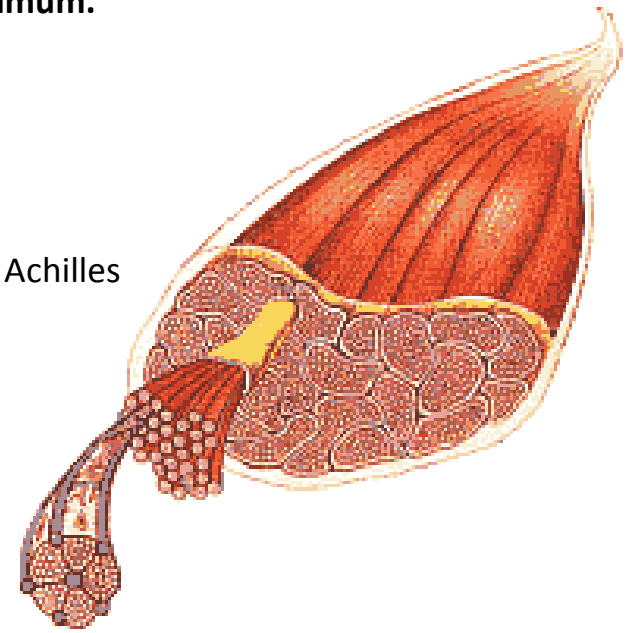
The Science of Triathlon

Strength and Flexibility for Triathlon

Strength Defined

Strength = the maximum amount of force you can apply with a muscle or set of muscles in one contraction. This is often measured as the "one-repetition maximum."

How do muscles work?



- Each muscle is attached to bone(s) at each end, via a tendon
  - Attachments are called the "origin and insertion" points.
  - Example: the calf muscle's insertion is at the heel via the Achilles tendon.
- Muscle cells are long fibers bundled into "fascicles."
- Muscle fibers can only contract or relax.
- Force is controlled by the number of muscle fibers contracting AND the thickness of each fiber.
- Muscle contractions can only cause the muscle to shorten, pulling the bones closer together.
- Muscles work in pairs to move the joints:
  - The "agonist" is the muscle contracting/shortening;
  - The "antagonist" is the muscle relaxing/lengthening;
  - Example: in an arm/biceps curl, the biceps is the agonist; the triceps is the antagonist.
- Stabilizer muscles may help stabilize a joint while agonists/antagonists move the joint:
  - Example: when doing biceps curls, shoulder muscles stabilize the shoulder joint.
-

SPORTFIT LAB
SCIENTIFIC TRAINING

Muscle Fiber Types and Roles

We used to classify muscle fibers into two types: “fast-twitch” and “slow-twitch.” Now fibers are classified into four categories:

Fiber Type	Type I fibers	Type II a fibers	Type II x fibers	Type II b fibers
Contraction time	Slow	Moderately Fast	Fast	Very fast
Size of motor neuron	Small	Medium	Large	Very large
Resistance to fatigue	High	Fairly high	Intermediate	Low
Activity Used for	Aerobic	Long-term anaerobic	Short-term anaerobic	Short-term anaerobic
Maximum duration of use	Hours	<30 minutes	<5 minutes	<1 minute
Power produced	Low	Medium	High	Very high
Mitochondrial density	High	High	Medium	Low
Capillary density	High	Intermediate	Low	Low
Oxidative capacity	High	High	Intermediate	Low
Glycolytic capacity	Low	High	High	High
Major storage fuel	Triglycerides	Creatine phosphate, glycogen	Creatine phosphate, glycogen	Creatine phosphate, glycogen

- All muscles contain some of each fiber type, but “white” muscles (like the pectorals in the chest) tend to contain more fast-twitch Type II fibers for strength; “red” muscles (like the calves) contain more slow-twitch Type I fibers for endurance.
- Fiber types vary from person to person; are mostly genetically determined; but can be modified with consistent, long-term training.

SPORTFIT LAB
SCIENTIFIC TRAINING

Strength & Triathlon

Do we need strength for triathlon success?

The myths:

- It's an endurance sport, so strength is not important
- Strength training will make me "bulky"
- Strength training will waste valuable training time

The facts:

- Economy: the fewer of your muscle fibers you need to use to move your body forward, the better your endurance
- Injury prevention:
  - Weak muscles fatigue quickly and are in danger of overuse injuries
  - Muscle strength provides stability for joints, preventing tendon and ligament injuries

Training guidelines for Triathlon:

- "Repetitions"= the number of lifts or "reps" done of any exercise before resting
- "Sets" = Groups of repetitions, with rest between each set
- 8-15 repetitions per set will build or maintain strength; continue until muscle fatigues (some "burning" sensation is OK; move slowly (3-5 sec.) through each repetition
- 2-3 sets of each exercise will build or maintain strength WITHOUT building excessive bulk
- 2-3 workouts per week (for each muscle trained) will build strength; 1-2 workouts per week will maintain strength
- Build strength during winter; maintain strength during race season
- Strengthen agonists, antagonists, and stabilizers

SPORTFIT LAB
SCIENTIFIC TRAINING

Strength Exercises - Swim

SPORTFIT LAB
SCIENTIFIC TRAINING

Which muscles (agonists) produce swim power?

- Latissimus ("lats") – pull arms from over head down toward the body
- Shoulder internal rotators – rotate the arm forward/down in the "pull"
- Gluteus maximus – kicks the legs

Which muscles (antagonists and synergists) provide stability and prevent injuries?

- Abdominals ("abs") – stabilize torso during the pull phase
- Shoulder external rotators ("rotator cuff") – stabilize the shoulders throughout the stroke
- Lower back (erector spinae) – stabilize the back during forceful kicking

Strength Exercises - Bike

SPORTFIT LAB
SCIENTIFIC TRAINING

Which muscles (agonists) produce bike power?

- Quadriceps (“quads”) – front-thigh muscles straighten the knee in each stroke
- Gluteus maximus (“butt”) – pushes the leg down, especially on hills

Which muscles (antagonists and synergists) provide stability and prevent injuries?

- Calves – stabilize the ankle so power is transmitted from thighs/hips to pedals
- Abdominals (“abs”) – stabilize the torso to maintain “aero” position and resist fatigue
- Hamstrings – rear-thigh muscles smooth the pedal stroke

Use only one leg at a time for more effective exercise.

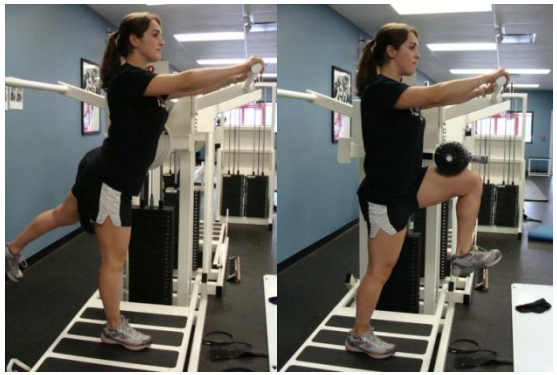
Strength Exercises - Run

Which muscles (agonists) produce run power?

- Hip flexors – upper thigh muscles lift the legs forward in the swing phase
- Calves – propel the body forward in the push-off phase
- Abdominals ("abs") – help the hip flexors pull the legs forward

Which muscles (antagonists and synergists) provide stability and prevent injuries?

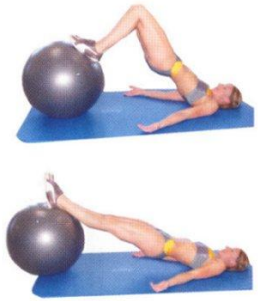
- Quadriceps – stabilize the knee and absorb impact in the stance phase
- Hamstrings – assist in stabilizing the knees
- Hip abductors – outer hip muscles stabilize the pelvis and hip during landing, stance, and push-off



Don't extend legs too far – lower back must be kept flat on the floor.

Don't bend the knee more than 45 degrees.

Use only one leg at a time for more effective exercise.



Advanced hamstring curls.

Flexibility and Stretching

SPORTFIT LAB
SCIENTIFIC TRAINING

Antagonists must be flexible to allow full range of motion without fatigue:

- Swim – shoulders (reach and rotation)
- Bike – lower back, gluteals, and hamstrings
- Run – hamstrings, abdominals

Stretching guidelines:

- Before training/racing:
  - Warm up before stretching
  - Do active stretches/movements, not static stretches shortly before racing
- After training/racing:
  - Do slow, static stretches to increase flexibility
  - Hold each stretch 20-60 seconds (mild discomfort is OK, pain is NOT)

Avoiding injuries is a balance of stability (strength) and mobility (flexibility):

- Muscles must be equally strong on each side of the body (symmetry)
- Avoid overtraining: rest after long or tough workouts (or races)
- Address pains when they're minor, with corrective exercises [come see us!]; don't wait for injuries to be serious
- Most injuries can be healed with good therapy and proper exercises
- Stay well-hydrated during training and races: dehydrated muscles damage easily