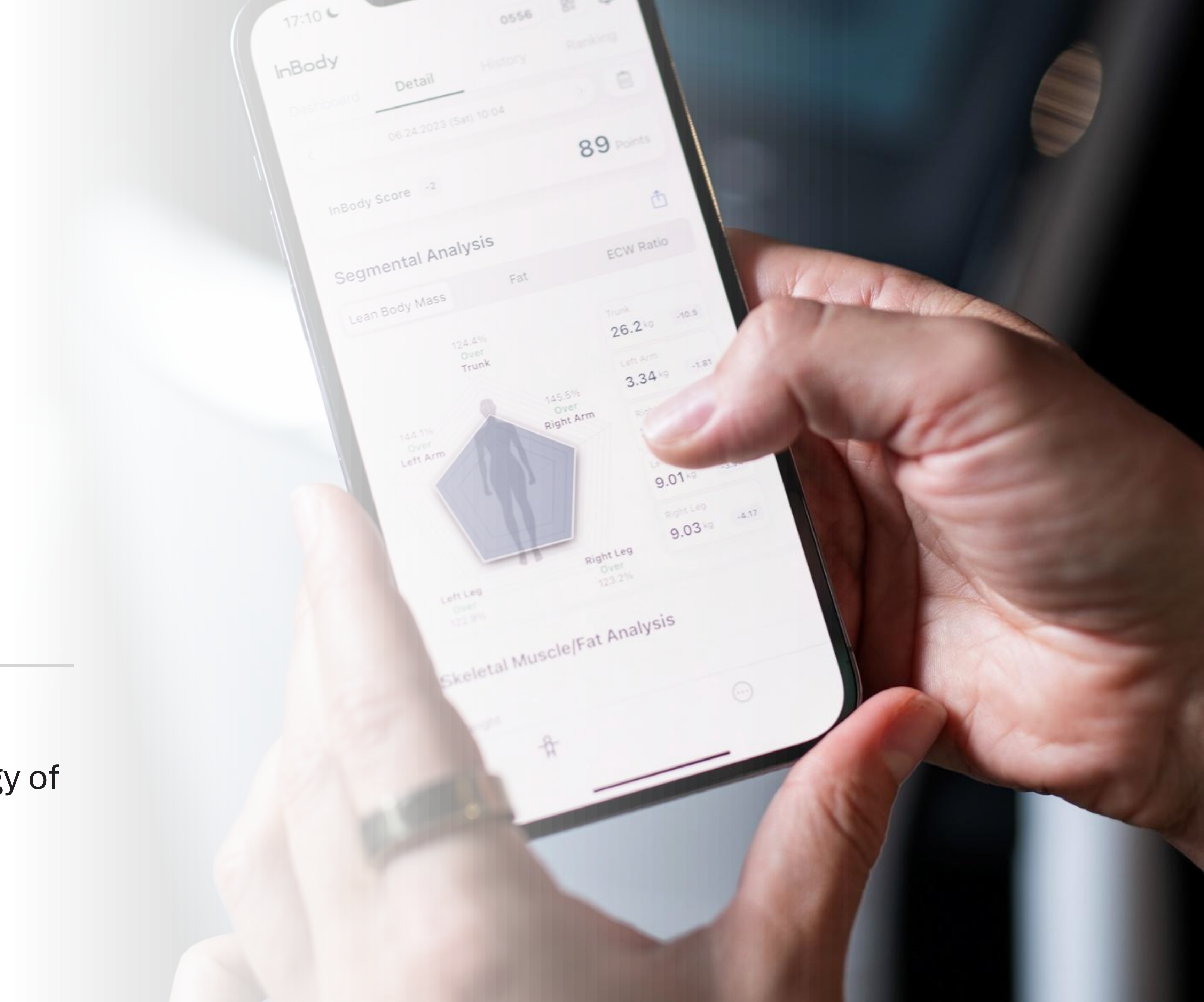
AURUM
Academy.

Training Physiology

Muscle as a Metabolic Organ, Energy Systems, and the Biology of Adaptation.



Learning Objectives

Muscle as Metabolic Organ

Explore how skeletal muscle contributes to whole-body metabolism, glucose disposal, and resting metabolic rate regulation.

The Three Energy Systems

Understand the phosphocreatine, glycolytic, and oxidative systems powering muscle activity during different exercise durations.

EPOC and Afterburn

Learn about Excess Post-Exercise Oxygen Consumption and its role in prolonged calorie burn after training sessions.

Supercompensation & Recovery Windows

Study the timing of recovery phases post-exercise that optimize adaptation and performance gains.

Muscle Fibre Types

Distinguish between Type I and Type II muscle fibres and their recruitment based on exercise intensity.

Key Hormonal Responses

Identify the hormonal changes like growth hormone, testosterone, and cortisol influencing muscle adaptation.

Metabolism

Muscle: The Metabolic Engine

01 Muscle Mass Contribution

Skeletal muscle constitutes approximately 40% of total body mass in healthy adults, making it the largest metabolic tissue.

02 Glucose Disposal Role

Muscle is the primary site for insulin-mediated glucose uptake, playing a key role in regulating blood sugar levels and metabolic health.

03 Resting Caloric Burn

Per kilogram, muscle tissue burns more calories at rest than most other tissues, contributing significantly to basal metabolic rate (BMR).

04 Muscle-Loss Metabolic Cascade

Loss of muscle mass leads to decreased resting metabolic rate, increased fat accumulation, and metabolic dysfunction, creating a detrimental cascade.

05 Permanent RMR Increase

Muscle hypertrophy through resistance training is the only proven method to permanently elevate resting metabolic rate (RMR), improving long-term energy expenditure.

The Three Energy Systems

01

Phosphocreatine System

Provides immediate ATP through phosphocreatine breakdown for rapid, high-intensity efforts lasting up to 10 seconds.

- Rapid ATP supply
- Supports explosive muscle contractions
- Immediate energy source
- Duration: 0–10 seconds

02

Glycolytic System

Generates ATP anaerobically by breaking down glucose, predominant energy source for AURUM sessions lasting from 10 seconds to 2 minutes.

- Anaerobic ATP production
- Primary energy system for AURUM
- Produces lactate as a by-product
- Duration: 10 seconds to 2 minutes

03

Oxidative System

Sustains prolonged, lower-intensity activity using aerobic metabolism with oxygen to generate ATP beyond 2 minutes.

- Aerobic ATP production
- Uses fats and carbohydrates
- Sustains endurance activities
- Duration: 2 minutes and beyond

04

Lactate Signal

Lactate accumulation indicates correct glycolytic system activation in AURUM, and contrary to misconception, it does not cause muscle soreness.

- Lactate signals anaerobic engagement
- Not responsible for soreness
- Validates energy system activation
- Supports training effectiveness

EPOC: The Afterburn Effect

01

Definition of EPOC

Excess Post-Exercise Oxygen Consumption (EPOC) is the elevated oxygen intake following strenuous exercise that supports recovery and adaptation processes.

02

Physiological Mechanisms

EPOC involves restoring oxygen levels, clearing lactate, replenishing phosphocreatine stores, and repairing exercise-induced tissue damage.

03

Duration of EPOC

The elevated metabolic rate from EPOC lasts between 24 to 48 hours after the exercise session ends.

04

Magnitude of RMR Elevation

Resting metabolic rate increases by approximately 6-15% during the EPOC period, enhancing overall energy expenditure.

05

Total Caloric Cost

The session's metabolic effect extends caloric burn well beyond the initial 6-minute workout window, contributing to sustained fat loss.

Supercompensation & Recovery Timing

Training Phase

The initial training session induces fatigue and a temporary decline in performance capacity.

- Session completion
- Fatigue induction
- Performance baseline established

Recovery Phase

During 48–96 hours post-training, physiological recovery processes restore muscle function and energy stores.

- Metabolic replenishment
- Muscle repair
- Reduced fatigue levels

Supercompensation Phase

Performance capacity temporarily surpasses baseline, representing the optimal window for subsequent training to maximize adaptation.

- Peak performance potential
- Enhanced muscle strength
- Increased metabolic efficiency

Return to Baseline

Without timely training, adaptations regress, and performance returns to or below initial baseline, risking lost gains.

- Performance normalization
- Adaptation decay
- Readiness for next training cycle

Muscle Fibre Types & Recruitment

Type I Fibres

Type I fibres are slow-twitch, rely on oxidative metabolism, and are highly resistant to fatigue, supporting endurance activities and continuous contractions.

Type II Fibres

Type II fibres are fast-twitch, predominantly glycolytic, capable of high force production, but fatigue more rapidly, suited for explosive and high-power movements.

Henneman's Size Principle

This principle states motor units are recruited in order of increasing size and force, starting from small, fatigue-resistant Type I fibres to large, forceful Type II fibres as effort increases.

Recruitment Threshold

Near-maximal or maximal effort is required to recruit Type II fibres, ensuring that high-intensity training effectively engages these powerful muscle fibres.

AURUM Set Peak

The final 20 seconds of an AURUM training set represent the period of peak Type II fibre recruitment, maximizing glycolytic activation and strength adaptations.

Hormonal Responses to Resistance Training

Growth Hormone

GH peaks between 15 and 30 minutes after a resistance training session, promoting tissue growth and repair through anabolic signaling pathways.

Testosterone

Testosterone exhibits an acute rise immediately post-session, enhancing muscle protein synthesis and supporting strength gains.

IGF-1

Insulin-like Growth Factor 1 acts as the primary anabolic signal, mediating muscle hypertrophy by stimulating protein synthesis and satellite cell activation.

Cortisol

Cortisol balances training stress and recovery; chronic elevations indicate overtraining risk and can impair muscle growth and immune function.

Insulin Sensitivity

Post-session insulin sensitivity increases, creating an optimal window for carbohydrate intake to replenish glycogen and support recovery.

Key Concept: ATP & Energy Currency

01

ATP: Sole Direct Fuel

Adenosine triphosphate (ATP) is the exclusive immediate source of energy that powers muscle contractions at the molecular level.

02

Limited ATP Storage

Muscle cells store only about a 2-second supply of ATP, which is rapidly consumed during contraction and must be continuously regenerated.

03

Three ATP Regeneration Pathways

ATP is replenished via phosphocreatine system (PCr), glycolytic system, and oxidative phosphorylation, each contributing depending on exercise intensity and duration.

04

Complete ATP Depletion

Total ATP depletion in muscle fibers corresponds to momentary muscular failure, the target during maximal effort sets like in AURUM training.

05

Coaching Implications

Coaches should emphasize maximal exertion, particularly in the final seconds of a set, to reach ATP depletion and maximize adaptive stimulus.

Key Concept: The Long-Term Arithmetic of Muscle Mass

01

Muscle Mass and RMR

Adding 5 kg of muscle increases resting metabolic rate by 50–75 kcal per day, boosting daily energy expenditure.

02

Annual Energy Impact

This daily increase equals an annual additional energy burn of approximately 18,000–27,000 kcal.

03

Fat Offset Equivalent

The annual extra energy expenditure from muscle gain corresponds to burning 5–8 kg of fat, without needing cardio exercise.

04

Permanent Metabolic Shift

Muscle growth provides a lasting upward shift in basal metabolic rate, enhancing long-term energy balance.

05

Unique Metabolic Advantage

No cardio, diet, or supplement can replicate the permanent metabolic boost provided by increased muscle mass.

Summary

Key Takeaways + Up Next

Muscle: Highest-ROI Intervention	Skeletal muscle is the most effective target for improving metabolic health and functional capacity, offering superior return on investment compared to other tissues.
Glycolytic Targeting & Lactate	Training primarily engages the glycolytic energy system; lactate production signals correct system activation and guides effective session design.
EPOC: 24–48 Hour Reach	Excess Post-Exercise Oxygen Consumption extends the metabolic benefits of a 6-minute session for up to 2 days, enhancing calorie burn post-workout.
Supercompensation Timing	Strategically spacing sessions weekly optimizes recovery and supercompensation phases, maximizing adaptation and performance gains.
Type II Fiber Recruitment	Near-maximal effort is essential to recruit fast-twitch Type II fibers, critical for strength, power, and hypertrophic adaptations.