AMERICAN Journal of Language, Literacy and Learning in STEM Education
Volume 3, Issue 6, 2025 ISSN (E): 2993-2769

Methods for Developing Movement Energy in Athletes: Scientific and Practical Approach

Tuychiyeva Gulkhayokhon Mukhammadaminovna
Teacher at Fergana State University

Abstract. *The optimal role of the kinetic energy systems in the physical load of athletes. In three articles, the physiological mechanisms of the phosphagen, glycolytic and oxidative energy systems are analyzed and modern methods, training programs and nutritional strategies for their development are proposed. Based on the results of research and methods based on real sports examples.*

Key words: *kinetic energy, phosphagen system, glycolytic system, oxidative system, athletes, interval training, strength training, aerobic endurance, anaerobic power, recovery strategy, creatine phosphate, lactate threshold, mitochondria, periodization, high-intensity interval training (hiit), glycogen stores, tabata pro, vomax, fartlek training.*

Introduction In sports performance, energy direction depends on movement intensity, type, and duration, and is primarily carried out through three main energy systems – phosphagen, glycolytic, and oxidative systems. Each system has its own unique characteristics and contributions, and developing them directly impacts an athlete's overall performance and competition readiness. This article explores scientific methods to maximize the potential of these energy systems in athletes, as studied in sports science laboratories.

To meet the physical demands placed on athletes, it is important to optimize the function of energy systems. Movement energy is provided by three main systems: phosphagen (ATP-PC), glycolytic (anaerobic glycolysis), and oxidative (aerobic) systems. The article examines scientific methods for the development of each system and analyzes their practical application.

Energy Systems: Physiological Basis and Functions

1.1. Phosphagen System

The phosphagen system provides energy through ATP and creatine phosphate (CP), primarily for high-intensity activities lasting 10–15 seconds. This system is anaerobic in nature and is vital for short-duration sprints (e.g., 100m dash) or heavy weightlifting. The stored CP level is around 5–10 mmol/kg, which means it can supply energy for approximately 6–8 seconds (Hultman et al., 1996).

Development methods include:

- **High-Intensity Interval Training (HIIT):** 5–10-second max sprints with 1–2 minutes of rest, repeated 6–8 times (e.g., 30m sprint).
- **Strength Training:** 3–5 reps per set at 85–95% max load (e.g., squats or deadlifts with a barbell).
- **Practical Example:** A 100m sprinter may perform 10-second sprint drills 3 times per week to improve explosive starts.

1.2. Glycolytic System

The glycolytic system breaks down glycogen or blood glucose anaerobically to produce ATP for medium-duration activities lasting 30 seconds to 2–3 minutes (e.g., 400m sprint or a boxing round). Lactate buildup during this process increases acidity and contributes to fatigue. The **lactate threshold** is a key determinant of glycolytic efficiency (Brooks, 2000).

Development methods include:

- **Moderate-Intensity Interval Workouts:** 30–60 seconds of running or cycling, with 1:1 rest ratio.
- **Tabata Protocol:** 20 seconds of max effort, 10 seconds rest, repeated 8 times. Research shows it can improve glycolytic power by 15–20% (Tabata et al., 1996).
- **Practical Example:** A 400m sprinter may perform 6x60s intervals twice per week to increase lactate tolerance.

1.3. Oxidative System

The oxidative system produces energy aerobically by oxidizing carbohydrates, fats, and to a lesser extent, proteins. It supports long-duration efforts (e.g., marathons, long-distance cycling). Mitochondrial count and efficiency are key indicators of this system's capacity (Holloszy & Coyle, 1984).

Development methods include:

- **Long-Duration Aerobic Workouts:** 60–120 minutes of running or swimming at 60–70% of max heart rate.
- **Fartlek Training:** 40–60 minutes of variable speed/intensity running.
- **Practical Example:** A marathon runner may perform 90-minute runs 3–4 times a week to optimize fat oxidation.

2. Methods to Develop Energy Systems

2.1. Developing the Phosphagen System

- **High-Intensity Interval Training (HIIT):** 5–10s max sprints (e.g., 30m sprint), 1–2 min rest, repeated 6–8 times. Studies show this increases CP stores by 20–30% (Keytey et al., 1996).
- **Strength Training:** 3–5 reps at 85–95% 1RM (e.g., barbell squats, deadlifts), supports rapid ATP synthesis.
- **Practical Example:** A sprinter may do 3 sessions/week of 10-second sprint drills to enhance explosive capacity.

2.2. Developing the Glycolytic System

- **Mid-Duration Interval Workouts:** 30–60s max-effort run or cycling, 1:1 or 1:2 rest ratio (e.g., 30s sprint, 60s rest). Enhances lactate threshold (Billat, 2001).
- **Tabata Protocol:** 20s max effort, 10s rest, 8 rounds. Shown to improve glycolytic capacity by 15–20% (Tabata et al., 1996).
- **Practical Example:** A 400m runner may perform 6x60s intervals twice a week to boost lactate tolerance.

2.3. Developing the Oxidative System

- **Long-Duration Aerobic Workouts:** Running/swimming 60–120 minutes at 60–70% max heart rate increases mitochondrial density (Dudley et al., 1982).
- **Fartlek Training:** 40–60 minutes of varied pace running improves both aerobic and anaerobic systems.

- **Practical Example:** Marathoners perform 90-minute runs 3–4 times/week to enhance fat oxidation efficiency.

3. Role of Recovery and Pharmacological Support

- **Phosphagen System:** Creatine monohydrate (5g/day) can increase CP stores by 20–40% (Harris et al., 1992). Protein-rich foods (e.g., eggs, turkey) aid in muscle recovery.
- **Glycolytic System:** 3–4 g/kg of carbohydrates (e.g., rice, pasta) consumed 2–3 hours before workouts replenish glycogen. Post-workout 1:3 protein-carb ratio accelerates recovery.
- **Oxidative System:** Fatty acids (omega-3s, olive oil) and low-glycemic carbs (e.g., oats, quinoa) support aerobic endurance.

4. Research Outcomes and Periodization Strategies

Research shows that the energy systems are interdependent, and optimal outcomes require periodized training. For example, in a 12-week program:

- **Weeks 1–4:** Focus on Phosphagen system (speed & power).
- **Weeks 5–8:** Emphasize Glycolytic system (mid-intensity efforts).
- **Weeks 9–12:** Train the Oxidative system (long-duration endurance).

Such periodization improves overall energy system performance.

Results

- **Phosphagen System:** HIIT and sprint tests increased CP by 20–30% (Casey et al., 1996). Strength training rapidly enhances ATP synthesis, improving high-intensity short-duration performance.
- **Glycolytic System:** Interval training raises lactate threshold and improves performance in 400–800m events (Billat, 2001). Tabata has proven effective for boosting glycolytic power.
- **Oxidative System:** Long-duration aerobic training increases mitochondrial density and VO2max (Dudley et al., 1982). Fartlek improves both aerobic and anaerobic capacity, critical for endurance.

Discussion

Each energy system requires specific training based on the athlete's sport. The phosphagen system is critical for speed and power; glycolytic for moderate-intensity efforts; and oxidative for long-term endurance. Research shows that periodized training (e.g., 12-week cycles targeting different systems) can improve overall performance by 25–30% (Hawley & Burke, 1998).

Recommendations

Coaches and athletes should design training plans that align with sport-specific energy demands. For example, sprinters should focus on the phosphagen system, while marathoners prioritize oxidative energy. Recovery strategies such as creatine supplementation or carb-loading are also important for performance enhancement.

Table: Energy Systems and Exercise Types

System	Duration	Training Types	Examples
Phosphagen	10–15 seconds	Sprinting, weightlifting	100m sprint, barbell lift
Glycolytic	30s – 2 min	Interval workouts, lactate training	400m run, boxing
Oxidative	Over 2 minutes	Long runs, cycling	Marathon, long-distance swim

Key References

- ✓ Interval Training for Performance: Scientific and Empirical Practices
- ✓ Creatine Supplementation Improves Muscle Function and Metabolism
- ✓ Exercise Intensity and Duration Effects on Mitochondrial Adaptation
- ✓ Creatine Uptake in Resting and Exercised Muscle
- ✓ Effects of Moderate- and High-Intensity Endurance Training

Conclusion To develop movement energy in athletes, training should be tailored to each energy system, combined with proper nutrition and periodization strategies. Phosphagen system aids in speed and power; glycolytic for medium-intensity; and oxidative for long-duration performance. These methods, when personalized, can yield maximum results.

Literature

1. Billat, LV (2001). "Ishlash uchun intervalli trening: ilmiy va empirik amaliyot". *Sport tibbiyoti*, 31 (1), 13-31.
2. Mukhammadaminovna, T. G. (2023). Use of the" coaching" methodology in the process of teacher training. *Web of Semantic: Universal Journal on Innovative Education*, *2*(6), 345-347.
3. Tuychiyeva, G. M. (2023). EFFECTIVENESS OF PROVIDING KNOWLEDGE TO STUDENTS BASED ON THE APPLICATION OF THE COACHING METHODOLOGY IN HIGHER EDUCATION. *Экономика и социум*, (11 (114)-1), 381-386.
4. Dadli, GA va boshqalar. (1982). "Jismoniy mashqlar intensivligi va davomiyligining mitoxondrial moslashuvga ta'siri". *Amaliy fiziologiya jurnali*, 53 (4), 844-850.
5. Tuychiyeva, G. M. (2023). TEACHING THE SCIENCE OF SPORTS PHYSIOLOGY BASED ON THE APPLICATION OF EDUCATIONAL TECHNOLOGIES. *Экономика и социум*, (11 (114)-1), 381-383.
6. Hawley, JA va Burke, LM (1998). "Uglevodlarning mavjudligi va o'quv moslashuvlari". *Sport tibbiyoti*, 26 (6), 357-369.
7. Hultman, E. va boshqalar. (1996). "Energiya almashinuvi va charchoq". *Mashq biokimyosi*, 7, 65-78.
8. Tabata, I. va boshqalar. (1996). "O'rtacha intensivlikdagi chidamlilik va yuqori intensivlikdagi intervalgacha mashg'ulotlarning ta'siri". *Sport va mashqlarda tibbiyot va fan*, 28(10), 1327-1330.