

How to Build Endurance

Endurance Energy Overview

Human endurance ranges from zero to many hours. The energy needed to endure – that is, for the muscles to continue to function optimally for the required time of an event – comes from the molecule adenosine triphosphate (ATP).

On the energy continuum, ATP is generated by the ATP-PC system (immediately to a few seconds), glycolytic (breakdown of glucose over roughly ~:15 to 2:00), and aerobic/oxygen system (fat and other substrates derived from the breakdown of different compounds from ~2:00 to hours). But it's not that simple because 1) there is an overlap between the energy systems, and 2) most activities that engage muscles vary in the efforts needed during their execution (e.g., multiple short-term, high-effort actions mixed with multiple long-term, low-effort actions as seen in a two-hour game of basketball).

Add to that the many variations that exist among all humans relative to fitness level, muscle fiber quality and quantity, body type, skill level, mental capacity, and nutritional intake – all of which affect not only endurance but performance results – the entire “How to build endurance” is not a simple task, as it should be specific to each person.

Four Types of Endurance

- * Muscular endurance – High maximum effort over a few seconds up to ~1:00.
- * Anaerobic endurance – Moderately high to high effort for ~:30 to 3:00.
- * Aerobic endurance -Moderately high effort for ~5:00 to 15:00.
- * Long duration endurance – Low to moderate effort for ~20:00 to many hours.

Again, there is overlap, and results depend on other factors noted above, but the four categories can help one develop optimal endurance training programs.

What Prevents Us From Enduring?

- Energy perspective: The energy to endure and survive ultimately comes from one's diet.
- The three macronutrients - carbohydrates, fat, and protein - can all be converted to ATP energy via phosphocreatine (PCr), glucose, amino acids (AAs), fatty acids (FAs), and ketones.
- The limiting factors are neurons, muscles, blood, heart, and lungs.

- Quitting is physical, not mental. Neurons in the brain pump out epinephrine. Cells called Glial monitor epinephrine release & shut it down.
- * **Neurons** – their firing is contingent upon ATP & need glucose, CHO, ketones, Na, K, Mg, and is pH-dependent.
- * **Muscle** – begins with PCr → glycogen → FAs. pH & temperature are important, as too high or too low will mean ATP is unavailable.
- * **Blood** – glucose, FAs, O₂, ketones.
- * **Heart-moving** blood increases fuel use and brain function.
- * **Lungs** – O₂ availability and breathing rate.
- All the above must collaborate to optimize endurance.
- The brain and heart are the two main organs to care for.

General Adaptation from All Endurance Training

- * Elevated heart rate: A lot of blood flow that, when returned to the heart, the left ventricle is overloaded and becomes thicker. That makes it stronger and increases stroke volume.
- * The increased stroke volume also increases nutrient delivery, which, aside from increased ability, improves brain function via more glucose and O₂.

Tips and Other Factors

- * **Hydration:**
 - A decrease of 1-4% in total body water can lower work capacity by 20-30% and decrease cognitive abilities. Rehydrate using the Galpin formula: body weight (in pounds) divided by 30 equals the ounces of water needed every 15:00 of work.
 - One can also lose one to five pounds of H₂O/hour in workouts, depending on the environment and effort expended. Hot environment = more hydration.
 - Urine is actually filtered blood.
- * **Recovery:** Use ice baths or cold showers for six to 24 hours post-training to boost mitochondrial density.
- * **Prioritize sleep:** and parasympathetic downregulation through focused breathing for five to 15:00 post-workout.
- * **Breathing:** Nasal breathing is best for inhaling when working at low to moderate intensity, while mouth breathing can be used as intensity increases.

* **Diaphragm:**

- To warm up the breathing muscles before training, practice diaphragmatic breathing.
- The warm-up expands the diaphragm & intercostals.
- The diaphragm moves down on an inhale and up during an exhale.

* **Fueling:**

- The body utilizes PCr, CHO, FAs, ketones, and in some cases AAs for energy.
- The body maintains metabolic flexibility, where it adapts to primarily using both CHO and FAs in most conditions.
- Low liver CHO (glycogen) can lead to quitting.
- When one "hits the wall," the remedy for it is running faster to obtain energy from another source (e.g., switch from mostly aerobic to anaerobic [fast glycolysis]).

* **Mental Strategies:** Utilize the visual system to improve running ability.

- Panoramic or "panning out" is more relaxing. Focused is "narrow" and increases energy use.
- Can switch back and forth between panoramic and focused viewing.
- "The kick" in running shifts one into another gear from the increased focus on a vergence point (e.g., the back of the runner ahead of you). The nervous system increases epinephrine to increase neural firing and provides better access to energy from another source.

* **Side stitch remedy:** It is due to an aggravated phrenic nerve. Perform the physiological sigh = a series of 1) long nasal inhale, 2) quick short nasal inhale, 3) long mouth exhale. It helps dispose of CO₂ and ease the phrenic nerve.

Protocols for Endurance Training

Muscular Endurance:

- Three to five sets of 12-100 repetitions.
- Sets should be taken close to failure.
- :30 to 3:00 rest between sets.
- Use compound body weight, barbell, dumbbell, or weight machine exercises (e.g., pushups, bar squats, machine pulldowns).
- Avoid slow concentric and eccentric movements and no plyometric/jumping exercises.
- Sessions are conducted 2-3 times per week, separate from or at the end of heavy resistance training work.
- Adjust the frequency, number of sets, etc., according to one's recovery ability and progress.
- The primary source of endurance adaptation is mitochondrial respiration.

Anaerobic Endurance:

- Three to 12 sets with a work-to-rest ratio of 3:1 or 1:3 (the latter allows for better form/quality of work due to the more extended rest).
- For example, do a movement for :30 and rest :10, repeat (3:1) or :20 of work and 1:00 rest (1:3) or some variant thereof.
- The frequency of this can be done in most cases, one to three times per week, separate from or at the end of other resistance training work.
- Adjust the frequency, sets, etc., according to recovery ability.
- The source of endurance adaptation here is increased cardiovascular output, given that it increases the heart rate and V02 Max close to 100%.

Aerobic Endurance:

- Like anaerobic endurance, three to 12 sets with a work-to-rest ratio of 3:1, 1:3, or 1:1.
- For example, run a mile, then rest/walk for the same duration as the mile run took.
- Do these one to three times per week, depending on other training types.
- Work up to five to seven miles total.
- Proceed slowly because it is longer endurance work.
- The source of adaptation here is increased cardiovascular output and capillary density. Given that it increases the heart rate and V02 Max to 100% or more, major cardiovascular adaptations will be stimulated.

Long Duration Endurance:

- One set of 12 minutes or longer (up to 45:00, 60:00, or several hours depending on training goals). Either way, it must be sustainable for the duration and use good form.
- Options: Run, row, swim, bike, etc.
- This can be done in most cases one to three times per week, separate from or at the end of other resistance training work.
- Adjust the frequency, sets, etc., according to recovery ability.
- If one's goal is also hypertrophy, doing it more than twice per week for more than 30:00 will likely start to compromise muscle growth potential unless the endurance efforts are very low in speed and intensity.
- The source of adaptation here is the efficiency of movement. Adaptations are also a result of changes to capillary density and heart stroke volume.