



SECOND EDITION

ROWING STRONGER

Strength Training to Maximize Rowing Performance

BY WILL RUTH

Reviews of Rowing Stronger, Second Edition

Rowing Stronger is an essential primer for coaches and athletes alike for addressing all of the peripheral, yet requisite elements for rowing performance and longevity. This is a must-read for coaches of every level, and I will be reviewing it every year for ways to improve my program!

— CAITLIN MCCLAIN

Will has constructed a fantastic handbook for rowing preparation, useful for both athletes and coaches alike. The book outlines how to structure a preparation program to complement rowing-specific training, and provides a clear path to writing a program that fits your needs. I refer back to this book yearly when writing the annual plan for the WWU Women's Rowing team, and have seen first-hand how effective the programming principles in this book are.

— DAMIEN FISHER

A great updated guide to strength training within the framework of block periodization. All the sections that existed in the first version felt more accessible with the reworking, plus the new guides for mobility assessment and more. Although the book does not come with an entirely pre-written program, it does have sample programs and is designed around the principle of “teach a man to fish.”

— ERIC DELACORTE

Will Ruth has written the pre-eminent handbook on strength training for the rowing athlete. *Rowing Stronger* skillfully guides the athlete and coach through the science of weight training; tricky concepts are made clear, and once lofty end-goals become obtainable. With the advice of Will's work, every one of my RowPhysio PT athletes now benefits from being stronger and more injury-resilient athletes at any age and skill.

— GREG SPOONER

Rowing Stronger is my go-to book for masters strength training. Fast boats are a priority for my athletes so having this detailed approach with targeted exercises is a must. A solid strength foundation keeps Roylerowers powerful, healthy, and on top of the podium in world class events. Follow Will's program and its guaranteed to boost your boat speed stroke by stroke. Highly recommended.

— MARLENE ROYLE

This 2nd edition is thorough and detailed enough to satisfy both athletes and coaches. There were a number of concepts I previously struggled with that Will explains with clarity and descriptive examples. The material is clear, easy to read, highly practical, and a very interesting read. There are a number of things that I can put into practice right away in my training as a masters rower.

— MIKE HUET

The second volume of *Rowing Stronger* includes detailed programs as well as explanations on how to write your own programme. Interestingly, Will explains how he has reduced the volume in his training and seen improved results. I also appreciate his careful explanations of transitioning between blocks and the whole chapter dedicated to masters athletes.

— REBECCA CAROE

I'm the strength coach for a big group of junior rowers. Over the years, I've gotten to know many exercises, tools and trends, but I got more and more confused with the specific demands of rowing and how to best train them in the gym. Then, I found Will's website and book. The new version is even more extensive, detailed, and leaves no questions unanswered. Will is a rower who thinks and feels like a rower and who writes for rowers and rowing coaches. There is nothing better!

— RENATE PODESSER

Will Ruth makes a valuable contribution to the sport of rowing with his comprehensive guide to strength and conditioning. This is a far cry from the usual one-size-fits-all training formula. Ruth details how individual athletes can use block periodization to create a program tailored to their individual needs based on age, weight, and competitive goals. He provides abundant information on specific exercises and how they fit into an overall strength training program. Any athlete or coach interested in minimizing injury and optimizing race performance would do well to read this book.

— SARAH RISSE

If we simply repeat what we've done, can we expect to get better? Will Ruth believes that we can all be better, if we get stronger, both physically and mentally. From gym to race day and all points in between, that only comes from an intelligent and rowing-specific approach to preparation. I found this helpful as a rower, coach, and parent of a high-performing rower.

— SHAUN ELLIS

Will has created a comprehensive, valuable and easy to follow guide to maximizing any boathouse crew's performance potential. He takes great care in emphasizing technique, safety, and planning for a successful year. As a masters coach, it will no doubt serve as an essential tool to guiding my masters in body and spirit to a mighty season!

— TARA MORGAN

What's New in the Second Edition?

WHETHER YOU BOUGHT THE FIRST ONE or are a brand new reader, thank you for buying the second edition of *Rowing Stronger*!

I've coached, written, and learned a lot since first publishing *Rowing Stronger* in 2015. I'm constantly reevaluating my programs and trying to find better ways to build stronger, faster, healthier, better rowers based on results, athlete feedback, and the latest research.

My general approach to using the block periodization system for rowing is still similar to what I wrote in the first version. However, I have consistently decreased the volume of strength training and found equal, or better, results in strength, power, and rowing performance, and I've adjusted the recommended sets and reps accordingly throughout the book. I have also added several new exercises to the exercise index and throughout my programs that I highly recommend for rowers. I still think the barbell is a great tool, but I now tend to include more exercise variety depending on the athlete, available equipment, and goals of training.

The biggest difference from version one is simply more content. In addition to some entirely new sections and chapters, I went through the entire book to update every section and add detail and clarification wherever necessary. I've also included some of the most popular article series from my website, "Mobility for Rowers" and "Mental Skills for Rowing," so you can keep those in one place for quick referencing.

I'm very pleased to be able to share the coaching of fellow rowing strength coaches Blake Gourley and Joe DeLeo in their guest chapters on movement assessments and kettlebell training. Blake, Joe, and I started the Strength Coach Roundtable podcast in 2016, and we have spent a lot of time talking on and off-air about how we can improve our coaching to help more rowers get stronger, healthier, and faster.

I have also included sample programs for each block of training, and templates you can use to build your own program. I didn't include this in the first version, because I was worried that readers would jump straight to the sample program instead of learning how to program for themselves and writing a program for their own personal goals, abilities, schedule, and equipment. However, I got a lot of requests for it, and I think it fits the educational goal of this book to demonstrate how the concepts from each block come together to create a training program.

I have worked a lot more with masters strength training since the original, and I greatly expanded the "Strength Training for Masters" chapter. In addition to an overview of training, you'll find an annual periodization template, a description of how each month of training can build towards your racing goals as a masters rower, and more.

I hope you enjoy this second edition, and that the knowledge contained within helps power you to new heights in your rowing training, performance, and career.

In Strength,

Will Ruth

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Introduction

ROWING IS UNIQUE AMONG OLYMPIC SPORTS in its demand of strength, endurance, and technique under intense amounts of fatigue, yet most training programs treat rowing as though it were purely an endurance sport. Those programs neglect the development of strength and power in favor of more meters, more miles, and more aerobic system training. This overemphasis on one area of training, and neglect of another, leaves much room for improvement. Increasing your strength through an intelligent system of training delivers power to your rowing stroke, improves endurance, and can reduce your risk of injury, keeping you in the boat for more consistent training and better performances. The intelligent approach is key, and as a former rower and current coach, I have made and seen many mistaken and unintelligent approaches ranging from mimicking the programs of elite rowers, to training rowers like bodybuilders and powerlifters, to doing some truly insane combinations of workouts in hopes of making improvement.

I have five goals for you after reading this book.

#1: You will understand why strength training is crucial for continued improvement in rowing, both to improve performance as well as reducing risk of common rowing injuries.

#2: You will be able to write your own annual periodized strength training program to

support your rowing training and achieve your goals for each season.

#3: You will know which exercises to do in the weight-room, why you are doing them, and how to structure them in a strength training session.

#4: You will be able to make adjustments to your training, evaluating areas for improvement and developing a plan for improving them. While I do include a sample program at the end, this is not a “just add water” program to follow blindly. You will learn how to program and adjust your training to suit your individual goals, needs, and equipment.

#5: You will understand that there is more to strength training than just exercises, sets, and reps, and that there are many ways beyond just sport and strength training, such as mobility, mental skills, and more, to improve rowing performance, reduce risk of injury, and enjoy longer, healthier rowing careers.

The cardiovascular system is your foundation of endurance; the muscular system is the ceiling.

The Top-Down Endurance Approach

The first key concept of rowing stronger is understanding why you should use strength training to build strength, and the water, erg, and cross-training to build the foundation of endurance. This is what I will refer to as the “Top-Down Endurance Approach.”

The goal of the top-down approach is to improve the rower’s maximum force potential to make the force required from one rowing stroke a smaller percentage of maximum force, and thus easier to endure for longer time and distance. Increasing your strength decreases the amount of effort required per stroke, which increases your endurance. You are stronger, so each stroke requires less effort to pull the oar through the water, therefore you can maintain that pressure for longer. The cardiovascular system is your foundation of endurance; the mus-

cular system is the ceiling.

Research suggests that one stroke at 2km race pace requires approximately 150lbs of force. The most common, though less effective, way to increase rowing endurance at that intensity is by doing high-rep endurance sets on squat or deadlift with around 150lbs. Instead, the top-down system uses lower reps and a focus on strength and power to make 150lbs a smaller percentage of the rower's maximum potential output, improving endurance by reducing per-stroke effort. We seek to build a rower's maximum squat or deadlift from 175lbs (150=85%) to 225lbs (150=66%), to 275lbs (150=54%), to 315lbs (150=47%), all while continuing endurance work on the water or erg via the usual rowing workload of thousands of meters per week. Endurance and strength thus develop in parallel over months and years to produce a powerful rower capable of sustaining great pressure for race distances.

For more on measuring rowing strength, see: Lawton, T., Cronin, J., & McGuigan, M. (2011). Strength testing and training of rowers: a review. *Sports Medicine*, 41(5), 413-432.

"Strength endurance training without adequate strength only means you are getting better at being weak."

– Ed McNeely

The top-down approach is especially important with athletes who are new to rowing, strength training, or both. Even rowers with years of rowing experience often have not had a structured and supervised strength training program. An approach of high-rep isolation machine exercises fails to teach the new trainee how to use their body and muscles in a coordinated way that will transfer to the dynamic sport of rowing. The high volume inherent in these light "endurance" circuits can also cause overuse injuries and muscular imbalances. Additionally, a rowing program can have heights ranging from 5'3 females to 6'8 males, and generic commercial exercise machines are not built for this range of athletes. is exposes athletes to further risk of injury with ill-fitting and ineffective machines that place tension on

vulnerable parts of joints, muscles, and bones.

Training with lower repetitions also allows an athlete to focus fully on executing every rep with proper technique and power. Mental focus deteriorates in high-rep sets, which leads to ineffective training, as well as potential injury resulting from a lapse in focus or breakdown in technique. Performing powerful and controlled repetitions in the two-to-ten rep range yields the most benefit from each exercise, effectively and efficiently builds strength, and reduces the injury potential of longer, high-rep sets of 20+ reps.

The top-down approach also reduces another chronic risk for rowers and endurance athletes—overtraining. Ask a competitive rower what their typical week is like, and it'll be at least 10 hours on the water or on the erg, 2-4 high volume lifting sessions (if any weight-room training is done at all), and 1-2 high volume cross-training sessions thrown in. This is a lot of mileage on the ankles, knees, and hips. Sitting in a boat or on an erg for 12+ hours a week, running, cycling, and lifting weights for high reps with sloppy technique, can combine to cause postural problems of the mid-back, shoulders, and hips. All of this training is then combined with student or typical employee responsibilities of sitting down to study, work, and commute, compounding these same postural problems. Added all up, injury or sickness commonly results in the overtrained athlete whose body is unable to recover from chronic or escalating stress. Overtraining can also have a detrimental effect on performance, causing lack of motivation to train, decreased cardiac output, higher resting heart rate, and even depression-like symptoms at the acute level. We'll discuss this more in the "Over-Training or Under-Recovering" chapter.

The system of strength training that I use with rowers is based around training sessions that are faster, more efficient, safer, and more effective for the goal of building better rowers. Athletes perform exercises to improve rowing performance, as well as exercises for specific target areas to reduce risk of common rowing injuries. We use squat variations for the legs, deadlift variations for the posterior chain muscles, overhead pressing for the shoulders and mid-back, rowing exercises for the back muscles, and bodyweight, odd object, and minor assistance exercises to reduce risk of injury and improve muscular

balance and overall athletic coordination.

“Main work” consists of strength or power work, using large muscle groups and compound exercises to increase strength to improve endurance over the long-term via the top-down approach. We then use “assistance work” for secondary goals, such as muscle size, strength, and injury reduction through exercises for targeted muscle groups.

We tend to use assistance work primarily to focus on building the muscles that rowing fails to develop through rowing training alone. There is much more detail on this in the “The Exercises” chapter. Lack of strength in the postural muscles of the mid-back is one of the main causes of the rowing hunchback. Look for rowers at your next regatta with internally rotated “caveman” shoulders and the “turtlesell” mid-back. It is likely that these athletes experience shoulder or mid-back pain, and leave power on the table at each stroke by slumping or caving at the finish. Sweep rowing causes even greater imbalances by putting greater reliance on one side of the body. It is imperative that these imbalances are corrected to restore bilateral (left/right side) balance as well as anterior-posterior (front/back) balance. This will improve comfort at achieving key rowing positions, improve performance with every stroke, and minimize the risk of overuse injuries while rowing and later in life.

I actually consider reducing risk of injury as THE primary benefit of an intelligent, appropriate, and rowing-specific strength training program, with performance improvement second. This is contrary to the beliefs of most, but I can explain why with a simple question. Does it matter how strong or how fast you are, or how great your endurance is, if you hurt too much to display it? What if you have the best fitness and can out-run or out-cycle everyone on your team, but due to a shoulder injury, can't row in the big race? What if you have the best technique in the boat, but can't race or go 100% because of a hip injury?

All of this boils down to a simple, two-pronged approach.

#1: Reduce risk of injury by developing muscles and movement patterns that rowing alone neglects.

This keeps athletes in the boat longer, and more productively. This provides more time to practice technique and gain opportunities to improve in the sport. This can earn the athlete a longer, healthier, and more successful career as a rower.

#2. Increase your strength to decrease the amount of per-stroke effort, improving your endurance and your rowing performance.

Please note that all of the following information about programming and training will not help you if you cannot, or do not, perform the exercises correctly. If you do not have a coach or trainer working with you regularly, I recommend at least a few introductory sessions with a qualified personal trainer to learn the basics of the exercises in this program. Performing any kind of training incorrectly can lead to injury, or at least failure to fully reap the benefits of that exercise. It is of the utmost importance that all exercises are performed safely and correctly at all times. None of the following is medical advice and it is recommended that you consult a medical professional before undergoing any physical training regimen.

Terms and Definitions

S KIM THIS SECTION AT YOUR OWN RISK. While it is possible to understand how to set up a program without knowing the following information, at least being familiar with the terms and definitions will help you be a more well-rounded coach or athlete. The following information is a synthesis of exercise science and adaptations to rowing training, and is as concise as it can practically be for complete understanding of the block periodization system for rowers of different levels. Ultimately, the more knowledge you have, the better you will be able to adapt the system to your individual needs.

Periodization

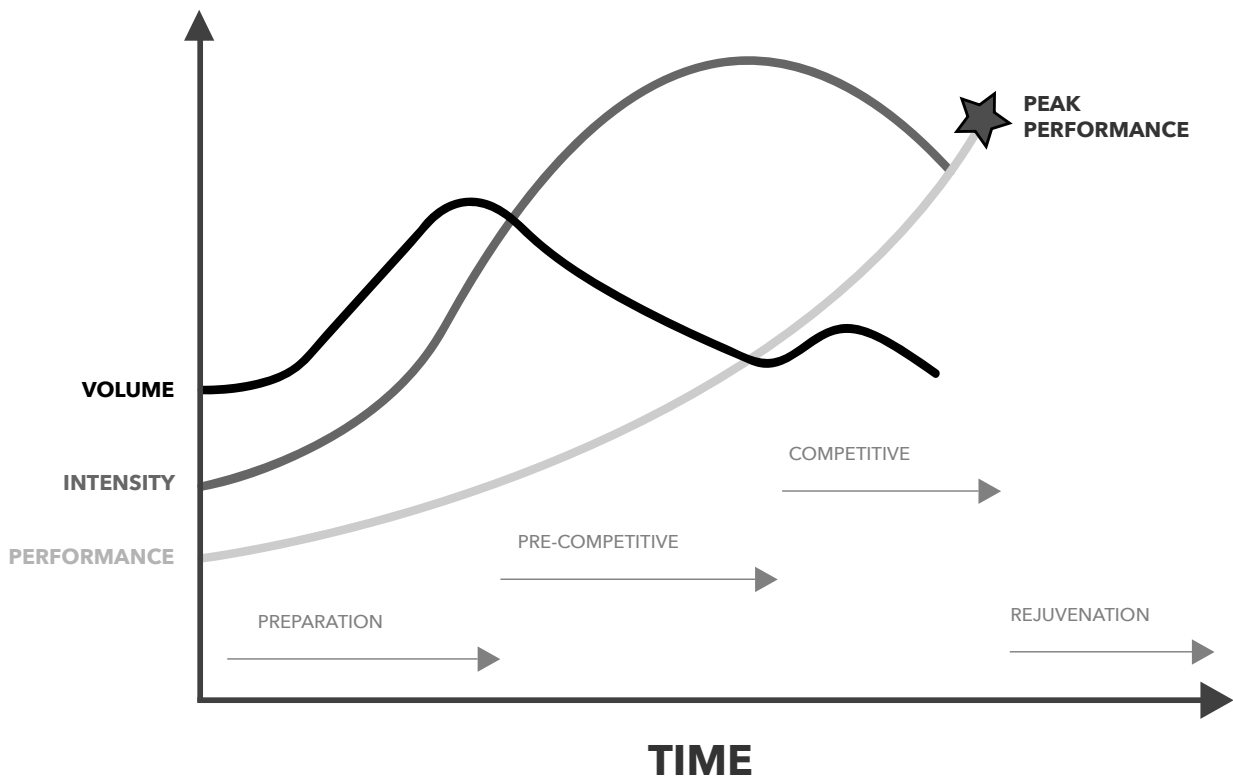
Periodization is a complex-sounding word that describes a simple concept. To periodize training simply means to recognize that we can't train everything to peak performance at once, instead focusing on developing different qualities at different times of the year, while maintaining other qualities. Periodization can take many forms, all of which revolve around the concept of not trying to train everything at once. The purpose of periodization, and the advantage over "trying to do everything at once-ization," is to organize training so that we develop the multiple necessary qualities of the sport in a way that builds throughout the year

to a peak performance. We focus on primary sport qualities in accordance with the focus of each major rowing season or block of training:

Distance (4km+) race seasons: technique, aerobic endurance, and muscular foundation

Sprint (1km or 2km) race seasons: technique, anaerobic power, and muscular strength and power

Off-seasons: recovery, general athleticism, muscular foundation



Rowing is an extremely physically diverse and demanding sport, and attempting to train all of the above qualities simultaneously will result in burnout, overtraining, and injury. This system of focusing on developing a few athletic qualities at a time will result in greater long-term athletic development and performance, with less risk of overtraining and injury.

The next layer of periodization is how to maintain the qualities that are not actively being developed. For example, when focusing on aerobic endurance and muscular hypertrophy during the distance race season, we still include some anaerobic work and strength work to maintain those qualities while still saving plenty of energy to develop the focus quality. During the sprint race seasons, we still include some aerobic endurance work and hypertrophy work to maintain cardiovascular system fitness and muscle mass. This is how we build to peak performance by focusing on developing specific qualities while maintaining others.

The major qualities manipulated when writing a periodized strength training program are **volume**, **intensity**, **frequency**, and **specificity**. There are other minor qualities as well that we will discuss later. These terms can be used to describe both strength training and rowing training, so I will provide examples for both and be clear when I am addressing one or the other.

Volume is the total amount of work performed in a given session or length of time. For weights, this can be calculated by sets (x) reps (x) weight. If one lifts 300 pounds for 3 sets of 10, the session volume is 9000 pounds. In strength training, volume typically refers to the number of sets and reps a lifter performs during a given training session or block of training. In rowing training, volume may be defined as meters or minutes rowed per session or week.

Intensity is the next variable. Generally, volume and intensity are inversely proportional, meaning that if volume is high, intensity is low, and vice versa. Intensity is the percentage of your 100% effort at which you are working during your training session. One 500-meter sprint, all-out, would be 100% intensity for the 500m distance, but one might do four 500-meter sprints at 80% intensity. It is easier to define intensity in the weight-room, where 100% intensity is represented by the maximum amount of weight lifted through a given range of motion (ROM). If a parallel back squat 1-repetition maximum (1RM) is 200 pounds, 80% of that 1RM is 160 pounds. Fewer reps are possible as one gets closer to the 1RM, which is why volume and intensity are inversely proportional.

Intensity can also be defined based on a **Rate of Perceived Exertion (RPE)** scale. RPE is

particularly helpful for those activities that are more difficult to objectively measure. The RPE scale is a scale of 1-10 that estimates how much effort the lifter exerts on a given exercise. There are many different methods to classify RPE. One example for strength training is below.

Description of Effort	RPE Scale
Little to no effort	1-2
Light effort	3-4
4-6 repetitions remaining	5-6
3 repetitions remaining	7
2 repetitions remaining	8
1 repetition remaining	9
Maximum effort	10

Research more on RPE before basing a training program around it. A common mistake is to think that everything needs to be at a 10/10, truly maximal RPE. All RPEs have a place in training, and it takes knowledge, skill, and experience to know which to focus on when.

Frequency is the amount of times in a given amount of time that a certain quality is trained. Strength training frequency might be higher in the off-season, but rowing frequency might be lower, while strength training frequency might be lower in-season when rowing frequency is higher. Total training frequency can also refer to the number of times per week any sport activity is trained, be it strength training, cross-training, or rowing training.

Because athletes have a finite amount of recovery from training, a program can usually only maximize only two out of three of these variables at any one time. A program can be high volume and high frequency, but the intensity will have to be lower to allow for recovery. A program could have high intensity and high frequency, but total volume would have to be lower. A program that is too high in volume, intensity, AND frequency, for too long of a time, will likely result in overtraining, burnout, and/or injury.

Specificity is the final variable, and is defined as how focused training is on the competitive sport and event within the sport. In both rowing and strength training, specificity increases as the competitive season nears. If the competitive season is the 2k race season, specificity would be highest during the spring, focusing rowing training on shorter distances, higher power, and refined technique at higher stroke rates, with very little cross-training, with peak power as the strength training priority. Specificity decreases sharply immediately following the competitive season, and then builds up from there. I highly recommend participating in another sport or activity during off-seasons, especially for the younger (high school age) athlete to develop a wide range of athletic qualities. For the collegiate or post-collegiate athlete, this period of low specificity might just mean doing other enjoyable activities, focusing more on cross-training through biking, running, or other active pursuits. Low-specificity strength training focuses on restoring muscular balance, moving in different planes of motion, and using different training modalities than focused on during the competitive season.

Below are some more terms and definitions useful for understanding core concepts of exercise science.

Hypertrophy is muscle fiber size. While extreme hypertrophy exhibited by bodybuilders and strength athletes is not desired for rowing, increasing muscular bodyweight to a certain point can benefit rowing performance by increasing the amount of mass that the athlete can use to pull on the oar. Additionally, muscle fiber size is one of the most important indicators of maximum force potential. A muscle with larger size (cross-sectional area) is typically a stronger muscle, as long as the athlete has the aerobic system to power it and the coordination to display it. This additional bodyweight has to be accompanied by additional strength and aerobic fitness to make the increase in mass worthwhile for rowing. I typically consider the hypertrophy rep range in my programs from 8-15 reps, not exceeding 20. We tend to use simpler exercises for hypertrophy training, such as a single-leg squat instead of a barbell squat, to reduce risk of injury from lifting under fatigue and to focus the effort on the target body part.

Volume	Intensity	Rest Interval	Example Rep Ranges
25-50 reps per exercise	60-75% of 1RM	1-3 minutes	5x10@60%, 4x8@65%, 8x5@70%, 3x12@65%

Strength is defined as maximal force production. Strength is mostly dependent on muscle fiber size, central nervous system (CNS) coordination, and motor pattern efficiency. CNS coordination and motor pattern efficiency allow for gains in strength without gaining additional muscle size. This is particularly useful knowledge for masters athletes and female athletes, who have less muscle-building hormones than younger, male rowers, and may struggle to increase muscle size. You can still improve your strength through CNS coordination, improving the ability of the nervous system to coordinate a muscular action, as well as motor pattern efficiency, or improving technique to better develop and display strength in a given exercise.

Volume	Intensity	Rest Interval	Example Rep Ranges
10-25 reps per exercise	75-95% of 1RM	3-5 minutes	3x5@80%, 5x5@75%, 5x3@85%

Power is the ability to rapidly exert force. Power is dependent on strength, and even more dependent on CNS coordination. The difference between power and strength is the factor of time in the rate of force development. Strength is simply the maximum amount of force, as in a maximal squat, while power is the intersection of maximum force and minimum time, as in a vertical jump. **Power is relevant to rowing as greater power will improve the rate at which the athlete can apply force to the oar, decreasing the time between catch, leg drive, and**

maximum propulsion. Note that rep ranges always stay low for power work to keep focus and explosive intent high for every rep, crucial to power development.

Volume	Intensity	Rest Interval	Example Rep Ranges
8-15 reps per exercise	65-80% of 1RM	2-4 minutes	10x1@65%, 6x2@75%, 8x2@70%

The “shortening” phase of muscle action, usually the “lifting” phase of an exercise, is referred to as the **concentric** action. This is as opposed to the lengthening, usually “lowering,” phase of muscle action, which is the **eccentric** action. The general rule for strength training is a 2:1 eccentric-to-concentric ratio, so a two-count on the way down and a one-count on the way up. This is especially important when training for power, where an explosive concentric phase of the lift is essential to gaining the benefit of power training.

Training Session Order: Within individual training sessions, athletes will train power before strength, and strength before hypertrophy. This ensures that we get the most out of each training modality, maximizing training effect and minimizing risk of injury.

Within a single day of training, research suggests that strength training and rowing or other aerobic training should be separated by several hours to minimize the interference effect of training for muscular endurance (rowing/aerobic training) and muscular strength. If this is not possible, research suggests strength training immediately before rowing or aerobic training.

Minimizing risk of injury is the major reason for the training session order and day-of-training schedule. We want to minimize non-productive, or counter-productive, fatigue before strength training. For example, performing high-fatigue hypertrophy work before strength work would result in one part or area of the body being fatigued, sacrificing its effectiveness

in compound movements. Similarly, rowing training before strength training fatigues the leg, back, and core muscles, which can result in athletes being unable to perform strength training exercises correctly, safely, and effectively.

The second, much more minor, reason is efficacy of training with regard to physiological adaptation. The interference of strength training to rowing training is much less than the interference of rowing training to strength training. However, I understand that it is not always possible to craft the perfect training schedule. Don't let perfect be the enemy of good enough. Strength training is absolutely still worthwhile even if you don't have the perfect schedule or perfect equipment availability. Keep the principles in mind and make adjustments to the training approach as your own individual situation requires. For example, if you must strength train immediately after rowing training, you will need to be very attentive to athlete fatigue from the rowing session, the exercises you choose for strength training, and the volume and intensity of your strength training programming. If you must do circuit-style training and cannot follow the individual training session order of power-strength-hypertrophy, again consider adjusting your exercise selection, volume and intensity, and circuit session design to be the best possible solution.

For more on the interference effect, see: Garcia-Pallares, J., & Izquierdo, M. (2011). Strategies to optimize concurrent training of strength and aerobic fitness for rowing and canoeing. *Sports Medicine*, 41(4), 329-343.

Rest intervals are another important variable in program design. The basic reasoning for rest interval programming is that ATP (energy) needs to be regenerated in the system in order to fully express strength. It takes 3-4 minutes for ATP to fully regenerate, so rest intervals for strength training will typically be 3-4 minutes in between sets. This is less important for hypertrophy training, where the goal is to elicit muscular fatigue, and full expression of strength is not a priority. While pure power output can require the same 3-4 minutes of rest as strength, power training for rowing often focuses on power endurance, and the rest intervals can therefore be decreased to 1-2 minutes. I find this particularly effective for building power endurance for the start and power-10 pieces.

Strength	Hypertrophy	Power
3-4 minutes of rest	1-2 minutes of rest	1-4 minutes of rest

Main work is the primary work done in a training session, performed first before other exercises.

Assistance work is the secondary work done in a training session, performed after the main work.

I define “**fitness**” for athletes as the ability to perform a certain task. When discussing rowing training, I use the term to describe how race-ready the athlete is for an upcoming race.

Exercise notation: I use the format (sets) x (reps) @ (% of 1RM). Thus, 3x8@70% would be read as “3 sets of 8 reps @ 70% of 1RM.” I will typically add a rest interval as well, like so: 3x8@70%, 60s.

Aerobic conditioning is the cardiovascular system’s ability to pump blood to muscles and organs, useful for lower intensity and longer duration efforts, as well as for muscular recovery in between sessions. A more effective cardiovascular system will transport nutrients and oxygen to muscles more rapidly, allowing for greater session-to-session recovery. As rowing is a majority aerobic sport, the conditioning of the aerobic system is highly important to be able to race at full performance. Keep the aerobic training to the erg, boat, and cross-training though, not in the weight-room.

Anaerobic conditioning is the ability of non-oxygenic energy systems to generate force repeatedly, useful for higher intensity and shorter duration efforts. Very few sports are 100% aerobic or 100% anaerobic. On the continuum, rowing is majority aerobic, but the anaerobic system still contributes strongly and rowers tend to neglect the anaerobic system in training. Most sources have a 2km rowing event as around 80% aerobic, but the starts and sprints are where the anaerobic power is really apparent. Anaerobic conditioning is even

more important for masters rowers who race 1km distances in sprint events. A 6km race will be more aerobic than a shorter race, and this training is discussed at greater length in the “Strength Training for Longer Races” chapter

Below are answers to frequently asked questions about strength training for rowing.

What about Olympic lifts?

I do not believe that the Olympic lifts are useful enough to rowing to merit the necessary amount of time spent teaching and practicing the lifts. This is not to say that the Olympic lifts are not useful, just that the time investment in order to be proficient enough to benefit from them for the purpose of becoming a better rower would be better spent squatting, deadlifting, swinging a kettlebell, doing other power-developing exercises, and of course, rowing. The lone Olympic lift variant that I will use is a high pull, in which the athlete lifts the bar like a deadlift, then explosively accelerates when the bar reaches the knees, propelling the bar with hip power to mid-torso height. The major flaw with the Olympic lifts transferring to rowing is that the recovery phase of an Olympic lift is markedly different than that of a rowing stroke. The Olympic lifts rely on rapid extension from the hips followed by rapid deceleration to pull oneself under the bar before standing up with the weight. This is a very challenging motion required for proficiency in the Olympic lifts, and it is not a motion that is replicated in the boat. Additionally, the main purpose of the Olympic lifts is to develop explosive triple extension of the ankles, knees, and hips, yet in rowing, only the knees ever reach full extension. The hips will extend to approximately 120 degrees at the layback stage, well short of the over 180 degrees of extension present in a clean or snatch, and the ankles are locked into partial flexion by the foot stretchers. For the purpose of becoming a better rower, there are simply too many other better ways to develop power with less investment in practice time required.

Are there separate strength training programs for male and female rowers?

No. The differences between males and females from a strength training perspective are minor, and often more anecdotal than supported by research. The myth of female “bulkiness” resulting from strength training has been sufficiently debunked by many scientific sources. Strong legs, a strong back, and a healthy body are necessary for both male and female rowers, and 2km is 2km no matter which reproductive system one is carrying. While you should make adjustments based on your individual athletes’ needs, I do not believe there is an inherent need to program differently for male and female rowers.

What level of rower can benefit from Block Periodization?

Any level of rower from junior novice to collegiate to masters to elite Olympian can benefit from taking a periodized approach to strength and rowing training. Remember that the block periodization system is simply a way to organize training, instead of trying to train everything at once and risking burnout, overtraining, and injury. The block periodization system provides a framework for training that you can adapt and adjust as you grow as a rower, or as you coach different levels of rowing and athlete ability.

I would also like to clarify that there are differences within block periodization program philosophies. I use the general annual structure of block periodization to progress from preparatory blocks to pre-competitive, and then competitive training, because it lines up nicely with most rowing competitive schedules. It is also very simple to manage, which allows the coach and athlete to focus on the effort and execution of training. I do make adjustments to the specifics of program design that are not necessarily representative of “textbook” block periodization philosophy. If you are interested in the history of periodization and training philosophy differences, I recommend reading some foundational work by Vladimir Issurin

and Tudor Bompa, as well as some modern research from John Kiely. I've studied and written on periodization paradigms in graduate school, so please email me if you'd like to discuss or request any of the articles I've collected.

How strong is strong enough?

Strength training can improve performance and reduce risk of injury at any level of rowing. However, strength training must adapt and adjust as the athlete progresses through the levels of rowing performance. For example, there certainly is a point of diminishing returns where more strength will only lead to marginal improvements in rowing ability. If there were not, the strongest powerlifters would also be the best rowers. But, exactly where this point is for each athlete is an individual calculation. Strength training has many more benefits than just maximum muscular output. If increased maximal strength is no longer yielding worthwhile returns in rowing performance, a very experienced athlete could deprioritize maximum strength training in favor of training specifically for reducing risk of injury, or strength maintenance, or peak power output and/or power endurance, depending on their specific needs and goals. Or, reduce strength training to simply maintain strength and muscle mass, and focus on other forms of training that offer more benefit.

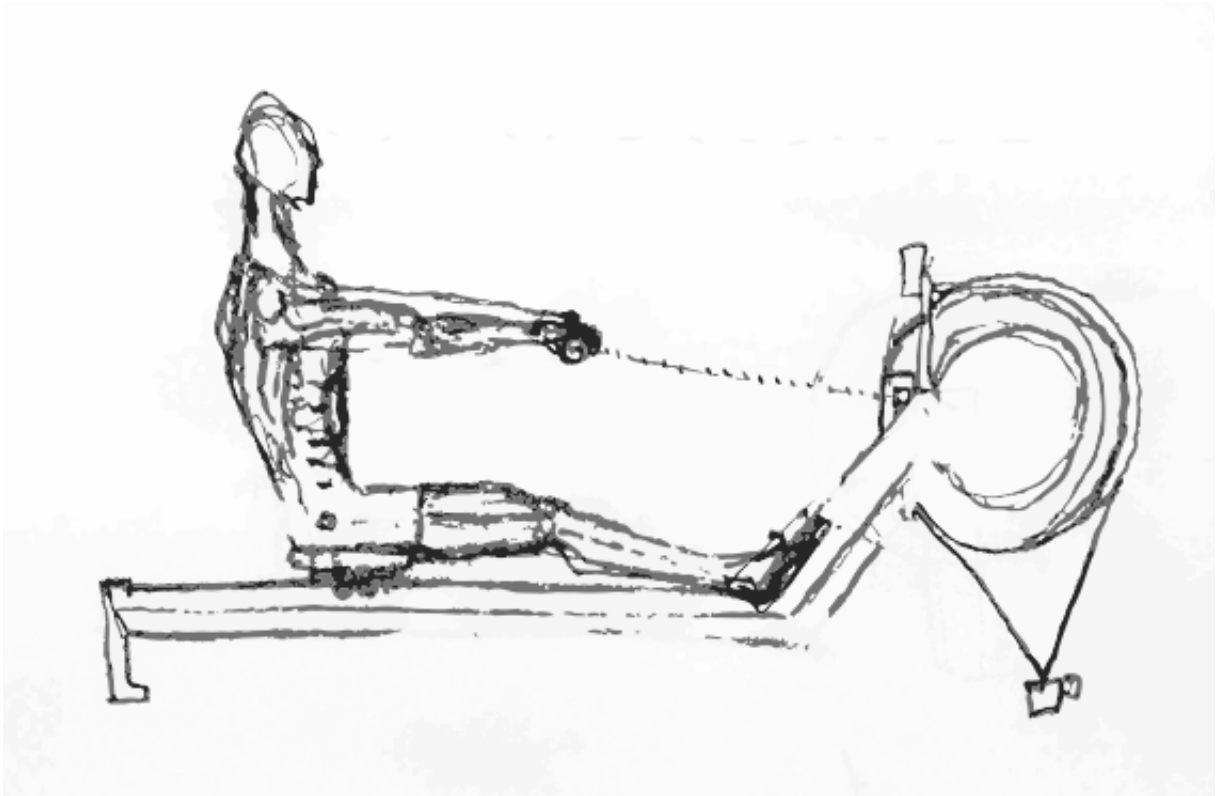
The legendary New Zealand pair of Hamish Bond and Eric Murray achieved some notoriety for allegedly rejecting strength training in their rowing training. However, in a 2018 interview on Rowperfect UK's Rowing Chat podcast, Eric Murray clarified several things about this training philosophy. First, that he had strength trained for 10-15 years before "eliminating" strength training from their rowing training. Second, that even when they "eliminated" it, Murray clarified that they really just removed heavy resistance training, and continued to train with bodyweight exercises, resistance bands, plyometrics, mobility exercises, and core training. Third, that the major reason for eliminating strength training was the massive increase (20-40km per day) in their on-water rowing training when they began training with coach Dick Tonks. Finally, he stated explicitly that he feels this approach would only work

for small boats, not for larger boats in which strength is more important. Far from being an indictment of strength training, this is a perfect example of an athlete investing in the long-term training process, building a great base of strength, and then making careful evaluations for which training modalities to focus on to yield the greatest return in performance at an elite level.

The Block Periodization System for Rowing

WE WILL NOW DISCUSS THE NUTS AND BOLTS of how to manage the four variables of volume, intensity, frequency, and specificity as part of an annual program to elicit the greatest benefit from each. The purpose of this manual is not to provide a cookie-cutter list of exercises to complete mindlessly, but rather to teach you how to program and effectively train yourself or your athletes. A thorough understanding of the four blocks of Block Periodization and what each of the blocks entail is essential to planning an annual training cycle to achieve the goal of peak performance. I will provide descriptions and examples of this block with the spring 2km-rower in mind. In the “Strength Training for Longer Races” chapter, I explain how to adjust this schedule to fit a distance racing focus. In “Strength Training for Masters,” I provide a detailed guide for training with a more variable competitive schedule.

I use the general annual structure of progressing from preparatory blocks to pre-competitive, and then competitive training, because it lines up nicely with most rowing competitive schedules and is very simple to manage. This allows the coach and athlete to focus on the effort and execution of training.



The Preparation Block

The annual plan begins with the Prep Block. This is the block of training furthest away from your competitive season, so if you are a spring 2km-rower, this block of training would begin your summer off-season training. The Prep Block is actually split into two sub-blocks, first General Prep and then Specific Prep.

The goal of both of these blocks is to build the muscular, aerobic, and technical base for peak performance to come later in the year. Overall, these blocks are characterized by higher volumes and lower intensities of work, with moderate frequency of training sessions, and low-to-moderate specificity of training.

The General Prep Block is the low specificity off-season. Training after a hard competitive season should use low intensity and higher volumes to facilitate recovery. Many athletes are

often carrying aches, pains, or minor injuries by the end of a competitive season, and it is crucial to long-term success to not carry injuries over from one season to the next. I encourage athletes to do more cross-training or even play another sport recreationally during the General Prep Block. If you spent all competitive season sweeping, and want to continue rowing, focus on sculling for this block of training. In the weight-room, we use this block to do a lot of unilateral work to restore muscular balance and focus more on building muscles neglected by hard, competitive, focused rowing training.

The Specific Prep Block is the moderate specificity off-season. For the spring 2km-rower, Specific Prep is the fall rowing season consisting of longer races. Even though we're training rowing and doing a few races, I still consider this the off-season because we are not yet focused on our primary goal of 2km performance. Moderate volume work at manageable intensities allows for plenty of opportunity to practice technique both on the water and in the weight-room, and improve muscular balance. The longer intervals of steady state rowing and cross-training work also increases the efficacy of the aerobic system to meet future training demands. The higher volume strength training work improves work capacity, muscular hypertrophy, and will enable greater strength and power outputs in later phases of training.

The Prep Blocks are vital to laying your foundation for the intense training to come in the Competitive Blocks. Heal from the competitive season, build a big aerobic base, increase your muscular strength across exercises and rep ranges, and improve muscular balance, and you will be well set up for future performance gains.

The Pre-Competitive Block

The Pre-Competitive Block begins 6-8 weeks before your first important race of the competitive season. We will train through the earlier races of the season, only planning a full taper-and-peak cycle for true peak performance at one or two regattas in a single season. For our spring 2km-rowers, we continue normal rowing and strength training through our

first three or four races of the season at lower level local or regional regattas. This allows us to get the most development out of our Prep Blocks, building our base before we transition to higher intensity performance work, and then maintain strength and power through our most important championship races.

The Pre-Competitive Block is characterized by less volume than the Specific Prep Block, but higher intensities and higher frequency, with the goal of transitioning between the base work and the performance work. In the Pre-Competitive Block, we gradually decrease volume while gradually increasing intensity, frequency, and specificity. A main focus of the Pre-Competitive Block is power development. The goal is to take the strength and muscle developed in the Prep Blocks and turn that into boat-moving peak power, while we continue to train power endurance through specific rowing training.

I typically recommend training the concentric portion of every main work lift with full explosive intent, or as fast as you can move the load. Remember from “Terms and Definitions” that the general rule for strength training is a two-count on the way down and a one-count on the way up. This is most important during the Pre-Competitive Block when we are training for power. The main work in this block tends to be explosive sets of low reps in the 60-75% range. This work will feel very easy if you are simply coasting through the reps, rather than lifting each rep with full explosive intent. I have a demonstration on my Youtube channel (link below) of full explosive intent in power training.

“Explosive Power for Rowing”: https://youtu.be/_QqUmB21V8E

The Competitive Block

The Competitive Block is where it all comes together for the main race season. The goal is simply maintenance of strength, power, and muscle mass so that all of the work you put in throughout the year comes together for peak performance. Rowers who stop strength training when their race season starts are strongest at the start of the season, when it matters least, and

weakest at the end of the season, when it matters most, so it's critical to have some approach to continuing strength training through the racing season!

To allow for plenty of recovery from hard rowing training and race performance, we use lower strength training volume and frequency. It is possible to maintain muscular strength and power while lowering frequency and volume, as long as intensity is kept relatively high. Strength training sessions during the Competitive Block are short and consist of working quickly up to approximately 85%1RM for a single low-rep set, then moving on to the next exercise, with a bit of muscular injury prevention work. There is much more detail on the training for this block in the “Writing a Program” chapter, including how to do a taper cycle.

Rejuvenation

While this block is often included in the Prep phrase, I feel that it merits a greater emphasis and special attention in its very own block. Rest is crucial in a training plan, but is often overlooked or ignored, especially by workaholic endurance athletes! I do not provide a structured program for at least two weeks following the last race of the competitive season, instead encouraging athletes to do activities that they personally enjoy, but may not get to do during the training year. This is referred to as “active rest,” and can be anything from hiking and biking to frisbee golf and ping pong. It is essential that an annual program include a physical and mental break from competitive sport to relax and heal, both mentally and physically, from the intensity of the competitive season before beginning the next training year. After this short period of active rest, athletes will feel more mentally and physically prepared to tackle the next off-season training block than if they went straight from racing to off-season training.

You should now have a thorough understanding of the individual demands of each block in a periodized program. The next issue is how to manage each of these blocks and to combine them together into an effective annual program.

The key to a periodized program is maintaining qualities of each block as you move on to

develop the next. When moving from one training block to the next, do not abandon all elements of the previous training block. We keep some endurance work from Prep Block in the Pre-Competitive and Competitive Blocks, and some higher intensity strength and power work in the Prep Blocks. This is how qualities are developed and maintained from each block to produce peak performance, the ultimate goal of block periodization. Although I refer to “maintaining” qualities, it may be better to think of it as “a secondary focus.” Here is an example of an annual plan for the spring 2km-rower with the rowing focus, primary focus, and secondary focus.

General Prep Block (summer)

- Rowing focus: General aerobic system
- Strength training (primary) focus: Hypertrophy/muscle balance
- Maintain (secondary focus): Strength

Specific Prep Block (fall)

- Rowing focus: Specific aerobic system
- Strength training (primary) focus: Strength
- Maintain (secondary focus): Hypertrophy/muscle balance

Pre-Competitive Block (winter)

- Rowing focus: Anaerobic system
- Strength training (primary) focus: Power
- Maintain (secondary focus): Strength

Competitive Block (spring)

- Rowing focus: Race performance
- Strength training (primary) focus: Race readiness
- Maintain (secondary focus): All qualities

Ready? In the next chapter, we take all this knowledge of the goals and methods of each block and start to put it together into an annual program.

Writing a Program

THE GOAL OF BLOCK PERIODIZATION is to develop and selectively maintain specific sport qualities while developing other specific sport qualities to ultimately attain peak performance. This section will explain this strategy of selective development, maintenance, and how it all comes together for peak performance on race day.

Step 1: Establish how many times a week you are willing and able to train, including strength training, cross-training, and rowing sessions. Honest evaluation is particularly important at this step, as this is the foundation of your training plan for the year. This number should be entirely realistic, not a goal or an optimistic number.

Step 2: Decide how these training sessions will break down by category--sport specific (rowing/erging practice times), cross-training, and strength training. The main concern when choosing from the below options is how strength training fits into the rest of your schedule. There is little evidence that one is markedly better than another from a performance standpoint, so just select the most sustainable option for your own schedule and desire.

2 Days Per Week	3 Days Per Week	4 Days Per Week
2 full-body sessions	3 full-body or upper/lower/full	Alternating upper/lower body
1-2 main work exercises, 1 upper and 1 lower, followed by assistance work for both upper and lower body	Either follow the full-body template from option #1, or do 1 session for upper body, 1 session for lower body, and 1 full-body session	This option is for off-season training only. Alternate upper body sessions with lower body sessions, 1 main work exercise followed by assistance work

Step 3: Plan your training blocks around your sport practice. First, block out the months when you will have scheduled water or erg practice sessions. A typical USA 2km-rower would have their season blocked out like so:

- Summer: Last championship race to start of fall season
- Fall: Start of fall season to last race of fall season
- Winter: Last race of fall season to first water practice of spring season
- Spring: First practice of spring season to last championship race

See the “Strength Training for Masters” chapter for a detailed description of setting up a program with more variable competitive goals.

Next, mark any scheduled races or other events in each block, as well as any holidays or other events that may preclude you from training normally. This is now the framework for your customized block periodization program.

Season	Approximate Dates	Block of Training	Length of Block
Summer	June	Rejuvenation	2-4 weeks
Summer	June to September	General Prep	12-16 weeks
Fall	September to January	Specific Prep	12-16 weeks
Winter	January to April	Pre-Competitive	8-12 weeks
Spring	April to June	Competitive	6-8 weeks

See: Appendix, Example of an Annual Plan

Step 4: It is very important to include some elements of previous training blocks in the current training block. Typically, I dedicate approximately two-thirds of an individual training session to the main focus of the block of training, and about one-third to maintenance of previous qualities. The exact math is less important than the core concept of continuing to train some qualities from previous training blocks only to maintain those qualities. This is how we build from one block to the next, maintaining previous qualities while developing new ones, to build to peak performance.

I typically use the main work of an individual session for the primary focus quality, and the assistance work for the maintenance quality. Remember to follow training session order of power-strength-hypertrophy from the “Terms and Definitions” section. For example, in the General Prep Block, hypertrophy is our focus quality, but we will do our strength maintenance work first to follow training session order.

In the table on page 37, I lay this out visually with suggested set and reps, and I provide examples of this in the sample programs at the end of the book. Follow the appropriate rest intervals for each objective from the “Terms and Definitions” chapter. These are simply suggested methods for reaching the total number of reps per exercise according to the intensity

parameters, and I encourage you to come up with your own workouts.

Note that all sets and reps listed are following a warm-up and progressively working up in weight. See the “Preparing to Train” chapter for a full description of a warm-up plan for strength training or rowing training. A proper warm-up is essential to reduce risk of injury, re-ingrain and practice the technique of the lift, and improve performance for strength or rowing training.

Step 5: Plan transitions between these training blocks.

Switching training focus abruptly is a great way to make athletes experience significant muscular soreness. Each new block of training represents a novel stimulus, which tends to increase immediate muscle soreness. To avoid hampering athletes with excessive soreness at practice the next morning (and irritating the rowing coach!), I plan a one-to-two-week transition block in between each block so that the athletes can adapt to the new focus and new intensity gradually.

Typically, I program a week of active rest and then a week of 50/50 training, where we introduce the new focus while continuing to work on the previous focus. The week of active rest is a great way to help the athletes come into each training block rested and aggressive, itching to train again, rather than worn-down from insufficient rest following the previous training block. This is also a convenient way to schedule some time off while still benefiting athletic development. Try to schedule a week of active rest during a low training period anyway (e.g. Thanksgiving, Christmas, final exams, etc.), then have a transition week when the athletes return to build momentum into your next block of training. During the transition week of training, approximately half of the training will be similar to the prior training block, and half will be training for the next block.

Remember to follow the training session order from “Terms and Definitions” to organize the session—power before strength, strength before hypertrophy—to maximize benefit from each quality. For example, when transitioning from the Specific Prep Block strength-and-hypertrophy focus to the Pre-Competitive Block of power development, the first half of the

Block	Focus	Sets/Reps	Maintenance	Sets/Reps
General Preparation	Hypertrophy	25-50 reps per exercise in the 60-75% intensity range. Examples: 5x10@60% 4x8@65% 6x5@70%	Strength	5-25 reps per exercise in the 75-90% intensity range. Examples: 1x5@87% 2x5@85% 5x5@80% 6x4@85%
NOTES:	Perform strength work before hypertrophy work, even though strength is the maintenance quality, to reduce risk of injury from lifting heavier weights under muscular fatigue. I typically decrease the volume of the strength work during the General Prep Block, working up to 1-3 sets of 5-8 reps, or 3-5 sets of 3-5 reps, to maintain base strength, then moving on to hypertrophy work for the focus quality. Check out the sample General Prep program at the end of the book.			
Specific Preparation	Strength	10-25 reps per exercise in the 75-90% intensity range. Examples: 3x5@80% 5x5@75% 5x3@82% 8x2@85%	Hypertrophy	30-50 reps per exercise in the 60-75% intensity range. Examples: 3x10@70% 5x10@60% 6x8@65% 7x5@70%
NOTES:	You can reduce the assistance work exercise volume and/or intensity slightly when strength is the focus quality. Compared to General Prep, do a bit more volume for the strength focus quality, then a bit less volume for the hypertrophy maintenance quality. Check out the sample Specific Prep program at the end of the book.			
Pre-Competitive	Power	8-15 reps per exercise in the 65-80% intensity range. Examples: 10x1@65% 6x2@75% 8x1@70% 5x3@75%	Strength	10-25 reps per exercise in the 75-90% intensity range. Examples: 5x5@75% 6x4@80% 4x6@75% 8x2@85%, etc.
NOTES:	Full explosive intent on each rep in the power focus work! I prefer to start with higher rep ranges on the strength maintenance work early in the block, gradually dropping the volume and increasing the intensity until close to the Competitive Block. This can be seen in the periodization picture in the last section with how volume drops as intensity increases. Early in this block I would suggest 15-25 total reps for strength maintenance, while later in the block, 10-15. Check out the sample Pre-Competitive program at the end of the book.			
Competitive	Rowing Performance		All	See Below
NOTES:	The goal of the Competitive Block is to maintain all the qualities you've worked hard to develop during the rest of the year, so that you are strong, powerful, and muscular for your most important races of the season. Strength training is low volume, concise, and focused on maintaining strength, power, and muscle and injury prevention. General session design is a bit of strength work and/or a bit of power work, then a bit of hypertrophy work focused on maintaining muscle mass and reducing muscular imbalances. 5-10 reps on strength and/or power exercises, and 2-3 sets of 10-15 reps on one circuit of hypertrophy exercises. Check out the sample Competitive Block program at the end of the book.			

session is done with a power focus and the second half of the session for strength and hypertrophy.

Now you have a periodized annual program with four distinct training blocks, each of which has its own goal or objective that builds toward success in your competitive season, including transition blocks in place to progress smoothly from one training block to the next. This alone is a far more thorough approach to training than many of your competitors will be taking, but why stop here? Now, let's plan the competitive season race taper to go the next step further in maximizing strength training benefit.

Step 6: The Taper

Competitive opportunities in rowing are fairly infrequent compared to other sports. When I coached high school lacrosse, we would play as many as 20 games in a 12-week season! Competitions require preparation before, travel time to and from, and extra recovery time after, so training has to accommodate the racing schedule to maximize performance and avoid overtraining. In a sport with frequent competition, you have to be “game-ready” for much of the week, which restricts long-term improvement. In rowing, you can program more complex and more extreme training cycles, as long as your program tapers to facilitate pre-race recovery. While immediate performance may decrease during an especially difficult training cycle, a well-programmed taper cycle can vault performance beyond previous levels once fatigue is removed and full recovery can occur.

This is the central difference between overtraining, which is a mistake by the coach or athlete, and overreaching, which is an intentional strategy. This is discussed more in the “Over-Training or Under-Recovering” chapter. A taper cycle progresses from normal training, to intentional short-term overreaching, followed by rest to allow fatigue to dissipate and supercompensation to occur.

A rower simply taking time off from strength training during the competitive race season results in that rower being weakest for the end-of-season championship races when it matters most. The purpose of the taper is to maintain strength and power while allowing for full re-

covery for race day. We do this through low volume, moderate intensity power work, with full explosive intent on every rep, and select high intensity, low volume strength-focused sessions, with a consistent focus on specific exercises for reducing risk of injury. See the previous chapter if you need a refresher on why full explosive intent is so key for power work.

Many athletes simply take time off from strength training before competitions. Novice rowers are still at the point where their technique, rowing, and racing ability, rather than their fitness, limits their speed and race performance. As rowers become more advanced, technique and racing experience becomes less of a competitive limitation, and more attention to the taper is required to deliver the best physical fitness for the best race performance.

You can go a long way in strength training for rowing using the basic “day off” taper. Continue to train in Competitive Block style for maintenance of strength, power, and muscle mass, then, during the week of a race, do an easier strength training session on Day 1, omit Day 2, race, and then get back to training the next week. I recommend that athletes do the dynamic warmup on Day 2, or from the hotel room if the race requires traveling, to stay loose and feel ready to race. I’ve written an example of this minor taper approach in the Sample Programs section.

More advanced athletes will require a more advanced approach to maintaining strength, power, and muscle mass, and being able to express all of that on race day. More advanced athletes are training in the weight-room and on the water with such intensity and volume that their performance can be dampened for more than a week following a tough workout. This is where the real, major taper cycle comes into play.

When planning a taper, we rely on the concept of residuals to get us to a competition strong and well recovered. Residuals are the prolonged effect of strength training (not aerobic or anaerobic fitness though, those windows are much shorter) that maintains muscular strength for up to 30 days. According to this theory, if the athlete is highly proficient in the exercise and therefore does not suffer motor pattern breakdown, one could stop strength training entirely for 30 days, walk back into the weight room, and perform roughly at the weights they were

capable of before. While it is unlikely that many athletes are proficient enough in each individual lift to truly accomplish this, the concept is useful for planning a taper. The main takeaway from the research on residuals is the suggestion to have a heavy strength training session at least once every 30 days to just maintain muscular strength.

I program the taper so that the athlete has an 85%1RM intensity strength training session once every 14-21 days. I refer to this as the “residual timer.” While this window is shorter than what research suggests is truly necessary, I have found it to be better for the majority of athletes rather than stretching it to the full 30 days. Work backwards from main race dates to program higher intensity sessions as “stimulus sessions” to reset the residual timer, and lower volume, lower intensity (65-70% of 1RM) power sessions as maintenance sessions to stretch the gap between intensity sessions. These lighter, shorter sessions also help keep technique fresh, allowing for full expression of strength during the heavier stimulus sessions.

Below is an example spring 2k schedule.

- Week 3: Minor sprint race
- Week 5: Minor sprint race
- Week 6: Local intercollegiate regatta
- Week 7: Conference Championship
- Week 8: Regional Championship
- Week 9: Major regional race
- Week 10: Major national race
- Week 12: National Championship

For the purposes of the taper, ignore all races before Week 7. Athletes should be able to perform well in minor early-season races with a small amount of fatigue. Remember, the main goal of strength training during the competitive season is simply to maintain strength,

power, and muscle mass, so we avoid overly difficult and fatiguing strength training during the Competitive Block. Performance is most important in the regional and qualifying regattas after Week 7, so extra recovery time is programmed for those races. Here is one way to plan the training weeks to accomplish this based off the example dates above:

- Weeks 1-6: Normal Competitive Block training for maintenance of strength, power, and muscle mass.
- Week 7: Low volume, power-only sessions, limited assistance work (specific injury prevention only).
- Week 8: Low volume, power-only sessions, limited assistance work (injury prevention only).
- Week 9: This marks 14 days from any intensities over 85%, so to avoid a decline in maximal strength, hit a heavy session here to re-start the “residual timer.”
- Week 10: Low volume, power-only sessions, limited assistance work (injury prevention only).
- Week 11-12: Recovery/travel Monday and Tuesday, then hit one high intensity strength session on Thursday or Friday. This will be the final 85%1RM session before the Week 12 National Championship, re-starting the residual timer once again with no more than 14 days away from high intensity training. The week leading up to Nationals will either be off for travel, or easy, very low volume, low intensity power-only sessions to facilitate full recovery.

Again, the whole point of the taper is to keep the athlete just as strong, powerful, and muscular as they were when they started the competitive season, while allowing for recovery so that fatigue is no longer masking fitness. Thus, the athletes are faster and more powerful than when the season began because full recovery has taken place, no fatigue is present, and

all of the hard rowing, sprint work, and technique improvements can pay off on race day. Ed McNeely suggests in *Rowing Faster* (2011) that a properly programmed taper can improve performance by 3-11% via nervous, muscular, and hormone system adaptations. Some personal experimentation will be required to dial in exactly how you or your athletes will need to taper, as the process can vary by experience, training age, and training volume.

I agree with McNeely's general guide to planning the taper below, adapted from Chapter 19 of *Rowing Faster* (2011):

Training Volume (hrs/wk)	Total Taper Duration
6-10	7 days
10-15	14 days
15+	21 days

Note that the numbers are **total** taper duration. The longer the taper, the more gradual it can be. If training 15 hours a week, the taper could start 3 weeks out with a slight reduction in training volume, followed by another reduction the next week, then a final reduction the week before the race. It does not mean cut all training 21 days out and coast to race day.

Now you know how to build the structure of a periodized training program, beginning with the General Preparation Block all the way to the championship races with transition blocks and tapers in between. In the next section, we cover how to select exercises to fit the goals of each session, block of training, and the ultimate goal of building better rowers.

Remember to check out the sample programs at the end of the book to see how all of these concepts come together in examples of each block of training, including a taper cycle.

Preparing to Train: The Warmup

BEFORE WE GET INTO THE EXERCISES, we first prepare to train. This full-body warmup is a series of exercises designed to stretch and activate target muscles important to rowing performance and injury reduction. You can use this warmup before rowing, erging, and strength training, as well as as its own mini-workout requiring zero equipment.

Warming up is an important part of maximizing performance and reducing injuries in both the short-term and long-term. A good full-body warmup helps prepare your body to execute the workout as effectively as possible. It is especially important for rowers who practice or train first thing in the morning to get everything in the body firing and ready to perform. The important areas for rowing are getting the glutes activated, hip flexors stretched, core muscles transmitting power effectively from lower body to upper body, and firming up the shoulder girdle for a great connection to the blade. This entire sequence should take no more than 10-15 minutes, and I think you'll find it a valuable part of your training.

You can watch a video demonstration of this full-body warmup on my Youtube channel at this link: <https://youtu.be/ZxFMk46VKsc>



1. 3-5 minutes of low stress aerobic activity

Before putting strain on the muscles, increase your core body temperature with 3-5 minutes of jump rope, jogging, stationary cycling, or light erging. You should have a light sweat and slightly elevated heart rate by the end of the 3-5 minutes.

2. 3-Way Ankle Stretch, 10 reps each position

3-way ankle stretch for better compression at the catch and prevention against a common source of knee pain.

3. 3-Way Hip Opener, 10 reps each position

3-way hip opener to stretch the muscles of the groin, hip flexors, and glutes. Hip flexor tightness is very common in rowing and is a main contributor to low back pain and poor body angle on the recovery. Loosening your hip flexors will also allow your glutes to contract more forcefully, resulting in a better braced torso and more power from the legs to the arms.

4. Glute Activation Triplet, 10 reps each position

Pendulum hip extension, fire hydrant, hip thrust. Three glute activation exercises to get the glutes firing and stretch the hip flexors through an active range of motion.

5. Full Tension Plank, 1-2 sets of 15 seconds

Do a full-tension plank to re-ingrain the bracing pattern and activate the abdominal muscles.

6. Band Pullaparts, Face Pulls (2 sets of 20 reps), or YWT Raises (10 reps each position)

Perform one of these exercises with a band, dumbbells, small weight plates, or bodyweight to prepare the postural muscles of the rhomboids, posterior deltoids, and trapezius for a strong stroke and good connection with the blade. These muscles balance the internal rotators of the shoulder and can help prevent the rowing hunchback posture.

7. Pushup Plus, 1-2 sets of 10-12 reps

The pushup plus is a great exercise for the pectoralis muscles and triceps as well as the serratus anterior. The serratus anterior is an important muscle in rowing and can help reduce risk of rib stress injury, a common injury in rowing. The pushup plus can also be scaled down and done from the knees.

8. Deep Squat Progression, 10 reps

Finally, put it all together with the deep squat progression. This exercise stretches the hamstrings and back, then the groin, then activates the thoracic spine muscles of the mid back, and ends with a squat. This is a great exercise to test any of the above muscles as well. If the deep squat reveals tightness or pain in the hip flexors, go back to #3 and work through the hip opener again. If you feel shoulder impingement going overhead, go back to #6 and continue warming up the upper back and shoulders, or add some thoracic spine foam rolling.

The Exercises: What, Why, and How

YOU HAVE YOUR PERIODIZED PLAN, you've done your full-body warmup, and you're ready to train. In this chapter, we'll discuss how to select exercises for the goals of improving rowing performance, reducing risk of injury, and ultimately building better rowers.

Rowing is a very effective way to build strength and muscle in the quadriceps, back, and biceps muscles. We use exercises such as the squat, deadlift, and rowing variations to continue to develop these muscles to improve rowing performance. However, rowing also fails to develop many muscles and movement patterns. Over time, these neglected areas can cause pains, injuries, and inefficiencies that detract from performance, health, and longevity in the sport, as well as quality of life during and after sport, so we use a variety of exercises to develop the muscles that rowing neglects.

Performance improvement gets all of the glory, but reducing risk of injury is an even more important reason to strength train for rowing. Does it matter how strong you are, how fast you are, how fit you are, how good your rowing technique is, or how much better than your competition you are, if you're too hurt to fully express that ability on race day? It will always be a goal of strength training for rowing to develop physical qualities that make boats move fast. In addition, we also do a lot of work to develop areas of the body that rowing alone fails

to develop, to improve muscular balance, facilitate recovery from rowing training, and reduce risk of injury. This allows athletes to train more consistently and more productively, supporting the ultimate goal of building better rowers.

Below is a table outlining areas of common injury in rowing, common causes of injury, common strength training solutions, and further notes. After this, we discuss how to combine exercises for rowing performance and reducing injury risk into a single strength training session, and then some additional notes on safety when strength training.

I consider my role as strength coach to be separate from, though mutually dependent on, rowing coaches and physical therapists. My job is to improve general sport qualities, such as strength, power, and muscle mass, and to use best practices to reduce general risk of common injuries in rowing. It is the rowing coach's job to take the athletic potential we develop through strength training, and turn it into technical expression and specific rowing performance. It is the job of the physical therapist (or other qualified medical professional) to diagnose, treat, and rehabilitate specific injuries.

The following section is in line with this philosophy as general best practices for reducing risk of injury. It is not meant as medical advice or specific diagnosis, and you should seek the advice of a medical professional if you suspect that you have an injury. Also, all of the following information about strength training will not help you if you cannot, or do not, perform the exercises correctly. If you do not have a coach or trainer working with you, I recommend at least a few introductory sessions with a qualified personal trainer to learn the basics of the exercises in this program. Performing exercises incorrectly can lead to injury, as well as failure to fully reap the benefits of that exercise. It is of the utmost importance that all exercises are performed safely and correctly at all times. Do not sacrifice technique for more weight or reps at any point in your training.

Much like the “Terms and Definitions” section, the names of specific muscles and body parts may not be already in your vocabulary. Resources such as Wikipedia and ExRx.net offer helpful illustrations of muscle actions and basic anatomy. Additionally, the free exercise index

on my website provides video demonstrations of all exercises in this book and in my training programs, as well as mobility demonstrations.

Body part where pain and/or injury can occur	Common cause	Common solutions	Notes
Shoulders & Elbows	Overdeveloped internal rotators and underdeveloped external rotators	Strengthen external rotators of the shoulder: posterior deltoid, teres minor, infraspinatus. Stretch/massage internal rotators: subscapularis, teres major, latissimus dorsi	Tight pectoralis muscles resulting from thoracic kyphosis can also affect shoulder health, potentially causing pain in the shoulder and upper arm
Elbows & Wrists	Overdeveloped forearm muscles from gripping the oar and feathering	Self-massage on forearm flexors and extensors. Finger extension exercises. Forearm strengthening to improve grip on oar	Technique when gripping and feathering should be the first consideration, then strength training interventions
Mid Back (Thoracic Spine) See chapter "Mobility for Rowers"	Overdeveloped internal rotators and inflexible thoracic spine (kyphosis)	Strengthen external rotators of the shoulder: posterior deltoid, teres minor, infraspinatus. Stretch/foam roll thoracic spine. Assess hip mobility as there is interplay between hip and spine function	Major postural problems can result from thoracic spine dysfunction in rowing. This can cause poor performance through inefficient technique, as well as specific injury. Rib stress injuries are closely related to thoracic spine function
Rib cage	Rib stress injury	Multi-faceted injury. Evaluate thoracic spine, lumbar spine, and hip function, as well as technique, training volume, and load	See "Appendix" for my lengthy guide to rib stress injuries, available on my website

Body part where pain and/or injury can occur	Common cause	Common solutions	Notes
Upper Back & Neck (Cervical Spine)	Rounded thoracic spine can lead to forward head position resulting in neck pain	Strengthen external rotators of the shoulder: posterior deltoid, teres minor, infraspinatus. Stretch/foam roll thoracic spine. Avoid forward head posture	Forward head position can put pressure on cervical intervertebral discs, potentially causing pain and herniation
Glutes and low back (Hip and Lumbar Spine) See chapter "Mobility for Rowers"	Tight/underdeveloped glute muscles and tight hip flexor muscles can cause anterior pelvic tilt, causing lumbar lordosis (swayback posture). Muscular low back problems are often the result of other problems in the glutes/hip	Stretch, foam roll, and strengthen glute muscles and piriformis, stretch and foam roll hip flexors (rectus femoris, tensor fasciae latae), strengthen abdominal muscles	Anterior pelvic tilt can put pressure on lumbar intervertebral discs, potentially causing pain, herniation, sciatica and sciatica-like symptoms, and/or snapping hip syndrome
Hip and knee See chapter "Mobility for Rowers"	Overdeveloped quadriceps and underdeveloped glute and hamstring muscles can cause knee and low back pain	Strengthen hamstrings and glute muscles, stretch hip flexors (rectus femoris, tensor fasciae latae)	Bilateral imbalances can cause uneven gait that results in hip, ankle, and back pain. Hip flexor tightness is a major culprit of low back pain
Ankle See chapter "Mobility for Rowers"	Tight calves and restricted ankle mobility shows up in the rower and in the boat as poor catch compression and often ankle/knee pain	Stretch and mobilize the calves and ankles. Strengthen the calves with single-leg calf raises with a 1-2 second hold at the top	Often overlooked, some lacrosse/tennis ball rolling for the plantar fascia is also worth adding to a routine

Below is an exercise bank of how to strengthen the above muscle groups. This is not intended to be exhaustive, and I encourage you to come up with your own based on your available equipment, training schedule, and personal preferences. I have video demonstrations of all of these exercises on my website and Youtube channel.

Movement Category	Target Muscles	Suggested Exercises
Horizontal Press	Triceps brachii, pectoralis major, deltoids	Bench press, incline bench press, floor press, dumbbell bench press, alternating dumbbell bench press, pushups
Vertical Press	Deltoids, triceps brachii, trapezius	Barbell overhead press, dumbbell overhead press, push press, 1/2-kneeling overhead press
Horizontal Pull	Trapezius, rhomboids, latissimus dorsi, biceps brachii	Dumbbell or barbell row variations, batwing row, inverted bodyweight row, Pendlay row
Vertical Pull	Trapezius, rhomboids, latissimus dorsi, biceps brachii	Chin-up or pull-up, pulldowns. Seated chin-ups and banded chin-ups can be used for easier versions.
Shoulder Assistance	Posterior deltoid, teres minor, trapezius, infraspinatus	Facepulls, Y-W-T raises, band/cable pullaparts, band/cable external rotation
Compound Hinge	Hamstrings, gluteus muscles, erector spinae, latissimus dorsi, trapezius	Barbell deadlift, elevated barbell deadlift, trap bar deadlift, barbell or dumbbell Romanian deadlift
Hinge Assistance	Hamstrings, gluteus muscles, erector spinae	Barbell or dumbbell Romanian deadlift, glute-ham raise, kettlebell swing, isolation exercises eg. "bird dogs," pendulum hip extension, "fire hydrants," hip thrusts, glute bridges

Movement Category	Target Muscles	Suggested Exercises
Compound Squat	Quadriceps muscles (rectus femoris, vastus lateralis, intermedius, and medialis oblique), as well as hamstrings, gluteus muscles, and trunk muscles	Barbell back squat, barbell front squat, goblet squat, bodyweight squat
Squat Assistance	Quadriceps muscles (rectus femoris, vastus lateralis, intermedius, and medialis oblique), hamstrings and gluteus muscles	Lunge, reverse lunge, step-up, rear foot elevated split squat, bodyweight squat
Core	Rectus abdominis, abdominal obliques	Plank variations, Pallof press, “dead bug” variations, anti-extension abdominal exercises

Training Session Design

A strength training program must include at least a barbell, array of weight plates, and a power rack or squat stand. This equipment is necessary to be able to safely and effectively load and perform foundational exercises of the squat, deadlift, and overhead press. Most gyms, and even many home gyms now, will have much more, including dumbbells, trap or hex bars, cables or bands, TRX or suspension trainer, and kettlebells. Bodyweight exercises are great, and are a staple of my training programs, but athletes beyond the novice level of strength training will need some form of external resistance to provide enough of a challenge to develop necessary qualities of strength training.

If dumbbells or cables are not available, I highly recommend investing in exercise bands of varying tensions. These bands can be used for horizontal and vertical pulling exercises, shoulder external rotation, dozens of isolation exercises, and abdominal exercises, and are a cost-and-space effective option. They are also portable and can make for a great “on-the-go” workout while traveling.

I encourage each coach or athlete to develop an exercise bank similar to the one I have provided above that reflects individual needs and equipment availability. I typically create categories of movements, as outlined above, and then fill in the categories with the available equipment and exercises. I then use templates in my sample programs to go from movement categories to specific exercises, based on the available equipment and other training session design parameters. Then, I use the tables from Step 4 of “Writing a Program” to fill in the details for each exercise. This increases the efficiency of writing programs, which allows me to focus more on instruction and execution of training.

Following the training session order of power-strength-hypertrophy, each session (after the warmup) will be organized from greatest stressor to least stressor. The easiest way to think about stressors is to go from “uses many muscle groups,” which would be a greater stressor, to “uses few muscle groups,” which would be the least stressor.

For example, below is the structure of a lower body session for the General Prep Block, followed by the detailed training session according to my specifics of athlete ability and available equipment.

Structure

- Warmup: See chapter “Preparing to Train”
- Main work: Compound squat, strength maintenance
- Assistance work: Compound hinge, hypertrophy focus
- Assistance work: Squat assistance, hypertrophy focus
- Assistance work: Core exercise supersetted with shoulder assistance exercise, hypertrophy focus

Specifics

- Warmup: See chapter “Preparing to Train”
- Main work: Front Squat, 5x5@75%, 3 mins rest

- Assistance work: Romanian Deadlift, 4x10@70%, 2 mins rest
- Assistance work: Single-leg squat, 4x10@70%, 2 mins rest
- Assistance work: Pallof Press (each side) supersetted with cable face pulls, 3x15, no rest

The session begins with the most compound exercise, the front squat, which uses the quadriceps, hamstrings, glutes, abdominals, and upper-back muscles, and ends with the least compound exercise, an abdominal exercise and an isolation exercise for shoulder external rotation. The session begins with strength work and is followed by hypertrophy work, according to the power-strength-hypertrophy training session order. This is the basic template for all training sessions--warm-up, 1-2 main work compound exercises for the focus/maintenance objective (depending on the block and if you are doing full body or upper/lower sessions), 2-4 assistance exercises that support the main work or maintenance focus, then 1-3 exercises done for reducing risk of injury.

See the sample programs at the end for 4-week examples of every block of training following this system of annual structure, individual session structure, categories of movements, banks of exercise and equipment availability, and then sets, reps, intensity, and rest.

A few more notes on safety in the weight-room:

A critical, often-neglected part of the warmup is the **gradual progression of working up in weight**. I advise athletes to always start with the empty bar for 5-10 reps, then take at least 3-5 low-rep sets to work up to the working weight of the day. This will result in better performance and decreased risk of injury compared to going straight from the empty bar to working weight.

A **lifting belt** is something many athletes choose to use, but many do not use the belt correctly. Use of lifting belts has nothing to do with safety, as is often claimed. If an athlete

knows how to use the belt properly, it can increase abdominal activation and allow them to lift a greater weight. However, many people do not use belts correctly. A lifting belt is by no means a requirement to lifting heavier weights, so if you are unsure of how to use one, either seek instruction or go without it. The mere presence of a lifting belt does not make an exercise any safer. Lifting belts exist to help the athlete lift more weight; good technique is what helps the athlete lift safely.

Spotters should be used for just about every exercise in the weight-room. I operate on the rule that no athlete should ever get hurt in the weight-room, and spotters are a big part of sticking to that. Compound barbell exercises of the squat, bench press, incline press, and even the deadlift should be spotted by at least one partner. For example, athletes should have someone handing off the bar on bench presses with clear communication to prevent the bar from slipping during transition from the rack to the athlete. I have seen athletes pass out on deadlifts and fall backwards, bringing the weight down on top of them and potentially injuring others around them. There should always be a spotter standing behind the lifter when deadlifting to prevent this.

Safety collars to prevent weight from sliding off of a barbell should be used on every barbell lift, including warm-up lifts. Sudden shifts in weight balance can cause injury to the lifter and nearby lifters.

It is everyone's responsibility to make sure that the **barbell is loaded correctly** for the lifter. Many times, a miscommunication on plate loading can cause a bar to tip, which can cause injury to the lifter and those in the nearby area.

Cell phone use in the weight-room should be minimized, and banned entirely for those spotting a lifter. Full attention and focus is required to maximize benefit and safety from strength training. This will also likely improve the efficiency of your training sessions!

Wrist straps are a useful grip aid tool for rowers with tired forearms and beat-up hands from rowing training. Used on exercises like deadlifts and rows, wrist straps help keep the emphasis of the exercise on the target body parts, rather than the grip or pain tolerance of the

hands.

Rowers and coaches should be aware of **calluses and bleeding** on equipment, and take proper sanitary measures to minimize risk from pathogens.

Strength Training for Longer Races

I HAVE PROVIDED MOST EXAMPLES SPECIFIC to the 2km-focused rower, because the periodization principles are the same for a rower whose competitive focus is longer distances. There isn't enough training time to run two full, productive annual training cycles together in one year, so competitive rowers will have to choose one main season or distance as their most competitive one for peak performance. A rower focused on the endurance races can certainly adapt the block periodization system to their training. Strong legs, strong back, and healthy body are still a priority in strength training, in addition to exercises to develop muscles and movements that rowing neglects, to reduce risk of injury. However, there are a few adjustments to make to accommodate a more endurance-focused training style.

First, make sure to adjust your annual plan from the spring 2km-focused template to one that accounts for your own training timeline and competitive goals. In the USA, most of the main competitive longer distance races happen during the fall season, with the sprint races during the spring. The structure for an annual, fall-focused training plan is below.

General Prep Block (winter)

- Strength training (primary) focus: Base strength/hypertrophy
- Maintain (secondary focus): Strength
- Rowing focus: General aerobic and some anaerobic conditioning

Specific Prep Block (spring)

- Strength training (primary) focus: Strength
- Maintain (secondary focus): Base-building/hypertrophy
- Rowing focus: Specific aerobic conditioning

Pre-Competitive Block (summer)

- Strength training (primary) focus: Power
- Maintain (secondary focus): Strength
- Rowing focus: Specific aerobic conditioning

Competitive Block (fall)

- Rowing focus: Race performance
- Maintain (secondary focus): Strength, power, hypertrophy

The concepts of each block and transitions between blocks still applies just the same between distance and sprint rowers. Distance athletes may wish to employ slightly lower volume of strength training to accommodate a higher volume of rowing training. While the overall importance of endurance versus power shifts much more toward the endurance side of the spectrum, strength, power, and muscle mass are still important factors. Because your rowing training will likely be higher volume and lower intensity to train for more on-water endurance, your strength training should actually be further toward the strength side of the spectrum. The Pre-Competitive Block would therefore be slightly more strength focused and slightly less power focused, concentrating more on the 75-85% intensity range and less on the 60-75% intensity range. This stays consistent with the top-down endurance approach while adjusting strength training to accommodate higher volume water and ergometer training. This concept is also commonly referred to as “polarized training,” which means spending a great majority of training time at a sub-maximal intensity level, then performing the other

portion of training above race pace at circa-maximal intensities.

For the endurance rowers who might have a hard time making this mental shift from weight-room endurance training, consider this. How many strokes a week do you take in training preparing for a 6k+? If rowing training is so focused on longer pieces and endurance, exactly how many reps would you have to do in the weight-room to see carryover to rowing endurance? With approximately 600 strokes in a 6k piece, do you do three sets of 200 in the weight-room to build endurance for this? My philosophy is that it is much more effective to train for strength and injury resilience in the weight-room, aiming for a downstream effect on endurance, and leave the water and the erg to developing endurance specific to your sport.

The taper for an endurance race is also shorter in length, since distance racing relies more on aerobic system endurance and less on anaerobic power than a 2k race does. Aerobic fitness has a much shorter residual than strength and is more fatigue-resistant, which means it can withstand greater training volumes and levels before seeing performance decrements. A taper for the endurance athlete should be no more than 14 days, and likely more like 5-7 days for the athlete training 10-15 hours a week. Strength training should be low-volume strength maintenance during the competitive season anyway, so this would simply mean scheduling the last strength-training session about 7-10 days before the major race, allowing strength to rebound for full recovery.

Even though the performance effects of strength training may be less pronounced in long distance racing, a year-round approach to strength training is still vital for long-term performance and injury resilience. If anything, a higher volume of rowing training on-water or on-erg to prepare for endurance racing means a higher injury risk from overuse and imbalance without a sound strength training approach. Keep your strength and power training in the weight-room short and relatively low volume, build up your muscular balance and movement quality through assistance work, and enjoy the results of your training!

Strength Training for Lightweights

THERE IS A COMMON MISCONCEPTION in many weight-class sports that lighter is always better. This is not always the case, especially for younger rowers. I would generally encourage a younger athlete of high school and early college-age to row lightweight for no longer than it is comfortable to maintain that weight. At the point where calorie restriction and other weight-cutting measures are necessary, it becomes detrimental to performance of both the short and long-term to continue trying to hold a light bodyweight. Restricting calories below what is necessary to recover from strenuous exercise can lead to overtraining, covered at length in a later chapter.

Additionally, maintaining a lighter bodyweight can decrease long-term potential. Through the top-down endurance approach, increasing strength and maximum force potential also increases endurance. If a lightweight rower is avoiding strength training to avoid putting on muscle mass to avoid growing out of the lightweight class, they are also reducing their maximum force potential and maximum endurance as well. I think that it is absolutely detrimental to both long-term sport performance and health for youth or high school athletes to undergo caloric restriction to make a weight class. Unless the athlete can maintain lightweight class standing without calorie restriction, I would much rather see high school athletes take advantage of that prime growing window, go openweight, and go on to be healthy college rowers

who reach their full potential.

However, the point of this chapter isn't to scare you off of lightweight rowing. Assuming you're a healthy lightweight rower who can safely maintain your bodyweight in a way that is beneficial for short and long-term performance, here are some adaptations to take in your strength training to become the best lightweight you can be.

Aerobic fitness is more important than muscular hypertrophy. Lightweights will still want to develop some hypertrophy to fill out their weight class, because greater muscle size yields greater power, but training priority is solidly on rowing and erging technique and aerobic fitness. Use the time in the Prep Blocks to dial in your technique and aerobic fitness, as these will be the greatest determinants of your race performance, and stay on the lower end of my recommended training frequency and volume.

Peak power, the highest wattage you are capable of pulling, is highly important, so seek to maximize peak power training over pure strength training in Specific Prep as well as in the Pre-Competitive Block. Peak power raises the ceiling for your performance and will make sustaining lower levels of power easier. Peak power is also critical for starts and sprints, and because many lightweights avoid strength training for fear of increased body mass, this is an area where you can really get a competitive advantage.

You may need to reduce your strength training volume even more in the Competitive Block, especially if you are doing any weight-cutting measures to make your weigh-in on race day. Seek the minimum effective dose of volume to still maintain strength and peak power. As few as 2-3 sets of 2-3 reps per main work exercise around 75-85% of your 1RM, combined with some explosive work such as kettlebell swings, jumps, or medicine ball throws, can be enough to maintain your strength, power, and muscle mass through race season.

Remember, strength training has many performance benefits beyond a faster race time. Lightweight rowers who avoid strength training to maintain a weight class are likely to develop muscular imbalances that hinder performance and can cause short or long-term injury. If you have to sacrifice your physical health and muscular ability to maintain lightweight status,

you should not be a lightweight rower. Balanced muscle groups will make you a healthier rower, even if they don't contribute to immediate performance improvement.

Strength Training for Coxswains

I WOULDN'T BE A STRENGTH COACH if I didn't believe that strength training can be beneficial for everyone, coxswains no exception.

I do think that coxswains participating in team strength training workouts can be beneficial for them individually, as well as for their relationship with the rowers. The weight-room can be a great opportunity to be more of a part of the team without having to maintain traditional responsibility roles, providing a refreshing change-of-pace from the usual practice hierarchy, and allowing coxswains to interact differently with each other and their teammates. However, I also understand that differences between rowers and coxswains in competitive mindset, personal motivations, and individual relationships can create a distraction in the weight-room and detract from the team training experience.

Whether or not coxswains in your program physically train with the rowers should be considered in a case-by-case scenario, as long as you do make time to consider it. Many coaches seem to simply overlook coxswains when it comes to physical fitness. Although it isn't strictly necessary for their performance, there are myriad benefits to strength training for all people for physical and mental health, weight management, and more. I'd like to use this chapter to provide some recommendations for how you might include coxswains in strength training if both parties are interested in doing so.



First, make sure to provide instruction for coxswains just like for rowers. It is still important that they train safely and effectively to maximize benefit from training and minimize risk of injury. I start my coxswains at the bottom of my movement progression just like with rowers, and work up from there in difficulty as their motivation and ability permits.

If you do your strength training at the boathouse using bands, bodyweight, and free weights in a circuit-style setting as many do, there's no need to have the coxswains loiter off to the side while the rowers work out. Coxswains can be included in circuit-style training just as easily as rowers. If you do your training in a large weight-room with multiple power racks or platforms available, the best way to start may be to have all the coxswains together at one station. I typically group rowers by height anyway to avoid making numerous equipment adjustments, and coxswains tend to be close in height. This will also allow coxswains to be proximal to, but not directly among, the rowers and may facilitate more coxswain-to-coxswain team bonding. I have also found that rowers appreciate seeing coxswains "getting after it" and sharing in some of the same physical struggle as the rowers.

Coxswains tend to be more comfortable self-directing than rowers, perhaps a product of their personality or by virtue of their training and position on the team. Once I am confident that they understand the basic movements of strength training, I offer them the choice of following the rowers' strength training program or customizing their own. I provide the program skeleton structure below and then am available for further help as they need it. I also write up an exercise bank with a list of the available exercises for our equipment corresponding with each category. For example, they can look at "horizontal row" and pick from our available options of dumbbell row, seated cable row, x-band row, etc.

- A. Team Warm-Up
 - B. Any Squat: 15 total reps*
 - C1. Any Deadlift: 15 total reps
 - C2. Horizontal Row: 30 total reps**
 - D1. Dumbbell Bench or Press: 30 total reps
 - D2. Vertical Pull: 30 total reps
 - E. Anything else you want to add
- * Eg. 5 sets of 3, 3 sets of 5, 8-5-2, etc.
- ** Eg. 3 sets of 10, 4x8, 2x15, etc.

This allows them to self-select their training intensity and exercise choices. There is nothing wrong with following the rowers' periodization plan, but since they don't share the rowers' performance goals or volume of training, there is also nothing wrong with freestyling and adding some training variety instead. Ultimately, the goal is simply to train responsibly in a way that is personally enjoyable and beneficial, while contributing to the team training environment.

Strength Training for Masters

MASTERS ROWING CAN MEAN A LOT OF DIFFERENT THINGS. It is a much more diverse group than junior and collegiate rowing in terms of training methods, frequency and length of competition, training history, and more. There are ultra-competitive masters rowers who compete frequently at regattas of all different distances around the globe, recreational masters rowers who took to the sport and race locally a few times a year, and everything in between.

Regardless of age, experience, gender, and competitive motivations, an intelligently designed, consistent, and progressively challenging strength training program can improve sport performance, resilience to injury, and general fitness beyond sport. The same potential benefits of strength training exist for masters as for junior and collegiate rowers. Strength gains are still fully possible even after testosterone levels decline via central nervous system (CNS) improvements. Strength training improves the number of motor units recruited with each muscular contraction, referred to as CNS coordination, directing more power to the muscles with every impulse. Aerobic systems lose relatively little with age, while peak power tends to degrade rapidly, so the combination of the improved CNS, healthy muscular system, plus a robust aerobic base can power boats well into one's masters years. In addition, the competitive racing distance of 1km instead of 2km during sprint race season makes peak power

and anaerobic fitness an even more important factor in race success. If you have relied solely on technique and aerobic training to this point in your career, the addition of an intelligent strength training approach could unlock the door to new personal bests.

I have generally found that healthy masters rowers can train similarly from age 25 to about 35 before modifications to a training plan are necessary. After 35, the good news is that you can make up for a bit of diminished recovery ability with years of training and racing experience, knowledge of your body, consistency, and the wisdom to stick with a program, all variables you may not have had as refined as a younger athlete.

Like any rower, it is important to use your judgment and not push through acute pain, and to pay attention to former injuries when strength training. Remember, your strength training program exists to benefit your rowing training and performance, so there is no point in doing things in the weight-room that may detract from your training and recovery.

As with all athletes, proper and thorough instruction of the exercises is crucial to personal success, as is movement quality and mobility. If you have not strength trained before, or if it has been many years, I highly recommend working with a qualified and experienced personal trainer to develop a solid grounding in the basic lifts before proceeding with a program. Many times, performing the exercise correctly will alleviate pain caused by improper execution of the lift. If the pain is still present despite performing the exercise correctly, then we can usually find a range-of-motion modification or close variation of the exercise that works as a substitute. Rarely do we exhaust all possible options and completely throw out an entire category of movement. For example, elevated deadlifts or trap-bar deadlifts, floor presses, dumbbell overhead presses, and single-leg squats are all viable substitutes if the conventional barbell version of the lift causes pain or injury.

Recovery time is also a factor to be considered at greater importance for a masters rower than for a junior rower. It is a simple fact of life that the systemic stress of a heavy workout, weights or rowing, may take longer to recover from as a masters rower than in youth. This is particularly important during the taper phase of training, and the timing of the “residual tim-

er reset” workouts. Unfortunately, there is no mathematical formula to find the exact amount of recovery time personally necessary for each rower. Document your training, evaluate your performance, and make adjustments for your next training block. Additionally, you may find that you respond better to certain training variables than others. Some trainees are more sensitive to volume training, while others find volume easier to recover from than intensity. The answer to any problem is an understanding of basic programming methods combined with careful record keeping and willingness to adapt training as necessary. Stay flexible in your training and keep an eye on the big picture of the annual plan, rather than a short-term day-by-day plan.

Finally, while the purpose of this manual is to make rowers stronger, faster, and more competitive, many masters rowers may also be interested in the long-term health benefits of strength training. In *Strength Training Past 50* (2015), authors Westcott and Baechele provide a list of research-based benefits of strength training for older adults, including maintaining muscle mass and metabolic rate, increasing bone mineral density, increase glucose uptake and gastrointestinal transit speed, and increased full-range lower back strength. While racing faster is certainly a more fun benefit of strength training, reduced risk of osteoporosis, improved body composition through better glucose uptake and digestion, and reduced risk of lower back injury and general disease are all great advantages as well.

Program Design for Masters Rowers

Another variable in masters rowing training is the greater diversity of competitive events. The USA junior and collegiate schedules are neat and tidy. The academic year begins in the fall with longer distance racing to lay an aerobic and technical foundation. Rowers largely train indoors during the winter months when the weather is unfavorable, shifting training to focus more on peak power and anaerobic ability. Spring weather brings a return to on-water rowing and 2k season, with a peak around late May for championship races.

Masters rowing is anything but neat and tidy. Depending on your location, competitive desires, and training situation, you can race year-round, in short and long distance events, indoor erging and outdoor rowing, more or less at any time you choose. This training situation can be difficult to manage for the coach or rower who wants to spend enough time building all the necessary athletic qualities of a successful masters rower, especially while also navigating any diminished recovery ability. This makes a well-informed periodized plan even more necessary to successfully manage all of the training variables to produce great race performance.

The first step in developing an intelligent strength training program is identifying the needs of the sport. Competitive masters rowers need to be able to perform in both the 1km distance as well as the 5km+ distance. Rowers will often complete multiple 1k races in a single day during sprint regattas. This requires:

1. Aerobic endurance to perform at longer distances, as well as recover in between more frequent, shorter races
2. Great rowing technique, whether sweeping or sculling in small boats or large boats, so that strength, power, and endurance can be expressed to their full potential in a way that maximizes performance and minimizes risk of injury.
3. Flexibility, mobility, and stability to reach, hold, and produce power from sound positions at each stage of the drive and recovery.
4. Power and power-endurance to be able to produce and sustain sufficient pressure during a race, especially the shorter 1km sprint races.
5. Muscular strength of muscles relevant for rowing performance, as well as muscles that rowing neglects, to minimize risk of injury.
6. Competitive muscle mass for the athlete's height and age.

As strength coach, I'm primarily concerned with numbers three through six on that list. I trust the rowing coach to develop on-water endurance, power, and technique, and ask that



they trust the strength coach to develop physical qualities of mobility, flexibility, stability, power, strength, and muscle mass. A strong partnership between strength coach and rowing coach makes developing all these qualities much more cohesive and efficient.

The next step in creating a periodized strength training plan is to customize those general needs to your own specifics. Perhaps your aerobic endurance (#1) is already excellent, courtesy of years of endurance base-building through cycling, cross-country skiing, and other cross-training before coming to rowing. Perhaps mobility (#3) is your biggest present limitation, and an extra few inches of compression at the catch would yield you the biggest improvement in your times. Maybe you are a Crossfit-to-rowing convert and have good power and anaerobic ability (#4), but run out of gas on longer pieces. This is all necessary information to construct a training plan that works for you.

The third step is to identify your most important competitions of the upcoming year. Some masters rowers focus entirely on sprint races, some focus entirely on distance races, and others pick-and-choose based on a variety of factors. Your competitive desires will shape your

training program. Generally, pick two or three regattas at most to focus on. You will likely race more than this, but those select races will be the intended peaking dates. The cost of tapering and peaking is time, and time that you spend tapering and peaking is time that you could spend building. Tapering and peaking for every single race is neither effective nor a good use of training time, so you will train through these less important races, saving the true taper-and-peak cycle for the few races most important to you.

Now, work backwards from your competitive goals to develop an annual schedule with objectives for each training block.

The general outline of the training year is below, based around a rower of fairly balanced ability who will participate in a handful of regional regattas through the spring and fall aiming to peak for USA Masters Nationals in August and the Head of the Charles in October. The general training schedule will shake out like so:

- November - January: General Preparation
- February - April: Specific Preparation
- May - June: Pre-Competitive I
- July - August: Competitive I
- September: Pre-Competitive II
- October: Competitive II

Now, let's look at the goals of each training block and how they build on each other to peak performance at the intended regattas. You will see that the characteristics and training goals of each block are similar to how they are described in the rest of the manual.

November

1. **Rejuvenate** — Take 2-3 weeks after your final race to do no structured training. Stay

active through whatever means you enjoy and don't stress about anything related to athletic performance. Actually, try to think about athletic performance as little as possible. This period is critical to mentally and physically recovering from a hard competitive season and building enthusiasm for the upcoming training year.

2. **Fix Imbalances** — You'll likely develop some imbalances over 6+ months of pounding the meters. Sweep rowers commonly have imbalances between their stroke/non-stroke leg and arm, as well as rotational imbalances, and both sweep and scull rowers commonly have underpowered glutes and overpowered internal shoulder rotators. The off-season is the time to set this right again, working unilateral exercises, challenging bodyweight exercises, and even incorporating some yoga-type of training.
3. **Aerobic Base** — I encourage athletes to pick up another form of training aside from rowing and erging in this furthest-away off-season block. Running, cycling, and swimming are all good options, and changing things up helps maintain long-term enthusiasm for the sport, contributes to restoring muscular balance, and achieves the goal of building the aerobic base. Your aerobic system is the foundation of your training, so build the base and build it wide!

December

1. **Continue to Fix Imbalances** — Use plenty of unilateral exercises and find ways to continue to challenge your movement. The off-season is a particularly important time to focus on mobility and setting your body up well for the harder training to come.
2. **Strength Base** — After an intense competitive season, we take the opportunity to lighten the load and build our base of strength for the rest of the training year to come. Keep training variety high and work the 65-80%1RM range, with around 3-5 sets of 6-12 reps per main work exercise. We'll use a lot of bodyweight, band, and dumbbell lifts during this training block, especially in assistance work where we lighten the load

and will do 2-4 sets of 8-15 reps. This can also help with rebuilding any lost muscle mass from the competitive season.

3. **Continue Aerobic Work** — Continue cross-training and building the aerobic base. OPTIONAL: If you're doing the CRASH-B's or a similar erging event in late February or early March, you'll likely begin your erg training in December.

January

1. **Strength Base** — Keep building the foundation.
2. **Monitor Imbalances** — Attention during the previous two months should have fixed any immediate issues, and most rowers can now bump imbalance prevention work back to maintenance. I like to fit some of it into my full-body warmup for before lifting and erging, plus a bit during the assistance work.
3. **Aerobic Base** — After 1-2 months of mostly cross-training, it's time to start adding erging or rowing back into regular training, continuing to focus on building the aerobic base. Start by just switching 1-3 of your cross-training days over to erging days. OPTIONAL: If you're doing an erg event in February or March, begin training sprint work to get 2k race-ready.

February

1. **Strength Base** — The Specific Prep Block of training sees an increase in intensity, a decrease in volume, and a slight decrease in variety. We'll gradually include some higher intensity training, moving into the 70-85%1RM range for main work while continuing to put in the reps for assistance work. I use unilateral exercises in the assistance work now to continue building muscular balance, and shift the main work to

more bilateral strength-focused work like front squats, overhead press, and trap bar deadlifts. Main work lifts are typically done for 3-4 sets of 4-8 reps.

2. **Phase in Sprint Work** — Shift your training over to primarily erging and begin introducing more sprint and interval work to prepare for returning to on-water rowing
OPTIONAL: Continue 2k prep for indoor erg racing.

March

1. **Strength Base** — Continue building strength in the Specific Prep Block.
2. **Return to On-Water Rowing** — Most masters will be getting back on the water in March. As you return to rowing technique, this is a great time to appreciate your hard work over the off-season. Celebrate the balanced body, the greater ease of achieving stroke positions, and the extra boost in your power.

April

1. **Transition to Peak Power** — After 8-10 weeks in the Specific Prep Block, it's time to move into the Pre-Competitive Block and start tuning up your strength base into boat-moving power. As with the other blocks, make sure to include a two-week transition period between these two blocks of training. Peak power training is all about full explosive intent to get the most out of the lighter weights. Instead of longer sets of 5-8 with 70-85%, now we'll be working the same weights on 5-8 quick explosive sets of 2-3 reps. Remember the concept of full explosive intent from the Pre-Competitive section of the "Applying Block Periodization" chapter. Assistance work stays relatively similar to previous block of training, but drop the volume slightly to accommodate for more on-water training if you find you need the extra recovery.

2. **Balanced Rowing Training** — Still at least two months out from major competitions, your rowing training should be fairly balanced between aerobic steady state, peak power and sprint work, and anaerobic intervals.

May

1. **Peak Power** — Continue Pre-Competitive Block training.
2. **Increase Sprint Work** — Rowing training during this time will likely shift to include more sprint and race-pace work, tapering down on the base aerobic steady state. Between this and your strength training, expect to see and feel a boost in your peak power as you get ready for race season!

June

1. **Peak Power** — Continue Pre-Competitive Block training. You will be training through your early season races, not tapering for every single one and short-changing yourself valuable training time, but don't be afraid to hit your main work and then take assistance work off or easy during the single training session before a race. We will often do strength training on Tuesday, then take Thursday off or light, before a Saturday race.
2. **Race Readiness** — Dial it in! Most rowing training is now focused on 1k performance, and repeat 1k performance for masters who will race multiple times in a weekend regatta. Your aerobic base you built up will serve you well in recovering between events, and your power and anaerobic system work will give you the boost within races. Do you have a race plan? Now is the time to start practicing it before you get to your main competitive events of the season.

July

1. **Maintain Strength and Power** — It is crucially important that you continue strength training through your competitive season. Rowers who stop strength training when their season begins are strongest at the start of the season when it matters least, and weakest at the end of their season when it matters most! Drop your volume down from the Pre-Competitive Block and keep your full explosive intent high. These should be relatively quick strength training workouts. 3-6 sets of 2-3 reps for your main work lifts, basically just touching some higher intensity weights around 80-85%1RM, then light assistance work. I'll bring back the bodyweight exercises here from the General Prep Block and emphasize solid movement patterns.
2. **Race Readiness** — Continue dialing in your race plan, technique, etc.
3. **Recovery** — Recovery is always an important factor in rowing training, but it becomes even more important as race prep and competitive events increase. Make sure you are building active recovery into your lifestyle as part of your training.

August

1. **Tapering** — I typically program a 10-14-day taper, depending on the strength, ability, and training time of the athlete. The higher the potential strength and speed, the more important the taper. Our last heavy lifting session will be 10-14 days away from Masters Nationals, so around August 2nd or 3rd. We'll do two sessions the following week with the same exercises, but dropped down to 2-3 sets of 1-3 reps at 40-60%1RM. I find it helpful to stay "in the groove" of the lifts and really feel that full explosive intent. 2-3 sets of 10-15 reps light for assistance work, again, just focusing on movement and staying away from muscular fatigue. Depending on the athlete's travel schedule, we'll either do another one of these light sessions on August 12th or 13th or spend the day

traveling to the regatta. After a day of travel, moving feels nice and can help stave off any pre-race jitters. Resistance bands are inexpensive, durable, and portable, and can be combined with a hotel room routine of some bodyweight or jump squats, a bit of core work, and a nice mobility routine to limber up any travel-weary muscles.

2. **Race Performance** — Let the horses run! This is what you trained for, so enjoy the moment and take pride in yourself.
3. **Recovery** — Stick to your recovery plan in between races as well as after all the racing is done. A week off after Nationals, both from strength training as well as rowing training, to rejuvenate for the next two months of training. If you want to do a light paddle to stay grooved, go for it, but keep the intensity low.

September

1. **Strength and Power Boost** — We'll go back to Pre-Competitive Block training for the month of September, getting a strength and power boost before tapering down again for Head of the Charles in October. Begin your first week back exactly the same as your Competitive Block training. Weights should feel light and smooth. Gradually increase your volume by adding 1-2 sets per week to your main work lifts to get back to 5-8 sets of 2-3 reps around 70-85%1RM.
2. **Lengthening Out** — It's a quick shift from the 1k's of Nationals to the 4.8k of Head of the Charles, so rowing training will likely be a gradual progression up to higher volume and longer distances to prepare.
3. **Recovery** — Stay on top of your recovery plan as the strength training ramps up and the rowing volume increases to get 5k-ready.

October

1. **Maintain Strength and Power** — Our rower picked up a head race or two before HOCR, so she follows the same strength training plan as during the first Competitive Block. Decrease volume back to 2-3 sets of 1-3 reps, with the final heavy strength training session 10-14 days before the race and then 1-2 lighter “grooving” workouts the week before the race.
2. **Race Performance** — Enjoy your final competitive race before you close the books on your training year and get ready for rejuvenation followed by the beginning of the next annual training plan. Take some time to reflect on the things that went well in training this year, and the things you’ll want to adjust for next year.

While block periodization may sound like a complex topic, the execution of it in practice is really quite simple. Starting from the earliest point in the training year, we build the base of strength and aerobic fitness as the foundation for all other qualities to come. We continue building the base and gradually add back in erging and rowing training, then we refine this base of strength, fitness, and recovery ability into boat-moving power. We come to the championship races strong, powerful, fit, healthy, and primed for peak performance. Then we do it all again the next year!

Strength Training for Juniors

JUNIOR ROWING RUNS THE DEVELOPMENTAL GAMUT from a pre-pubertal youth rower to an advanced junior rower who might as well be considered pre-collegiate. There is a massive difference in age 11 and age 18 from mental and physical development, to athlete ability, to growth response from training, and everything in between.

Youths

At the youth level, typically defined as ages 7 to 12, many parents are often concerned about strength training and its effect on growth plates and other pubertal factors. I consider this mostly a misunderstanding of what strength training is. While most people think about eye-popping maximal squatting and heavy benching to failure, age-appropriate strength training for youths should focus almost entirely on solid fundamentals of athletic movement. Bodyweight exercises, light loading, and odd object lifts such as light sandbags and medicine balls are all great tools to teach young athletes how to move athletically. Development of movement literacy is the primary goal at this stage of training, not building muscle and not really even building strength or improving rowing ability. Build great movement patterns,

develop fundamental athletic skills, and reap the rewards as the athlete grows and matures.

Research has shown that strength training in this age-appropriate manner can actually help minimize injuries resulting from other sports, and the myth of strength training stunting structural growth of children has been proven false. Authors Dahab and McCambridge of the 2009 Sport Health Journal article, “Strength Training in Children and Adolescents,” state that, “*the rare case reports of epiphyseal [growth] plate fractures related to strength training are attributed to misusing equipment, lifting inappropriate amounts of weight, using improper technique, or training without qualified adult supervision.*”

As with all athletes, proper and thorough instruction of the exercises is crucial to personal success. Strength training, like all sports, does carry some inherent risk of injury. For those new to strength training, I highly recommend training with a qualified and experienced personal trainer to develop a solid grounding in the basic lifts before proceeding with a program.

This is actually one of the best times to begin a structured and age-appropriate strength training program to develop those basic movement skills. With excellent instruction and coaching, young athletes can use sports training to improve their motor control and coordination, develop better movement mechanics to improve sport performance and decrease injury risk, and build lifelong habits of physical activity. National strength and conditioning, as well as sports training, organizations frequently have position statements on common issues in strength and sports training. In their 2009 position statement on youth resistance training, the National Strength and Conditioning Association (NSCA) of the USA states that resistance training can offer unique benefits in addition to aerobic activities, so long as it is appropriately prescribed and supervised. They offer several pages of evidence-based best practices for training youth athletes, and numerous references to support this position. The International Youth Conditioning Association is also a great resource for youth strength training, including their exam guide textbook *Developmental Essentials: The Foundations of Youth Conditioning*, available online for free.

In a 2010 *New York Times* interview (“The Benefits of Weight Training for Children”), lead

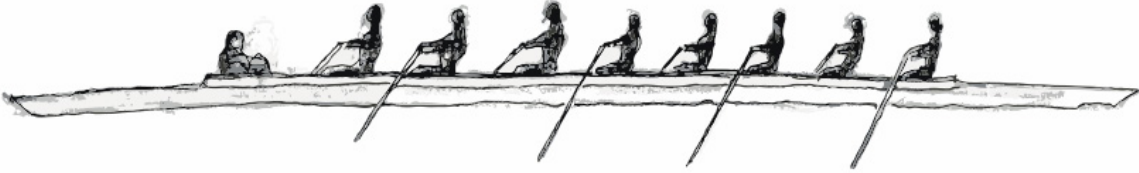
author of the NSCA position statement Dr. Avery Faigenbaum stated:

“Any age is a good age. But there does seem to be something special about the time from about age 7 to 12. The nervous system is very plastic. The kids are very eager. It seems to be an ideal time to hard-wire strength gains and movement patterns. And if you structure a program right... it can be so much fun that it never occurs to the kids that they’re getting quote-unquote ‘strength training’ at all.”

It is particularly important for youths to begin with bodyweight, free weight, and odd object training rather than machines and cables. By learning how to control their bodies in space, young athletes develop balance and movement patterns that will contribute greatly to their short and long-term athleticism, sport performance, and durability. By contrast, young athletes who rely on machines learn how to activate individual muscles in isolation, but not as a cohesive unit as is required in athletics. Early development of muscular coordination is key to reaping the benefits of strength training.

I would not recommend taking a periodized approach with youth athletes, or any overly structured approach at all. Age-appropriate training at this stage is about building solid athletic movement patterns, introducing strength training through a variety of modalities, and most importantly, encouraging enjoyment of the process. My training for this age range typically follows the below pattern for a 60-minute session:

1. 10 minutes: Cardiovascular and movement preparation warm-up
2. 10 minutes: Agility game
3. 15 minutes: Strength training circuit of mixed bodyweight, free weight, and odd object exercises for 3-4 rounds of 4-8 reps per exercise
4. 10 minutes: Conditioning game or relay race
5. 10 minutes: Stretching (make this fun as well with jokes, stories, verbal games, etc.)



Teens

There is still a great developmental difference between 13-to-15-year old athletes in the early stages of puberty and 16-to-18-year old athletes in the later stages. Consider chronological age (years of life), biological age (physiology and maturational stage), and training age (years of training experience) when designing a strength training program for any athlete.

If the athlete has been strength training since youth, this is where you start to really see the training gains realized. The emphasis shifts a bit closer to performance and building some rowing-specific strength via loaded squats, deadlifts, and plyometric exercises, but the foundation of training should still be great movement and exercises from the bodyweight, free weight, and odd object categories. Periodization can be introduced for the experienced trainee to design a strength training program that supports the athlete's rowing training and performance.

Teenage athletes without prior strength training experience will likely experience some struggle at first. Bodies do not grow uniformly during puberty, so acquiring new skills as body proportions and mechanics change on a season-by-season basis can often be frustrating. Consider each athlete on an individual basis, but in general I would recommend training inexperienced teen athletes more like youth trainees with a heavy emphasis on developing movement fundamentals and ability, without much in the way of loaded exercise. The increased focus on movement and physical awareness will likely help the athlete in his or her rowing ability at this stage more than a focus on strength and musculature. Many bad habits that appear in rowing at this stage are the result of poor movement mechanics, not necessarily a muscular weakness,

and strength training is a great opportunity to teach these fundamental skills and application to rowing technique. For example, an athlete who does not rock over properly on the recovery may not have a core weakness, as is frequently diagnosed, but may simply not know how to hip hinge. Master the hinge in a controlled on-land environment, and it will be easier to teach the athlete how to apply this skill to the rowing stroke.

Hormones such as testosterone and growth hormone are important for muscular growth and will become present in puberty. A specific training focus on muscular hypertrophy is not necessary, as any strength training will stimulate muscular growth at this stage of training. Strength training should still be balanced between strength work in lower rep ranges with free weights, power work via plyometrics or lower load exercises, and general hypertrophy work in higher rep ranges with a variety of modalities (eg. bodyweight, dumbbell, barbell, etc.), rather than focusing heavily on any one individual factor. Follow my general recommendations from “Writing a Program” for set, rep, and intensities, provide the instruction and supervision, and watch them grow!

Over-Training or Under-Recovering?

OVERTRAINING COMES IN TWO MAIN FORMS, chronic and acute. Chronic overtraining is fairly rare and traumatic, but acute overtraining has broader symptoms and affects many athletes. Acute overtraining can be caused by training with too high frequency, intensity, and/or volume, or by failing to recover sufficiently from training via sleep, diet, and lifestyle. Overtraining is not to be feared, but recognizing overtraining symptoms is key to better managing your training, recovery, performance, and mental state.

The Internet pendulum swings rapidly on the subject of overtraining, and a brief survey on the topic will reveal attitudes both of constant fear of overtraining even in the lowest volume training situations, as well as the macho “there’s no such thing as overtraining” attitudes. The reality lies somewhere in the middle, and the polarity of opinion is mostly the result of a lack of understanding of what overtraining actually is.

First, let’s clear up what overtraining is not. Overtraining is not overreaching. Overreaching is a strategic training period as part of a taper cycle when fatigue will be incurred past a recoverable level. Many athletes will experience this as a natural part of a training cycle. This period is strategic, intentional, and should be carefully monitored by the coach and athlete. The athlete overreaches for a short period of time (1-3 weeks) during which time fatigue is

very high and performance is diminished, then training is scaled back for another short period of time (1-3 weeks) to allow for recovery before a peak performance. This is the strategy of tapering to produce an immediate short-term spike in performance for a peak event.

Overtraining is different from overreaching in that it is not strategic, does not have a performance purpose, and is the result of a mistake or error on behalf of the coach or athlete. Another good way to think of overtraining is that it is a state of failed adaptation. Your training is failing to produce results, because your body is no longer adapting to the stimulus you are applying to it.

Many coaches often overestimate athlete recovery ability, fail to appreciate that the athlete has other priorities in life such as school or work, or abide by an old school “toughen up” mentality that creates an environment of training to survive training, rather than training to excel in performance. I quite like the saying, “you get medals for your performance, not for effort.” If you can improve more with less training, why not do it?

However, if the athlete deviates from a training program to include more training such as extra sessions or higher intensities without the coaches’ knowledge, or fails to prioritize recovery from training by neglecting sleep, nutrition, hydration, and other factors vital to recovery, they should bear more responsibility for their state of overtraining than the coach and training program. Communication is key for both parties to honestly assess this interaction of training plan and athlete.

If your training and recovery are not balanced, your training will not be effective. When training outpaces recovery for a prolonged period of time, overtraining is likely to occur. Because training and recovery affect each other to a great degree, we cannot discuss training volume and intensity without also discussing recovery.

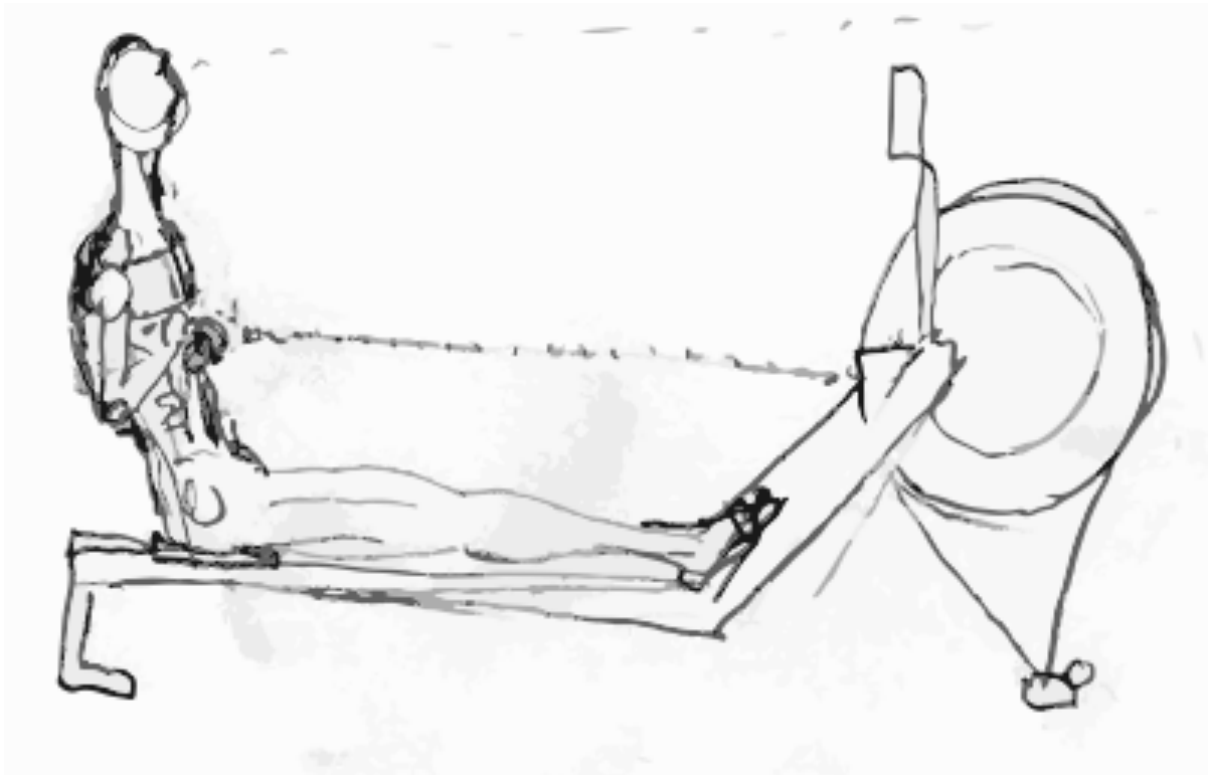
Overtraining takes two forms, commonly referred to as chronic overtraining or acute overtraining. Chronic overtraining is typically what people mean when they say, “there’s no such thing as overtraining,” because chronic overtraining is very rare. Chronic overtraining is usually traumatic and takes a long time (several weeks to months) to recover from. Symptoms

include blood in the urine, extreme muscle cramping, soft tissue injury, depression, severe exhaustion, inability to gain or maintain muscle mass, and prolonged plateau in performance even after weeks of rest, as well as actual biochemical changes at the hormonal level.

Acute overtraining is much more common and often goes unrecognized. Symptoms of acute overtraining include stagnant performance, irritability, mood swings and depression, elevated resting heart rate, sleeplessness, suppressed appetite, increased susceptibility to illness, dampened enthusiasm for training and competing in the sport, lasting fatigue, and increased likelihood of injury. This kind of overtraining is commonly referred to as “staleness,” “burnout,” “over-fatigue,” “just feeling run down lately,” etc. Are you experiencing any of these symptoms? Nearly every athlete I’ve worked with has experienced some of these symptoms in their training career separate from strategic overreaching. This is to be expected, as training can’t always be perfect, and as an athlete who pushes the envelope, it’s natural that you’ll tread over this line at some point. However, it is important to recognize and acknowledge the symptoms and know how to make a change to prevent long-term chronic overtraining, illness, or injury, and to get performance back on track.

There are two sides to the issue of overtraining. One side is predominantly the responsibility of the coach (or self-coached athlete) to manage training volume and intensity. Volume, intensity, and frequency cannot all be high at the same time beyond a short period of time before overtraining sets in. The other side is largely the responsibility of the athlete to manage recovery through sleep, nutrition, hydration, and rest. This is the source of the common phrase, “there’s no such thing as overtraining, only under-recovering.” While this sounds nice on social media or macho athlete sound bites, the reality is that athletes do not have unlimited recovery abilities. Even professional athletes have a limit, and even more so for athletes who have school, work, a family, or other stress and obligations that take up time, mental energy, and physical energy.

It can be difficult to diagnose whether overtraining is a result of too much training or too little recovery, but a responsible athlete or coach should be able to take a careful look at lifestyle and training to make a determination. The same training can have different effects at



different times based on different situations. The training you once tolerated and improved on may be too much for you at a later stage in your career, so it is important to look at your program holistically.

The first question is, are you improving? If it has been months since your last PR, your training may be out-pacing your recovery. I find it best to use a few rowing-specific indicators of progress, such as a 10-stroke max watt test, 7-minutes-for-meters, or a rate-capped distance piece that you find correlates to improvements in your competitive race distance. Performing at least a test or two once every four-to-eight weeks can give you a good indication of whether or not your training program is effective. Rowing-specific indicators are more effective for this than lifting indicators, because it is more relevant to your sport and less affected by other variables such as non-sport technique. If your rowing performance is improving, then your progress in the weight-room matters less and we can be reasonably sure that you are not

overtraining. Prolonged specific performance plateaus are one of the best indications that something isn't right in the training-recovery balance.

Next questions to determine training-recovery balance:

- Are you getting enough macronutrients (calories in the form of protein, carbohydrates, and fats) and enough micronutrients (fiber, vitamins, and minerals) from quality sources each day? A diet deficient in these may lead to decreased recovery. Caloric restriction, whether intentional (dieting to lose weight) or accidental (failure to prepare) can dramatically decrease ability to recover from hard training.
- Are you getting at least 6-8 hours of quality sleep per day? For some athletes, this may include naps, but be wary of counting low-quality sleep toward this number. Snoozing with the TV on, or on the bus in the morning, does not count as quality sleep.
- Are you drinking at least half your bodyweight in ounces of water per day? For example, a 200lb athlete would aim for a bare minimum of 100 ounces of water per day.
- How stressful is your life in the sport and off the water? If you experience a higher stress school, work, or family situation, your recovery will be lower than an athlete who has an easier degree, easier job, or non-stressful family life. These factors are important to consider, as emotional stress and physical stress all register simply as stress to the body.

If you are getting sufficient nutrition, hydration, sleep, and experience minimal stress, but still have overtraining symptoms, then you may simply be training too much.

- Have you had at least two consecutive days off from any kind of training in the last 6-8 weeks?
- Have you had an entire week off of structured training in the last 3-4 months?

If either of those answers are no, you may be training too often or for too long without time off. Remember, training that is high in volume, frequency, and intensity is not sustainable and will likely lead to overtraining if continued beyond a short period of time. Regular, short periods of lighter training intensities and volumes are necessary to avoid overtraining, especially in such a repetitive sport as rowing. I typically plan for a week off of structured training after each block of training, referred to as “active rest,” followed by a transition week for the next block, then starting the current block of training. This allows the athlete to rest and pursue other enjoyable activities during the active rest week, then acclimate to the demands of the next block of training, then fully set in with enthusiasm and rested body and mind for the next training block.

Overtraining isn't to be feared. It is good for athletes to learn their body and understand why they're feeling what they may be feeling, and how to get back on track. If you're feeling run down and your rowing performance and lifts aren't improving, take a look at your training. If you're training too much or recovering too little, take some time off to rest and then adjust and move forward. The only thing really “bad” about overtraining is when there is also a failure to adjust and correct.

Movement Assessments for Rowing: Guest Chapter By Blake Gourley

Pinpointing the Limiting Factor

By Blake Gourley: M.S., CFSC, FRCms, FMS, CPT, PES, CES

THIS GUEST CHAPTER COMES FROM BLAKE GOURLEY, fellow podcast co-host of the Strength Coach Roundtable. I've learned a lot from Blake and his approach with the rowers he coaches and trains. In addition to his own rowing experience, which you'll hear about some in this chapter, Blake has several years of on-water and strength training coaching experience with juniors, collegiate, and masters rowers. Blake has a great ability to break down and find improvement in how rowers move on the ergs, on the water, and in the weight-room, and he shares some of his methods in this chapter. You can find more of Blake's written work, podcasts, videos, and coaching updates on his website, <http://www.rowingstrength.com/>.

The Current State of Rowing

It's unclear what the cause was for my injury. What was clear was the fact that my five year rowing career had just come to an end. I found myself lost and confused. My coaches and teammates made me feel like I was weak and exaggerating the injury to remove myself from the competitive rigors of Division 1 rowing. After five months and five different doctors it was clear that I wasn't exaggerating anything. I had spondylolisthesis at L5, S-1 and two herniated discs. Surprisingly, I was told that this injury was common in rowers and that it was complete-

ly possible to continue my rowing career. In actuality this may have been true, but I feared continuing would only make it worse. I eventually decided against continuing with the hope of being able to play with my kids in the distant future.

Injuries like mine are far too common in the sport of rowing. Yet the biggest issue is that these rates are accepted as normal in the sport. Every season athletes get injured and not much effort seems to be put into avoiding these injuries. As Mike Boyle has said, coaches treat the sport as a “survival of the best bone and connective tissue contest, a twisted take on the survival of the fittest theory. Those who don’t get injured by the volume of training survive to compete” (3). All too often this mentality creates an environment where rowers are pushed to row to the point of injury and often through injuries.

I didn’t know it at the time but my injury happened for a reason. I’ve spent the last 8 years of my life trying to figure out how to reduce the chance for injuries in the sport of rowing. I don’t claim to be the best coach by any means but I do believe I’m making a difference in these kids lives. What I hope to do by sharing my experience is to create some thought that may help more kids than I can personally reach.

Just A Part of The Sport?

It’s no surprise to any rower that rowing places extreme demands on its participants. The movement itself, the intensity, the technique required, and the traditional approach to training makes injuries a common occurrence. Studies have found that 32-51% of rowers will experience an injury each year. When it comes to back pain, 82% of rowers report pain annually (2).

So, is that just the nature of the sport? Is there no way to get around these numbers? What most people don’t realize is that we are completely capable of flipping the switch on these numbers.

Fortunately, there are only 3 ways to get injured from rowing (excluding a freak accident

or a serious crab).

1. Over-use or Under-recovery
2. Technical error
3. Movement Limitations

Since rowing is a non-contact sport we have a lot of control over all 3 mechanisms listed above. Lucky for us, we don't have to deal with contact injuries such as ACL tears and concussions that are so prominent in other sports. The only way you can truly keep a football player safe is by keeping him on the sideline. We, on the other hand, can reduce the chance of all injuries from ever even occurring in the first place. All we have to do is make injury reduction a priority.

The simple truth is that staying healthy is the easiest way to improve your performance. Rowers are really good at putting in the time and effort. What rowers often miss, is the fact that you not only have to outwork your opponents, you have to outsmart, and out-recover them as well.

These injury rates are not the sport, it's not normal. It's how we've been training for it. In fact, there are several things that you can do that can drastically reduce your chance of getting injured. Just to be clear, no one can prevent injuries, but we can reduce the overall number of injuries significantly. If we get lucky, and we put in the time and effort, we can have an injury free season(s).

Nonnegotiables

If you want to design a safe and effective training program use the 2 essential rules listed below as guidance. Do your best to make them your priority and keep them in order. Remember, an injured athlete can't improve or perform.

Rule #1: Reduce injury potential

No one can prevent injury. Injuries happen. It is possible however, to reduce the chance of an injury from ever occurring in the first place. As coaches, we need to accept that injuries that occur during our watch are partly our fault. This is especially important in a sport that only has three injury mechanisms, all of which are under our control. We should be looking to reduce injury potential during training, and during competition. Finding the right training program will keep your athletes healthy at practice, and make them more robust for competition.

Rule #2: Improve Performance

The other part of our job is to increase performance. Prioritize safe, progressive training, but make sure that it's effective. Think about the risk/benefit ratio and let it guide your decision making. Think, what is the minimal effective dose? How can I get my athletes as fast as possible in the least amount of time? How can I do so without hurting them? Anytime you can load someone less (with weight or volume) and still get the same benefit, the better.

“The ideal program takes risk, but analyzes risk to benefit ratio. The ideal program works on all aspects of training but in a progressive manner that minimizes exposure to undue stress. The big key is that the program improves performance but, never at the expense of health” (3).

How do you know you're finding the right balance? If your team is improving and staying healthy you're on the right track. If you have one without the other, something needs to be tweaked.

Movement

As human beings we are meant to move freely and effortlessly. However, as we have evolved our daily tasks have become automated and less and less movement has been required from us. Most of our athletes sit all day in class and then head to practice and continue to sit in

a boat. For this reason as well as others, our movement has been altered. If proper human movement isn't addressed we will develop movement limitations. Our bodies are meant to move freely and effortlessly. With clean movement, we find ourselves in an optimally aligned position which produces the most amount of force with the least amount of effort.

Movement limitations effect our performance, technical ability and overall health. When you remove movement limitations you remove the roadblocks to your athlete's success. Movement limitations can prevent your athletes from even changing in the first place. Once you remove the limitation we are only left with technical changes, proper loading strategies, and rigging adjustments.

Movement limitations are a liability. They create energy leaks and may lead to pain and injury. Imagine the flow of water from a hose. Now, poke some holes in that hose. That's an energy leak. Clearing movement limitations provides a mechanical advantage and allows you to row in a way that provides more boat speed for your athletes. On the other hand, movement limitations require you to rig and adjust around the individual athlete which tends to effect rhythm and decrease potential force production.

It is possible for a rower to perform well, even with poor technique. Yet, their performance will be inconsistent, they may experience excess fatigue, soreness, and may even breakdown resulting in injury. The goal of a rowing specific training plan should always be to reinforce efficient movement in the boat. Efficient movement will help the athlete conserve energy, practice more often, and compete more effortlessly.

Movement Assessments

My preferred form of assessment is a complete Functional Movement Screen with a certified instructor. However, if that is not available to you, I've simplified and narrowed it down to just a few important measures. Most of which I've borrowed from the FMS and altered for simplicity. Be aware that since I did simplify the assessment process it is not as accurate and

it may have some missing information when compared to conducting a complete FMS with a certified instructor. To find out more about the FMS, to find a certified instructor, or to get certified yourself, check out their website at FunctionalMovement.com

Over the last 8 years I've been using a complete FMS to look at limitations in my athletes, clients, and other's athletes. These 5 are the most important in relation to rowing. They are often the problem children and I've seen the way they affect the stroke, the athlete, and the person. In the image sequences below, passing grade pictures are on the left, failing grade pictures are on the right.

If you find pain in any movement, see a medical professional before continuing.

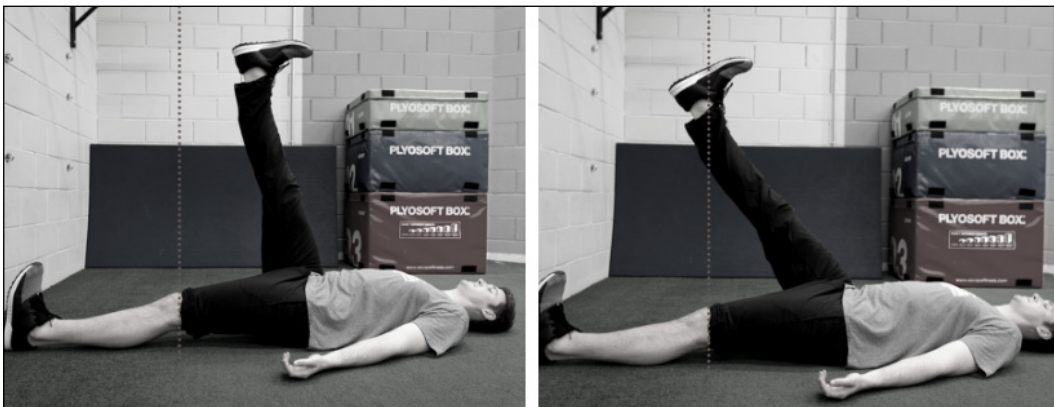
Ankle Mobility

Kneel a fist length away from a wall. Without lifting the heel, drive the knee towards the wall and your pinky toe. Can you touch the wall without lifting your heel, rotating at the hips, or dropping the knee in towards the big toe?



Leg Raise

Lie on your back with your arms by your side and palms facing the ceiling. Can you lift your ankle past your kneecap without bending your knee or turning the down foot out?



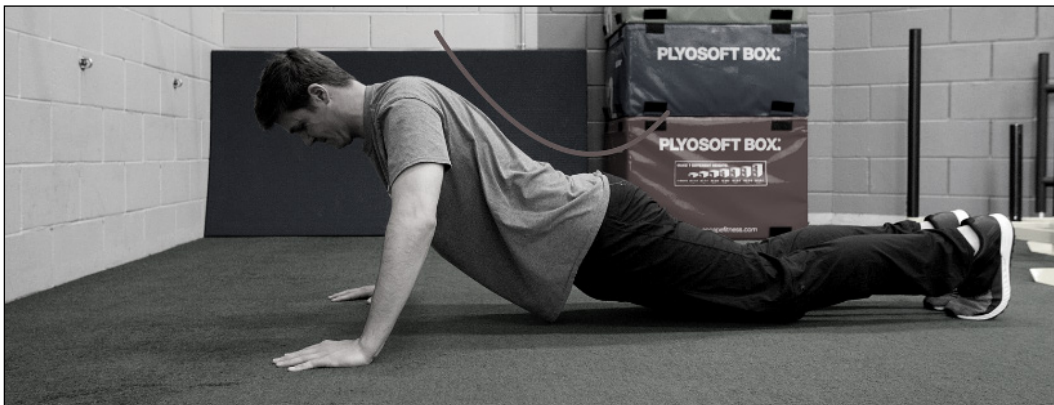
T-spine Rotation

Take a knee with your up leg at 90 degrees and your heel directly in front of your hip. With a dowel rotate as far as you can over your top leg. Can you pass 45 degrees?



Push-up

Lie on your six pack (or belly), align your hands with your collarbone and thumbs with your armpits. From here, can you press yourself to the top of a pushup without sagging at the hips?



Overhead Squat

With your feet straight ahead and shoulder width apart reach your arms overhead and squat down as deeply as you can. Can you get your quads parallel to the floor, can you keep your torso from falling forward, and can you keep your hands behind your toes?



Priority

Assessments are in the order of their priority. For example, if you identify an issue with ankle mobility there is no point in moving on to the leg raise until the ankle is cleared and so on down the list. The movement before effects the movement after. Clear one, move on to the next. Be aware of large asymmetries.

Rowing Implications

We can look at the rowing stroke and identify movement limitations based off of the technical errors we see. We can also look at these results and predict that same error. If there is a movement limitation it is the main cause of your athlete's biggest, and maybe even smallest technical issue. Clear the limitation and they will make changes more easily, and sometimes effortlessly. Think about that athlete who hears the same cue/technical change every day on the water. They want to change, but something is standing in their way and it's beyond their control until you identify it, find an intervention that works for them, and assign them homework until it clears.

Movement	Technical Error	Common Pain
Ankle Mobility	Lack of compression, bad body position at the catch, collapse into the catch.	Back and Knee Pain
Leg Raise	Lack of forward body angle, butt tucks underneath them as they approach the catch.	Back pain
T-Spine Rotation	Shoulders round forward at the catch and finish, excessive reach at the catch, difficulty with rotating into the catch, and controlling the body into the catch. Upper back posture is excessively rounded.	Shoulder, Back, and Rib Pain
Push-up	Trouble finding connection (shoot butt, swing early, or shrug. Rounding of the back as they pick up (a visible change in spine position).	Back and Shoulder pain
Overhead Squat	Collapse into the catch, pick-up with the back too early. Bad body position into the catch.	Back and Knee pain

Interventions

Here are some of my go-to correctives that can help improve each weak link. However, please note that every athlete responds differently to interventions. One intervention may work for 80% of your team while 20% won't respond to that intervention at all.

Ankle Mobility

Kneeling a fist length away from a wall, drive the knee towards the wall rocking back and forth in a smooth fashion with no pauses. Drive the knee towards the picky toe and do not lift the heel. Repeat until you reach the wall with your knee.



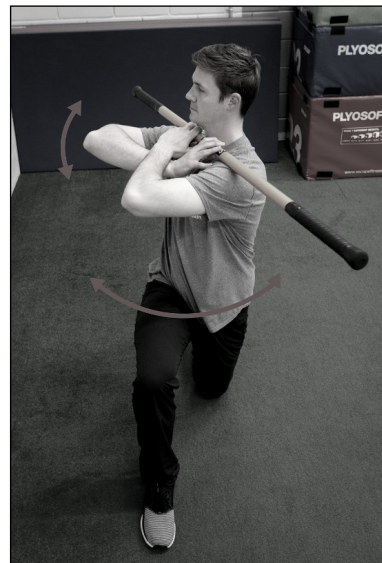
Leg Raise

With a band lie on your back and take your straight leg as high as you can without lifting your butt off the ground. Lift your other leg to match the stretched leg, slowly lower the leg to the floor. Repeat for ~10 reps each.



T-spine Rotation

In a kneeling position place a dowel across your shoulders. Rotate as far as you can over your top leg. Once you reach your sticking point, pause, side bend, return to upright and continue rotating further. Try 3-5 reps per side or until sides are equal or closer to 45+ degrees of rotation.



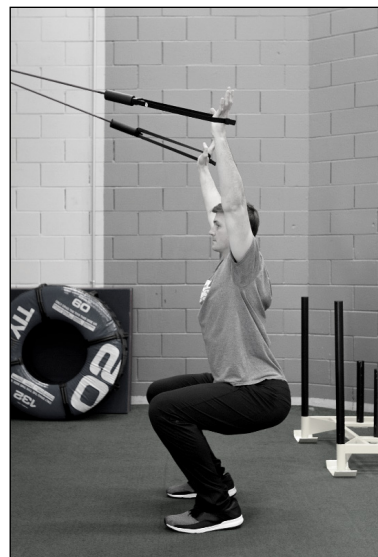
Push-up

Regress your push-ups until you can pass the test. Make sure your push-ups are emphasizing core engagement and a collective movement. No sagging or an increase in the arch of your back is allowed. Regress by elevating your hands onto whatever height allows you to do a high quality push-up. As you get stronger, progressively lower yourself back down towards the floor.



Overhead Squat

With a resistance band anchored above you, set-up for a squat. Stay as tall as you can, and resist the pull of the band. Your goal should be to get the quads parallel to the floor, keep the body upright, and the hands behind the toes. Try 5-10 reps.



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Kettlebell Training for Rowing:

Guest Chapter By Joe DeLeo

By Joe DeLeo: NSCA-CSCS, FMS-II, Rocktape FMT-II,
Strongfirst Level 1 Girya and Bodyweight Instructor

T HIS GUEST CHAPTER COMES FROM JOE DELEO, fellow podcast co-host of the Strength Coach Roundtable. Joe was really the one who turned me on to using kettlebells in rowing training, and I'm happy to have his experience for this chapter on how you can also put this tool into practice to become a better rower. Although the sets and reps will look different than I've described in the rest of the book, you will see similar programming principles at play in Joe's sample programs. Note how he builds volume progressively through the fall (Specific Prep) season, then reduces volume and increases intensity in the winter (Pre-Competitive) season, as well as the same principle of power endurance work in the winter program with lower reps performed for higher sets with lower rest. Joe also emphasizes using the kettlebells as a teaching and training tool for the hip hinge, in a way that supports the goal of building better rowers and supporting major movements of the deadlift and squat exercises.

You can see more of Joe's work, including articles, podcasts, tutorial videos, and publications, at his website, <http://leotraining.io/>.

Why Kettlebells?

I am often asked this question when it comes to strength and conditioning for rowing. While I utilize all modalities: barbell, bodyweight, kettlebell, sandbags, Indian clubs and the gada, kettlebells are my preferred tool to train rowers with for several reasons.

I have found it is easier to teach and for athletes to learn the technique and skill required to lift well by beginning with kettlebells. You can use a moderate to heavy kettlebell and you can teach an individual many different lifts with one tool. It's an excellent entry point for an individual with no strength training background and makes it a much smoother ramp of progression to the barbell.

Second, the kettlebell offers some benefits that you cannot do with machines and the barbell. It allows us to continuously assess the movement quality of the athlete unilaterally. As their skill progresses we can see how they perform lifts and skills on the left and right side. This allows the coach to see if there are restrictions in mobility, stability, or strength from the left or right side or perhaps just poorer coordination overall.

For example, the sumo kettlebell deadlift will eventually progress to a double kettlebell single leg deadlift and from there a contralateral single leg deadlift. In other words the bell is in the opposite hand of your stance leg. This challenges the athlete's balance and develops frontal plane stability – an athletic attribute that is not addressed with the barbell and often an injury risk of training purely in the sagittal plane.

The two-arm kettlebell swing can be progressed to one arm and after the athlete develops skill and comfort with a moderate weight here you can begin to integrate various athletic drills such as the side stepping swing or moving the feet in and out during the swing. This presents additional challenges to the athlete and helps develop athleticism, hand and foot coordination, rhythm and timing and power.

Finally, the last reason I love using kettlebells to train rowers is we can develop many different attributes. We can work on conditioning and fitness in the fall through higher reps

and as the season progresses we can go heavier and do lower reps or single reps to develop crushing power!

Sport Specific vs. Sports Transfer

Often, when we look at the training done in strength and conditioning we want or look for something that is sport specific. In reality what we really want is skills, lifts, and exercises that will provide the athlete with the greatest transference to their sport.

One of the lifts that has the greatest transfer from the gym floor to the erg and boat is the deadlift and then followed by the kettlebell swing. The deadlift is a great skill because it teaches and reinforces the proper sequencing in the rowing stroke.

Athletes learn the following in the deadlift:

- How to hip hinge
- Connecting to the handle of the kettlebell (or bar) through the latissimus dorsi
- Rooting into the floor and pushing with the feet
- Quadruple extension of ankles, knees, hips and trunk
- Force transfer
- Coordination of lower body and upper body

All of these qualities in the deadlift help transfer to the rowing stroke by improving:

- Suspension during the drive
- Force transfer from the foot plate to the oar handle and face of the blade
- Learning to coordinate the movement with the lower body first and patience with upper body

Another great benefit of teaching someone the sumo kettlebell deadlift is that the bell is directly between their feet and under the center of mass. This is again easier to learn and control

and more spine-sparing for individuals with a history of low back injuries.

Kettlebell lifts can be broken down into two categories: ballistics and grinds.

“Ballistics” refer to power exercises and develop the qualities of explosiveness, pulsing, rhythm and timing. Examples include the kettlebell swing, clean, snatch, and jerk.

“Grinds” refer to slow, controlled push, pull, or squat exercises. Grinds demand constant, high tension to complete the lift.

Ballistics have a clear work and relaxation phase to them whereas grinds you are working hard the entire lift and only are relaxed once the lift is complete.

Which of these two categories has the qualities of the rowing stroke? If you guessed ballistics – you are correct.

We begin with the deadlift to pattern and cement the hip hinge pattern and add load. This presents an opportunity to work on proper biomechanics and build maximum strength.

Once we have established a strong foundation in the deadlift and own the mechanics we can then progress to the kettlebell swing. The kettlebell swing has two phases just like the rowing stroke has the drive and recovery. Athletes need to learn to relax during the eccentric phase and generate power during the concentric phase. This interplay between tension and relaxation helps to reinforce the same qualities in the rowing stroke. Even better, athletes can practice this in a more controlled environment with less noise and distractions of a rowing launch and wake from other crews.

While both, the deadlift and kettlebell swing are still hip hinge patterns there are some additional benefits to the kettlebell swing that will have great transference to rate of force development and power output because it's a ballistic lift.

A concept and definition worth sharing is neural drive. Neural drive is simply the ability for the nervous system to generate greater force to the muscle even though the muscle is the same size. Increasing muscle mass is not a requirement for increasing strength and force production.

Why Rowers Should Care

By training the mind and body to produce greater force which will lead to greater power production per stroke. More power means a faster erg and the opportunity to generate greater boat speed. The kettlebell swing is a fantastic ballistic lift that helps produce horizontal power.

Now, that we have provided a good background of the benefits of these two lifts it's now time to teach you how to pattern and execute them.

The Sumo KB Deadlift

1. With a kettlebell between your feet, adjust your stance so your feet are shoulder width apart and turned out to ten and two o'clock respectively.
2. The kettlebell handle should be lined up with the malleolus (ankle bone) of your feet.
3. Perform a hip hinge.
4. Reach between your legs for the handle of the kettlebell.
5. Grip the floor with your feet, crush the handle, and pull your shoulders down toward your hips.
6. Take a sniff of air through your nose and store it in your diaphragm.
7. Stand up and “push your feet through the floor.”
8. As your knees and hips extend exhale through your lips and make a “tsssss” sound.
9. Stand up straight so you form a straight line from your ankle to your ear.
10. Take a sniff of air through your nose and hip hinge to return the bell to the floor.
11. Be sure to guide the bell back to your ankles as you return to the floor.
12. Repeat and add a second bell to increase load and perform a double sumo kettlebell deadlift.

The Two Arm Kettlebell Swing

1. Stand one foot behind the kettlebell
2. Hip hinge and reach forward for the bell.
3. Tilt the handle of the kettlebell toward you and drag it toward you to engage your lats and pack your shoulders.
4. Using your arms and shoulders only, hike the bell off the floor so that your wrists are connected to the inside of your thighs.
5. Immediately stand up tall by “pushing your feet through the floor”.
6. As your knees and hips extend exhale through your lips and make a “tsssss” sound.
7. The kettlebell will swing forward utilizing the energy you have generated from your hips and float to chest height.
8. Be patient. Wait until your elbow connects to your rib cage then hip hinge and allow your wrists to connect to the inside of your thighs.
9. Stand back up and repeat for the prescribed number of repetitions in the set.
10. On the final repetition sit your hips to the floor.
11. Allow the arms to pendulum swing forward – like an airplane coming in to land on the runway. The bottom of the bell will skid across the floor and come to a stop.
12. Allow the bell to come to an upright position. Once it’s “parked” on the floor stand back up.

The One Arm Kettlebell Swing

1. Stand one foot behind the kettlebell
2. Hip hinge and reach forward for the bell.

3. Tilt the handle of the kettlebell toward you with one hand and drag it toward you to engage your lats and pack your shoulders.
4. Use the opposite hand to touch the corner of the kettlebell handle to square your shoulders, then move this hand to the side so it is aligned outside of your knee.
5. Using your arm and shoulders only, hike the bell off the floor so that your wrists are connected to the inside of your thighs.
6. Immediately stand up tall by “pushing your feet through the floor”.
7. As your knees and hips extend exhale through your lips and make a “tsssss” sound.
8. The kettlebell will swing forward utilizing the energy you have generated from your hips and float to chest height.
9. Be patient. Wait until your elbow connects to your rib cage then hip hinge and allow your wrists to connect to the inside of your thighs.
10. Stand back up and repeat for the prescribed number of repetitions in the set.
11. On the final repetition sit your hips to the floor.
12. Allow the arms to pendulum swing forward – like an airplane coming in to land on the runway. The bottom of the bell will skid across the floor and come to a stop.
13. Allow the bell to come to an upright position. Once it’s “parked” on the floor stand back up.
14. Switch arms for the next set or you can swing switch during the set for an added challenge to work on core stability and hand/eye coordination.

Skill Acquisition

Before we can discuss programming we have to take a moment to talk about skill acqui-

sition. Before you can start to really focus on volume and intensity and get into sets and reps and periodization you must take the time to learn the hip hinge pattern, then the deadlift, and finally the kettlebell swing.

This is critical to long term progress as each of these skills builds upon one another and the progression continues from the swing to the kettlebell clean and eventually overhead with the kettlebell snatch.

Once the hip hinge becomes dynamic with the kettlebell swing you want to have the strength and core stability groundwork laid down before hand. Cementing the hip hinge pattern is where the deadlift comes into play and you develop some excellent strength by cementing the hip hinge pattern.

Programming

Swings are ballistics and a power exercise. As such, this lift should fall at the beginning of your session after your warm up and activation exercises to train power first, then strength.

Power requires more from the nervous system and needs to be explosive in nature. There is a speed component to this quality and we want to utilize the freshness the athlete has at the beginning of the session to produce the greatest adaptations and gains. Power work should be terminated once speed slows down otherwise you are just training your mind and body to go slow.

The following is an outline of a sample program rowers can do during the year.

In the fall, athletes are returning to the sport and working on developing their base level of fitness. Below is a 12-week program to build conditioning and fitness using the kettlebell swing twice a week. This program can be combined with your regular strength training using the programming methods Will provides in this book. Reduce other exercises that also use the posterior chain while you focus on the kettlebell swing.

Note from Will: Joe's advice is spot-on. If you're going to do the kettlebell program, this should be the only specific hinge work you do. Keep your deadlifts and squats in your main work and remove other hinge assistance exercises while you focus on the kettlebell swings. Do the squat or deadlift work first, then the kettlebell swing program, to make sure you aren't carrying fatigue from the swings into the squat or deadlifts. The lighter, more ballistic nature of the kettlebell swings changes the recommended sets, reps, and intensity from what I've written in the rest of this book.

Fall Conditioning Swing Program

Day 1 – Two Arm Swings

Day 2 – One Arm Swings

Note: Swings will be performed “EMOM” (every minute on the minute) for the prescribed reps. Work-to-rest ratio will progress from approximately 20” on/40” off to 40” on/20” off over the course of 12 weeks. Prescribed bell weight should be approximately 24kg for men and 16kg for women.

Week 1 – Day 1 | 6' x 10 Two Arm Swing

Week 1 – Day 2 | 6' x 10 One Arm Swing

Week 2 – Day 1 | 8' x 10 Two Arm Swing

Week 2 – Day 2 | 8' x 10 One Arm Swing

Week 3 – Day 1 | 10' x 10 Two Arm Swing

Week 3 – Day 2 | 10' x 10 One Arm Swing

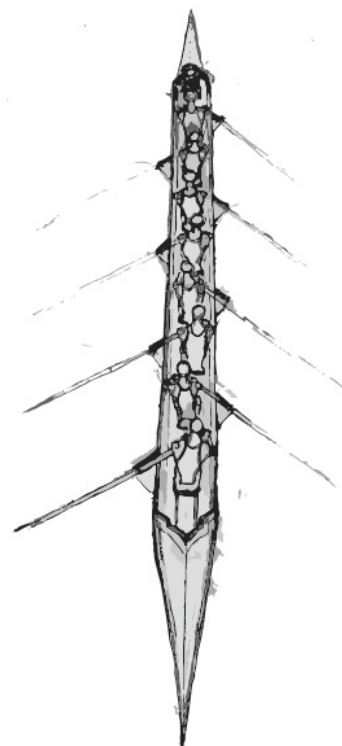
Week 4 – Day 1 | 7' x 10 Two Arm Swing

Week 4 – Day 2 | 7' x 10 One Arm Swing

Week 5 – Day 1 | 6' x 15 Two Arm Swing

Week 5 – Day 2 | 6' x 15 One Arm Swing

Week 6 – Day 1 | 8' x 15 Two Arm Swing
 Week 6 – Day 2 | 8' x 15 One Arm Swing
 Week 7 – Day 1 | 10' x 15 Two Arm Swing
 Week 7 – Day 2 | 10' x 15 One Arm Swing
 Week 8 – Day 1 | 6' x 15 Two Arm Swing
 Week 8 – Day 2 | 6' x 15 One Arm Swing
 Week 9 - Day 1 | 6' x 20 Two Arm Swing
 Week 9 – Day 2 | 6' x 20 One Arm Swing
 Week 10 – Day 1 | 8' x 20 One Arm Swing
 Week 10 – Day 2 | 8' x 20 One Arm Swing
 Week 11 – Day 1 | 10' x 20 Two Arm Swing
 Week 11 – Day 2 | 10' x 20 One Arm Swing
 Week 12 – Day 1 | 6' x 20 Two Arm Swing
 Week 12 – Day 2 | 6' x 20 One Arm Swing



Winter Power Swing Program

Day 1 – Dead Swings aka Single Reps only. Focusing on Maximum Power Generation.

Day 2 – Sets of 5 reps of One Arm Swings

Note: Swings will be performed as single reps on Day 1. Prescribed bell weight should be approximately 50% of bodyweight, i.e. a 90lb kettlebell for a 180lb rower.

Week 1 – Day 1 | 3 x (10 x 1) Two Arm Swing Dead Swings
 Week 1 – Day 2 | 8 x 5 One Arm Swing
 Week 2 – Day 1 | 4 x (10 x 1) Two Arm Swing Dead Swings
 Week 2 – Day 2 | 10 x 5 One Arm Swing
 Week 3 – Day 1 | 5 x (10 x 1) Two Arm Swing Dead Swings
 Week 3 – Day 2 | 12 x 5 One Arm Swing

Week 4 – Day 1 | 3 x (10 x 1) Two Arm Swing Dead Swings

Week 4 – Day 2 | 8 x 5 One Arm Swing

Week 5 – Day 1 | 6 x (10 x 1) Two Arm Swing Dead Swings

Week 5 – Day 2 | 14 x 5 One Arm Swing

Week 6 – Day 1 | 7 x (10 x 1) Two Arm Swing Dead Swings

Week 6 – Day 2 | 16 x 5 One Arm Swing

Week 7 – Day 1 | 8 x (10 x 1) Two Arm Swing Dead Swings

Week 7 – Day 2 | 18 x 5 One Arm Swing

Week 8 – Day 1 | 6 x (10 x 1) Two Arm Swing Dead Swings

Week 8 – Day 2 | 14 x 5 One Arm Swing

Week 9 – Day 1 | 9 x (10 x 1) Two Arm Swing Dead Swings

Week 9 – Day 2 | 20 x 5 One Arm Swing

Week 10 – Day 1 | 10 x (10 x 1) Two Arm Swing Dead Swings

Week 10 – Day 2 | 22 x 5 One Arm Swing

Week 11 – Day 1 | 11 x (10 x 1) Two Arm Swing Dead Swings

Week 11 – Day 2 | 24 x 5 One Arm Swing

Week 12 – Day 1 | 9 x (10 x 1) Two Arm Swing Dead Swings

Week 12 – Day 2 | 20 x 5 One Arm Swing

Mobility for Rowers

NOTE: THIS IS A CONDENSED VERSION of the “Mobility for Rowers” series from my website. You may notice some overlap with Blake’s “Rowing Assessments” chapter, with some similarities and some differences.

With its unique demands as a seated sport and a taxing repetitive motion, rowing requires an informed and specific mobility regimen to maximize performance and minimize risk of injury. In this four-part mobility for rowers series, you’ll learn how to effectively target common problem areas with a combination of self-manual therapy, dynamic stretching, static stretching, and strength training for improved performance and longevity in the sport. Ideally, you’ll implement these routines before you experience pain, restriction, or another problem. Each area only takes 10-15 minutes to work through, so these are great to incorporate into your training as a regular part of your recovery plan. Simply taking care of your body with a little extra attention goes a long way toward reducing minor aches and pains through a hard rowing season.

For most athletes, practicing and competing in their sport is a daily break from the usual routine of sitting necessitated by the lifestyle of a student or desk-bound employee, but not so for rowers. While mobility work is important for all athletes, it is especially important for

rowers to maximize performance and reduce risk of injury in both the short-term and long-term. Rowing is a difficult repetitive motion requiring great flexibility, stability, and strength. If you lack range-of-motion to even achieve basic positions of the stroke, how can you expect to generate and sustain race-pace force from those positions?

The major areas we'll focus on in rowing are the thoracic spine (mid-back), hip flexors (anterior thigh and hip), glutes (posterior hip), and ankles (lower leg and foot). Training for rowing tends to affect these areas disproportionately compared to other areas, and taking some extra time for preventative care can go a long way toward improving performance, reducing risk of injury, and minimizing general aches and pains.

In order to enact significant, lasting change, a dedicated comprehensive program that involves all modalities is critical. I recommend focusing on one problem area at a time, at least one 10-15 minute session per day. Spending 20 minutes a day working on mobility for 2-3 weeks while watching a TV show or sports, for instance, is a great way to progress toward full function. Foam roll, perform self-manual release on specific trigger points, and stretch, then make sure to perform additional strengthening exercises while implementing proper technique into your rowing and erging training. Also, be cognizant of posture throughout the day. Many times, those with mobility restrictions will spend much of the day in poor positions that exacerbate the problems. Once you achieve full function, daily maintenance is simply performing daily activities from that now-strong position that your body can now adopt as normal positions.

Thoracic Spine Mobility for Rowers

The thoracic spine is the mid-back area from the T12 to T1 vertebrae, and includes the scapular muscles (supraspinatus, infraspinatus, teres major/minor), posterior deltoid, rhomboids, lower/middle trapezius, and latissimus dorsi muscles. You can test your thoracic spine mobility with the scapular wall slide test or the overhead reach.

In rowing, thoracic spine restrictions tend to result in some or all of: hunchback posture, inconsistent handle heights, rounding during the stroke (finish, recovery, and/or catch), and over-reaching at the catch.

Additionally, thoracic spine restrictions are a major risk factor for the rib stress injury (RSI). RSIs are a multifaceted injury that occurs as some combination of training volume, training load, and technical errors in the stroke that puts excess stress and strain on the rib muscles and bones, resulting in bone injury. Over-reaching at the catch and catching in a poor position with excessively protracted shoulders increases the amount of upper body force in the stroke and strains the rib cage. Rowers must have functional thoracic spines (adequate flexion, extension, and rotation to both sides) and strong upper body muscles to maintain stability in the stroke and keep the drive emphasis on the lower body muscles, reducing load on the rib cage and reducing risk of injury.

Hip mobility and thoracic spine mobility are often related. Rowers who have poor hip mobility may compensate with excessive thoracic spine or lumbar spine flexion and extension. Make sure to evaluate both the thoracic spine and the hip when evaluating movement.

Fixing Tight T-Spines in Rowers

Restriction of these muscles most often displays as a rounded upper back, referred to as thoracic kyphosis or hunchback posture. The inability to reach thoracic extension or maintain a neutral thoracic spine under load causes uneven handle heights and difficulty with a “soft hands” approach at the catch, as rowers will naturally round further at the catch, making it more difficult to smoothly place the blade in the water. This also may look like overreaching, but it is really just what the rower perceives as a neutral spine because neutrality feels like extension to them. Finally, hunchback posture puts great stress on the anterior side of the spine, compressing discs and possibly causing damage to the thoracic vertebrae, especially when under load.

We start self-care by foam rolling broadly over the mid back. Do not roll on the lumbar spine or the neck. Roll both up and down the middle of the back as well as on the sides of the back, by the latissimus dorsi. After a few broad strokes up and down the back, begin at the bottom of the mid back and hinge up and down over the foam roller, moving up one vertebra at a time. Remember to not do this on the lower back or neck area. Further self-manual release work can be done with a lacrosse or tennis ball if you find one particular spot of tightness, commonly referred to as a trigger point. Two tennis or lacrosse balls taped together (known as “The Peanut”) is of great use for self-manual therapy on the thoracic muscles, as is a “Theracane,” in my personal experience. With any specific trigger point work, take special care to avoid rolling directly on vertebrae or bones, focusing on muscles.

I have found one thoracic spine stretch to be particularly helpful. The athlete kneels in front of a bench, places their elbows or upper arms on the bench, and then flexes and extends the thoracic spine to end range-of-motion, holding each position for a few seconds. This achieves a great stretch through the latissimus muscles and posterior shoulder area. I also recommend using resistance bands to stretch the same areas.

Thoracic spine rotation is also particularly important. Sweep rowing is a rotational sport, and rowers who row mostly (or entirely) on one side of the boat can develop movement imbalances, as well as muscular imbalances, to their stroke side. Blake covered thoracic spine rotation well in his chapter, so make sure to revisit that and include testing and training of thoracic spine rotation in your mobility and strength training.

Strength Training Thoracic Muscles

Overhead press variations, as well as specific scapular exercises such as the face pull, Y-W-T raise or prone Y-W-T raise, band pullapart, as well as more general mid-back exercises like the pull-up and front squat will improve the strength and endurance of the scapular and postural muscles of the mid-back and shoulder region. The Sotts Press is also a useful acti-

vation and strengthening exercise, as seen in the mobility video. When doing these exercise, it's essential to pay strict attention to technique and keeping shoulder blades depressed and externally rotated, also referred to as “packed” or “back-and-down.” It is common for athletes to get fatigued during a set and find themselves shifting the emphasis from the target muscles onto the lats and upper traps. Focus, re-cue, and correct. There is no point training from poor positions.

“Thoracic Spine Mobility” on Youtube: <https://youtu.be/Asvo5XnJVvs>

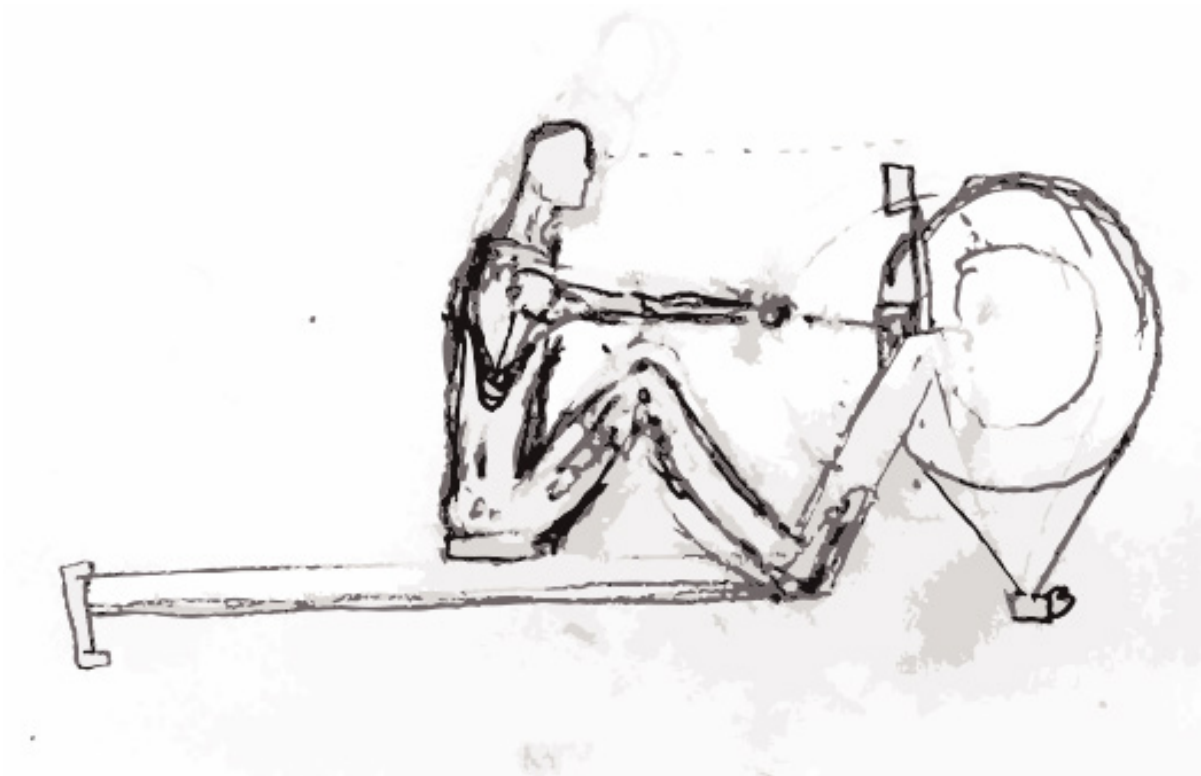
Hip Flexor Mobility for Rowers

Hip flexors have become a popular one to smash on, and with good reason for rowers, and it is effective to understand this muscle group, what it does for you in performance, and the specifics of how you can care for it. Rowers use the hip flexors almost all the time in training, so even if there isn't a specific injury or condition, this muscle group can really benefit from a little extra care to facilitate recovery and effective training.

The hip flexors are the anterior thigh and hip muscles of the rectus femoris, psoas, iliacus, and tensor fascia latae. The rectus femoris is the largest of the four quadriceps muscles and crosses both the hip joint and the knee joint, and the rest of the muscles are in the anterior hip area. You can do a test called the Thomas Test to evaluate your hip flexor flexibility.

In rowing, restricted hip flexors tend to result in poor compression at the catch, poor reach during recovery, and poor drive sequencing. Tight hip flexors can also be a contributing factor, or cause, of low back pain.

Hip mobility is also a major factor in rib stress injury (RSI). If rowers cannot achieve stroke length and power through the hips, they will compensate with the lumbar spine or thoracic spine. This increases the upper body force contributions to the stroke and puts excess strain on the rib muscles and bones. This could look like a thoracic spine issue, but actually be a hip issue, so make sure to evaluate both areas when doing a movement assessment of rowers.



Why Rowers Get Tight Hip Flexors

“The hip flexors” refers to main muscles of the rectus femoris muscle of the quadriceps and the tensor fasciae latae (pronounced “ten-sir fasha latay” or just “TFL”), as well as the psoas and iliacus. The rectus femoris is the biggest muscle of the quadriceps and does most of the work in terms of leg power. The rectus is a two-joint muscle, as it crosses both the knee joint (as a knee flexor) and the hip joint (as a hip flexor). I have heard rowers complain of tight hip flexors without knowing what “a hip flexor” actually was, let alone that there are actually several muscles in this group!

Hip flexor restriction is a major problem for rowers for a few reasons. Non-rowers often experience hip flexor tightness from spending all day sitting in a chair, at a desk, at work, in the car, and on the couch at home. Rowers then sit for another couple hours a day on an erg or in the boat in a sport that, unlike lots of other standing sports, doesn’t train hip extension!

Restricted hip flexor mobility is common, and this is a contributing cause of low back pain, poor function of the glute muscles, and inefficient drive mechanics. Tight hip flexors can also cause anterior pelvic tilt, which can result in tight hamstrings, weak glutes, and lumbar lordosis (arched low back), which all contributes to an inability to sit up straight while rowing, effectively transfer force in the drive, and increases risk of low back pain. Additionally, the hip flexors often contribute to another common and uncomfortable rowing injury, snapping hip syndrome.

Fixing Tight Hip Flexors for Rowing

Begin by foam rolling up and down the quadriceps muscles broadly, as well as the lateral (outside) portion of the thigh. Self-massage in this manner may feel good on a heavily used muscle group, and that alone is beneficial for recovery. The quadriceps are a group of four muscles--the vastus lateralis on the lateral (outside) side of the thigh, the rectus femoris down the middle of the thigh and up into the top of the hip, the vastus medialis on the inside of the thigh just above the knee, and the vastus intermedius underneath the rectus femoris. The rectus femoris is the only quadriceps that is also a hip flexor, but massaging the others feels nice and can still help achieve a general mobilizing effect.

Work up to the top of the pelvis, avoiding rolling directly on bones. After a few broad strokes, get a lacrosse or tennis ball and work back up the rectus femoris before positioning it on the TFL muscle and iliacus muscles, located at the high anterior thigh and hip area. Spend some time rolling over that area, attempting to find a trigger point and then holding it for 30-90 seconds, then do the same on the opposite leg.

Following the self-massage work, begin to stretch with either a lunge stretch or the 3-way hip opener stretch. If these stretches are easy, proceed to the couch stretch. I suggest stretching each hip flexor for bouts of 2-3 minutes at a time, progressively trying to attain a deeper stretch throughout that period. A common error when stretching the hip flexors is to achieve extra

depth by arching the low back. Keep the glutes and abs engaged (flexed slightly) while stretching to maintain a stable torso position and keep all of the stretch pressure on the hip flexors. I used to like the couch stretch a lot, but I found that too many athletes would arch the lumbar spine to get into position, and I have come to prefer a banded half-kneeling stretch more. I have demonstrations of all of these stretches and exercises on my website.

As with the thoracic spine, rotation is an important part of hip mobility training as well and is included in the hip mobility exercises demonstrated in my video below. If you note more difficulty on your left side versus your right side during the three-way hip opener stretch, or unilateral glute activation exercises like the fire hydrant, consider adding in some extra training to improve flexibility or activation of the weaker side.

Hip Flexor Strength Training

Hip flexor problems most often result from general tightness, rather than weakness. Thus, strengthening exercises in this case is mostly about strengthening the muscles around the hip flexors so the hip flexors are relied upon less. Bilateral exercises like barbell squats can contribute to hip flexor tightness, as the hip flexors contract strongly to maintain an upright torso. Single leg exercises, on the other hand, stretch the non-active hip flexor (the back leg) while working the front leg. For this reason, as well as the fact that single leg exercises can help even out bilateral imbalances resulting from sweep rowing, single leg squats are a staple of my rowing programs.

Additionally, exercises that emphasize full hip extension will also move the hip flexors through a complete range of motion while strengthening muscles that badly need strengthening to maintain good posture. If you just stretch the hip flexors but don't strengthen the other muscles around them, you'll end up back in the same posture once the temporary effects of stretching dissipate. Train the hip hinge with exercises like the hip thrust, pull-through, kettlebell swing, and Romanian deadlift to develop good lumbopelvic rhythm, a strong posterior chain, and good posture.

“Hip Flexor Mobility” on Youtube: <https://youtu.be/be89nX8ygd0>

Glute Mobility for Rowers

The hip flexor's counterpart is the glute muscles of the posterior hip. The glutes are important muscles for rowing, responsible for a significant amount of power in the drive, as well as stabilizers of the hips and spine in all parts of the stroke. Much like the hip flexors, glutes can get fatigued, sore, and achey without any acute injury or condition, and are well worth the time in preventative massage, flexibility, mobility, and strength training for rowers to enjoy healthy bodies, good performance, and long careers.

The glutes are colloquially referred to as “the butt muscles,” and can be found on the posterior hip. The largest muscle is the gluteus maximus, with smaller muscles of the gluteus medius, minimus, and the piriformis muscle also deserving attention.

In rowing, poor glute muscle function can result in poor compression at the catch, inefficient leg drive and swing during the drive, and shortened reach during the recovery.

Importance of Glutes for Rowing

On the opposite side of hip flexors, the gluteal muscles are in a constant semi-stretched position during long bouts of sitting. Because full hip extension is never reached in rowing, the hip extensors are not often worked through their full range of motion. Inhibited compression, posterior pelvic tilt, and poor reach during the recovery are common results from gluteal restriction. Legs splayed during the recovery or at the catch is also common with rowers with tight glutes. Similar to hip flexor tightness, restricted glute muscles can be a culprit of back pain as the muscles all interact with the lower spine and hip region.

Fixing the Glutes for Rowing

With one leg crossed over the other, begin by foam rolling over the glute muscles broadly.

If you find a trigger point with just the foam roller, work it for a couple minutes. Next, repeat with a tennis, softball, or lacrosse ball (ordered in ascending intensity). This should really allow you to dig in to the glute muscles, particularly the piriformis. Repeat this on both sides of the hip, then move on to static stretching. The pigeon stretch, figure-four, and lying glute stretch are the main stretches I use. The specific trigger point work can be done several times daily, as long as it doesn't cause tenderness or bruising.

Strengthening Glutes for Rowing

First, we do a glute activation and hip warmup, or a full body warmup, before every strength training session, and I encourage rowers to do them before erging and rowing sessions as well. This sequence ensures that the hip flexors are being stretched and the glutes are being worked through a full range of motion at least once per training session. This helps keep them mobile before getting in a boat or on an erg. Including exercises that work the hips through a full range of extension motion is critical to strengthening the glute muscles. Banded good mornings, Romanian deadlifts, x-band walks, and bilateral and unilateral hip extensions (thrusters or bridges) are always included in my rowing programs. Additionally, squats are great for glute development, as well as leg drive power.

“Glute Mobility” on Youtube: <https://youtu.be/zJL2az4Xm1Q>

Ankle Mobility for Rowers

Remember, the goal of mobility training is to improve flexibility, strength, and stability in major muscle areas to improve rowing performance and reduce risk of common rowing injuries. Knee, hip, and low back pain often happens as a result of something going on at the start of the kinetic chain, the feet and ankles. Ankle mobility for rowers is crucial to set the

rest of the body up for great performance, and to minimize excess force on other structures.

I am including the calf (gastrocnemius, soleus), shin (tibialis anterior), and foot muscles in the general ankle area, as well as the ankle joint itself. The calf muscles are on the posterior lower leg, the shin muscles on the anterior, and the plantar fascia is the main area of the foot to focus on. You can test your general ankle mobility with a test I call, and demonstrate on my website, “the power rack test.” The athlete stands a few inches away from one upright of a power rack and, keeping the heel firmly on the floor, bends the knee to drive it to gently contact the power rack. If this was easy, the athlete can move an inch or two further away from the power rack. Repeat this until you find the limit of flexibility.

In rowing, ankle restrictions manifest as poor compression, splayed legs at the catch, and poor leg drive at the catch from being in an unstable position. Tight lower leg muscles can also cause knee pain.

Ankle Function in Rowing

Poor ankle mobility results from muscles of the lower leg, including the calf muscles of the soleus and gastrocnemius, and the tibialis anterior and posterior, and even the plantar fascia at the bottom of the foot. The plantar fascia is a sheet of connective tissue covering the muscles on the bottom of the foot. Any of these tissues can become restricted, resulting in poor mobility of the ankle. Ankle mobility for rowers is important to maximize effective length and power in the stroke. A restriction here will limit the rowers’ ability to get to full compression without another fault at the catch. For example, rowers with poor ankle mobility may splay their legs at the catch, lift excessively from the heels, or round at the lumbar spine (posterior pelvic tilt) to compensate for the lack of ankle mobility. Knee pain, ankle pain, and shin splints can result from restricted muscles of the lower leg.

Fixing Tight Ankles in Rowers

Begin by foam rolling the calf muscles in a seated position with one leg outstretched, one leg at a time, covering both the middle portion (gastrocnemius) of the calves as well as the outer portion (soleus). Go slowly and methodically. If this is too easy, place one leg on top of the other to add pressure to the bottom leg receiving the manual therapy. Once you have made several broad strokes over the calves, use a tennis/lacrosse ball to go through again and search for trigger points. Work from the base of the ankle all the way to the top of the lower leg, sitting on each painful point for at least 30 seconds. You may then do the same on the tibialis anterior, the large muscle running along the shinbone. Use only the tennis/lacrosse ball, not the foam roller, and be careful not to roll along the shinbone itself. Then, sitting in a chair or on a bench, place the ball under one foot (bare feet or socks for this part) to roll the plantar fascia. Apply pressure as necessary, just roll over the area. This is great to do while on the computer, watching TV, etc. Repeat for both sides, then move to dynamic stretching for the ankles. After dynamic stretching, try to sit in the deep squat for 1-3 minutes. This will be difficult for many on the first attempt, but this is great to do for full ankle range of motion. I demonstrate all of the above on my website.

Ankle Strengthening for Rowing

The ankle muscles of the calves and shins tend to need more loosening than strengthening, thanks to a stroke cycle that relies heavily on these muscles. I do not believe that additional ankle muscle strength training is necessary for rowing, as compound strength training (squats, deadlifts, etc.) as well as rowing and common forms of cross-training all serve to develop these muscles. However, one effective way to combine training is to perform the self-massage work to increase range-of-motion, then stretch the area via the deep squat or the dynamic stretching, then do some local strength training for the area such as calf raises to full flexion

and extension. Stand on a raised area so you can descend as far as your flexibility will allow, pause for 1-3 seconds there, then flex the calves to raise as high as possible, pause for 1-3 seconds there, and do 1-2 sets of 10-15 reps in that same style. This combination of massage, stretch, and full range movement can be great for improving movement quality.

“Ankle Mobility” on Youtube: <https://youtu.be/TElkXPnsTJ4>

Mental Skills for Rowing

I'LL LEAD THIS CHAPTER OFF WITH AN UNDERSTATEMENT--rowing is a hard sport mentally and physically. The constant pressure of technical improvement, the drive to improve on ergometer tests and in training, and race-day nerves, can all be a lot to deal with. Athletes not equipped to deal with this stress often find themselves burned out after a few seasons. My goal for this chapter is to teach you some basic mental skills that you can incorporate into your own training as a rower or coxswain or into your team's training if you are a coach. Mental skills training (MST) is similar to physical training in that you can't just flip a switch and be in shape. Often, athletes neglect the mental side of training until a problem appears, like hitting a wall in erg performance or suffering intense pre-race anxiety. Just like physical training, mental training will be most effective if introduced early, before a clear problem is present. Mental skills will take time and dedication to improve, but the benefits, including reduced anxiety, increased performance, improved focus, happiness in sport and beyond sport, are worth the work. Mental skills are a great area for sport-to-life carryover, as athletes who develop a strong mindset for rowing can learn to transfer those skills over to academics, employment, and their personal life beyond rowing.

In the long term, MST can help reduce anxiety and build good mental habits to lay a foundation for race day and tests. Just like in school, you can't just cram for a few hours and expect to

do well on the test—you have to work at it all quarter.

In the short term, MST can help improve performance by reducing distractions, improving focus, and decreasing anxiety. The basis of short-term MST is maintaining a mindset of positivity and not getting bogged down in uncontrollable factors. Control what you can control, let everything else go.

The following seven mental skills are those I’ve found most helpful in my own training and coaching.

1. Goal-Setting

Make it easier to achieve your goals by clearly identifying your start point, the endpoint, and checkpoints along the way. A goal without a plan is just a hope.

Everyone knows about SMART goals, but have you ever actually written one out? Many people say their goal is “to improve 2k erg score,” so here’s how we can make that into a SMART goal.

- **Specific:** Pull a 2k erg test in 6 minutes or less. What’s your race plan? Negative split? Even split? What’s your start sequence and 500m targets?
- **Measurable:** The erg provides a good standard for measurement, time and meters, so there’s not a lot to do here to adapt it to rowing.
- **Action-Oriented:** Your goal should be positively worded and action-oriented. “Don’t choke in the third 500” is negatively worded and not action-oriented, but “pull a 2k in less than 6 minutes” is positive and action-oriented.
- **Realistic:** Is your goal and the timeframe to accomplish it realistic? If you currently have a 6:40 2k, is a 40 second drop in your given timeframe realistic? Consider running this past your coach for advice. Ultimately, if you truly believe it is realistic, then go for it. Setting a goal too ambitious can make it easy to fail (“oh well, it was a reach anyway”), and

setting a goal too easy won't challenge you to work your hardest. The intent of making goals realistic is to find a sweet spot of challenging and still achievable.

- **Time-Sensitive:** Put time parameters on your goal to increase motivation and accountability. You can also set smaller checkpoints along the way. If your goal is to go from a 6:12 2k to a 6:00 2k in 3 months, you know you need to reduce approximately 4 seconds per month. You could calculate this improvement into your other workouts using your goal split, and smaller benchmarks could be pulling 500m repeats at a 1:30 split, for example.

Goals don't have to always be outcome oriented like a 2k PR. Process goals are excellent ways to build great habits that contribute to your athletic success. Spending a certain amount of time doing something or doing something a certain number of days per week are two possible process goals. For example, a SMART process goal might be, "do four 10-minute sessions of mobility work per week for two weeks, then five 10-minute sessions per week for the next two weeks."

COXSWAINS: Your goals will be more focused on processes than outcomes. You can set a goal for weekly time spent preparing, whether that's reading, listening to recordings of other coxswains, watching videos of upcoming race courses, reviewing your own recordings, or preparing for the next day's workout. Coxswains often keep a log or notebook. An example process goal for you might be to write down three thoughts from each training session for three weeks. This is specific, measurable, action-oriented, realistic, and time-sensitive.

2. Progressive Muscle Relaxation (PMR)

Improve mental control over muscles and facilitate relaxation to make it easier to fall asleep, and make rest and naps more effective for recovery.

PMR is a process of progressively contracting and relaxing each muscle, usually starting

from your forehead and moving down or from your toes moving up, and combined with deep, rhythmic, diaphragmatic breathing. If you're having trouble falling asleep, or only have a short time for a nap, focus on the process of relaxation rather than the outcome of falling asleep. PMR can enhance relaxation by reducing subconscious muscle tension, improving recovery through deep, diaphragmatic breathing, and giving you something to mentally focus on as you relax. PMR can also help develop greater muscular control and awareness.

Until you are able to do it on your own, I recommend searching online for progressive muscle relaxation scripts and guided videos. These resources will help you progress through every muscular area of your body and may offer you helpful tips to improve relaxation.

COXSWAINS: No modification needed. I highly recommend this for coxswains, as well as rowers.

3. Cognitive Reframing and Positive Self-Talk

Any situation is potentially negative. Given any situation, it is your choice whether you view it as negative, positive, or neutral. Cognitive reframing is reframing potentially adverse events as challenges or finding a positive within the adverse event. Consistent cognitive reframing combined with a positive inner narrative is positive self-talk.

The ABC Model: Activating Event, Belief, Consequences

"I blew up on a 2k test, I suck at this and will never PR." For many athletes, a failed 2k test produces this ABC Model, which leads to the consequence of feeling unmotivated and disappointed. A cognitively reframed ABC for a failed 2k test might be: "I didn't achieve my 2k test goal, I know I can get it if next time I do ____ better," which resets the goal for the next test and includes a proactive action item for the rower to take.

Take a few minutes to use the template below. First, write out some of your activating events that commonly produce negative thoughts. Next, what beliefs do you create from a bad water workout, a grueling land workout, or missing selection for a boat? What are the con-

sequences for these beliefs? Finally, how could you reframe the belief next time to produce a positive path forward for yourself, and what are those positive effects?

Activating Event	Beliefs	Consequences	Reframed Belief and Positive Effect

Positive Self-Talk

Think of positive self-talk as simply saying to yourself what you might say to a close friend or teammate experiencing the same problem. This seems like a silly trick, but I have found that athletes tend to be much harsher to themselves than they would be to a friend or teammate. Keeping your inner narrative positive is a real key to long-term success in sport.

Self-talk describes your internal narrative as you perform an activity. This goes with cognitive reframing to some extent, but is more in the moment. When you are erging or training, it is important to maintain all of the positive mindset that you have built up before training. All of your mental training does you no good if you experience an adverse event on your first stroke and flinch back to, “ugh, this hurts and I’m no good at this.” It is crucial that this self-talk is positive, especially when things are going poorly, to get back on track and maintain concentration and self-confidence.

COXSWAINS: Often, you ARE the source of positive talk for your rowers. It’s important to identify what activating events can lead to a negative belief and negative consequences in your rowers. If you can anticipate these situations, you can plan for how to reframe them as a challenge with potentially positive outcomes. For example, the “A” is a boat walking on you in a race. Your rowers’ “B” might be “they’re gaining on us, we’re screwed,” which has the consequence (“C”) of them losing motivation and slowing their pace. If you can pre-empt their

negative belief with your own positive call, you can turn that adverse event into a positive challenge. You also have to be positive in your own self-talk. You might not always get the top boat, rowers might not always like you, and you might someday hit a dock or another boat or botch a turn in a race. How you manage these adverse events has a lot to do with your own mental mindset.

4. Visualization & Imagery

Create a positive picture of success in a controllable environment and mentally rehearse your actions to improve focus and familiarity when you do them physically.

Visualization, imagery, and mental rehearsal are terms used to describe creating a mental picture of a positive outcome. You can visualize your performance from the perspective of an outside observer or spectator, or from a first-person view. Both can be useful depending on your personal preference. Spend 5-10 minutes the night before training or competing imagining in vivid detail the workout or race, focusing on positive elements under your control. Engage all senses to create a vivid mental picture. Hear the sound of the erg fan, feel the sweat trickle, smell the crisp morning air, feel the oar in your hands, see the buoys fly past you as you race. Focus only on positive thoughts and remember to visualize success with any technical cues you're working on as well as the physical effort of the race or training session.

Like many sport psych routines, visualization may feel silly at first. Fake it until you make it. You weren't a perfect rower the first time you sat in a boat, and your mental skills won't be perfect the first time either. You will get better with dedication.

COXSWAINS: Visualization can be extremely useful for you to mentally rehearse your race plan, steering the course, and your calls, as well as the practice plan, technical focus of drills, which pieces of a practice plan or race will be particularly tough for your rowers, and more. Quite literally, your only limit is your imagination.

5. Pre-Practice & Performance Routines

Use routines to get into a consistent and focused mental state for training or racing.

Our brains love routines. You probably have several routines without knowing it, such as a set land warm-up, a sequence of water warm-up drills for practice, a race plan, even a specific pre-race song or moment with your teammates.

Developing routines can help eliminate distractions and improve focus. Imagine the opposite of routines--total randomness. Waking up on race day not knowing where you are, how to get to the venue, where to find food or what food is even available, where your boat will be at the venue, if it will be rigged already, or what your launch/race time is. It's safe to say that you wouldn't be at your best focus, even if you did manage to get to the start line.

We typically have incidental routines, and going beyond these into intentional routines helps improve focus and performance even further.

Take a few minutes to write down 3-5 things that you are in control of and like to do before practice. Stick to it for at least a week before making changes. For example, a short playlist for the commute to the boathouse, a certain pre-practice meal, or a certain order of doing things to get ready for practice. Do the same for race day, and then make it happen. If you write down "coffee, perfectly-ripe banana, and a protein shake 60 minutes before launching," bring your own coffee, hot water, perfectly-ripe banana, and protein shake so you are in control of your situation and not left sifting frantically through the banana bin before your event.

I should mention that nothing is ever truly 100% in your control, and it is important that your routines are routines and do not become superstitions. There is a fine line here, but the key is that you should still be able to race even if you don't have your perfectly-ripe banana. The idea is simply to develop routines that allow you to focus more on the upcoming training session or race, not to become entirely reliant on a predetermined set

of circumstances.

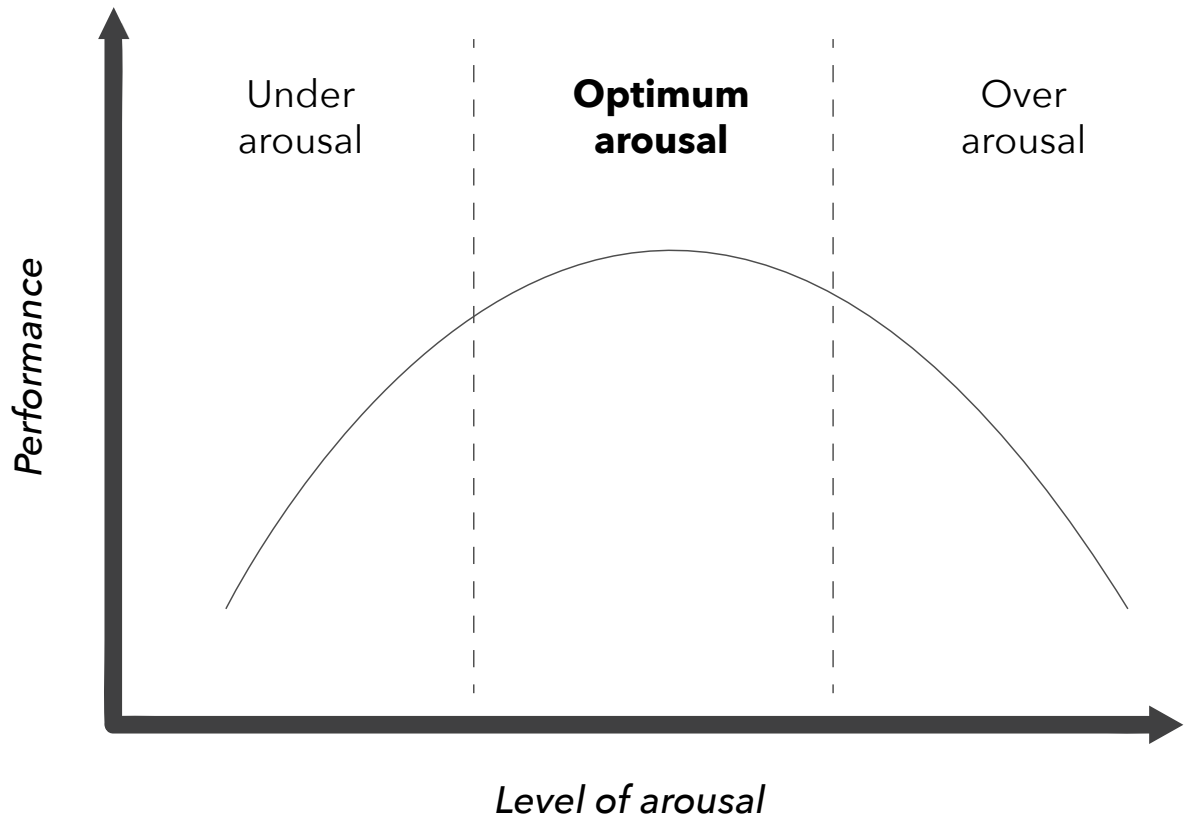
COXSWAINS: Use routines to make sure that you're personally prepared for each race and training session. Make sure you're well-fed, adequately clothed for weather, and have all of your tools or personal items as part of your pre-practice routine. If you receive the practice plan ahead of time, part of your routine can be going over it by yourself or with your fellow coxswains. Your pre-race routine should likely also include checking speakers and headsets in boats, keeping your rowers on track in their routines, and making sure to launch, warm-up, and line up at the appropriate times.

6. Mental Reset Routines

Create a physical cue to refocus after an error or adverse event.

Reset routines are physical and/or mental routines that focus on cues to mentally reset after a mistake, adverse event, or even a successful event. This helps minimize positive and negative emotional carryover from one event to the next, creating a more consistent state of mind for more consistent performance. A baseball player's pre-batting routine is a great example of a reset routine. It clears the player's mind from the previous pitch and allows him to focus on the next one. The same can be done in-between pieces on the erg, sets in the weightroom, or pieces on the water. Some athletes will physically brush off their shoulders after a sloppy drill to "wipe away" the mistake and reset them for the next drill. For rowers, a good reset routine could be something like rotating your handle three times, repeating a mantra, checking your oarlock or footstretchers, slapping your legs, or another brief movement done deliberately to get you ready for the next drill, piece, or set.

COXSWAINS: Mental reset routines are just as useful for you to clear your mind and re-focus. You can also remind your rowers to do this in the boat by instructing them to take a few seconds to reset between pieces.



7. Arousal Management

Recognize when you're outside your optimal zone of arousal and learn how to increase or decrease your arousal accordingly.

The idea of “zones of arousal” is simply that everyone has their own level of emotional excitement or relaxation at which they function and perform best. I've known people who need to get slapped silly to get amped up enough to be at their best, and I've known the “zen masters” who are so relaxed before a race that they could be asleep. Both of these athletes are at their own optimal level of arousal. What's yours? If you recognize that you're outside the zone of arousal too high or too low, what do you do?

Combining other skills, such as visualization with breathing, visualization and PMR, PMR and breathing, and using routines is also an effective way to regulate your arousal levels.

COXSWAINS: Your control of your own energy is critical to your rowers' success. If you're nervous or anxious before a race and rowers can feel it in your calls and commands, it will likely transfer to them and make them nervous and anxious as well. If you're too emotionally high before a race, your exuberant calls could result in them expending too much energy too early in the race and going off of the race plan. Too emotionally low and they may have trouble getting amped up themselves. Tune into where your rowers' zone of arousal is and be the emotional leader of your boat.

Putting it all together

Now you have several different mental skills in your toolbox, so how do you put them together into a training plan? It's important to realize that just like there's no perfect training plan in mental training just like there is no perfect plan in physical training. Start with one variable and individualize it from there. Here are some ideas for incorporating these skills into your training:

- Set some SMART goals for physical and/or mental training. A SMART goal for mental training might be, "practice PMR for 10 minutes four times during the week for one month, then five times during the week for the second month."
- Write out a few adverse training situations you've experienced and do the ABC exercise for cognitive reframing. Start with three and commit to cognitively reframing when those situations arise.
- Make time the night before practice to review the next day's training. Start by just

looking at the workout ahead of time if you know it and taking note of any particular pieces or technical emphases. Once this is routine, add in visualization for a challenging part or two of the training session. This might be a heavy lift, maximal piece, or a technical emphasis for you personally.

- Try out PMR relaxation practice before going to bed or taking a nap.
- Write out a pre-practice routine and stick to it for at least two weeks.
- Come up with a mental reset routine for yourself and stick to it for at least two weeks.

As rowers spend the vast majority of their time training compared to competing, most of these suggestions are aimed at incorporating mental skills into a practice situation rather than a competitive situation. It will also be much easier to use these skills in competition once you've practiced them in lower stress practice situations. As you'll see from the examples below, it's much easier to apply practice mental skills to competitive mental skills once you have them dialed in.

- Set SMART goals for races and erg tests.
- Write out some adverse events that can come up in testing and racing and do a cognitive reframing ABC model for them to be prepared.
- Review race courses, race plans, and do visualization leading up to the test or race.
- Learn what relaxation techniques you respond best to to ease anxiety before a test or race.
- Modify your pre-practice routine to be a pre-race routine, including warmup, pre-race meals, and any additional routines you've responded well to in training.
- Remember to use your mental reset routine if you need to during race warmups.

Just like with physical training, building a great base of mental fortitude and positivity carries over excellently to performing well in competition. If you spend 90% of your season training, cognitively reframing and positive self-talking when adverse events come up, setting effective goals and checking off progress points, recovering more efficiently between sessions thanks to relaxation and improved sleep, and enjoying better, more focused training sessions due to superior mental preparedness, your mental armor will be so strong that nothing will be capable of fazing you during that 10% of competition.

Sample Programs

THE PURPOSE OF THIS BOOK is to teach you how to program for yourself or your team. Every program should be created specifically for the level of athlete, availability of equipment, training schedule, and regatta schedule. There is not a “one-size-fits-all” approach to strength training. It can be helpful to see some examples of how the principles and concepts from the rest of the book come together to create workouts, so I’ve provided some excerpts from each block of training in this chapter. Use these 4-week snapshots as examples to see the concepts of volume, intensity, rest, and exercise selection in action, not as definitive instructions for exactly how to train.

Revisit the “Training Session Design” section within the “The Exercises” chapter for a refresher on how to create programs progressing from the annual structure, to individual session structure, to categories of movements, to banks of exercise and equipment availability, and then to sets, reps, intensity, and rest.

For each block of training, I have provided a template, then a sample program based on that template.

	Exercises	Week 1	Week 2	Week 3	Week 4
Day 1	Warmup				
	A. 1/2 Kneeling OHP	3 x 10, 60-90s	3 x 12, 60-90s	4 x 8, 60-90s	4 x 10, 60-90s
	B1. Rear Foot Elevated Split Squat	3 x 10, n/a	3 x 12, n/a	4 x 10, n/a	4 x 12, n/a
	B2. Alternating DB Bench	3 x 10, n/a	3 x 12, n/a	4 x 10, n/a	4 x 12, n/a
	B3. Batwing Row	3 x 10, 60s	3 x 12, 60s	4 x 10, 60s	4 x 12, 60s
	C1. Facepull	2 x 15, n/a	3 x 12, n/a	3 x 15, n/a	2 x 20, n/a
	C2. Band/Cable Pullthrough	2 x 15, n/a	3 x 12, n/a	3 x 15, n/a	2 x 20, n/a
	C3. Any Plank Variation	2 sets, n/a	3 sets, n/a	3 sets, n/a	2 sets, n/a
Day 2	Warmup				
	A. Goblet Squat or Front Squat	3 x 10, 60-90s	3 x 12, 60-90s	4 x 8, 60-90s	4 x 10, 60-90s
	B1. Alternating DB OHP	3 x 10, n/a	3 x 12, n/a	4 x 10, n/a	4 x 12, n/a
	B2. DB Romanian Deadlift	3 x 10, n/a	3 x 12, n/a	4 x 10, n/a	4 x 12, n/a
	B3. Landmine Row	3 x 10, 60s	3 x 12, 60s	4 x 10, 60s	4 x 12, 60s
	C1. YWT Raise (each letter)	2 x 15, n/a	3 x 12, n/a	3 x 15, n/a	2 x 20, n/a
	C2. Hip Thrust	2 x 15, n/a	3 x 12, n/a	3 x 15, n/a	2 x 20, n/a
	C3. Pallof Press or Dead Bug	2 sets, n/a	3 sets, n/a	3 sets, n/a	2 sets, n/a

Specific Prep Block

The Specific Prep Block is similar to the General Prep Block, with the inclusion of some heavier strength training work. Intensity goes up a bit, volume goes down to accommodate it, and variety stays fairly high. The biggest change in Specific Prep is the rowing training, as athletes transition back to full-time, or close to full-time, rowing after a block of high variety aerobic cross-training. This is a significant change in training stress and muscular stimulus on its own. Strength is the focus quality, muscular hypertrophy is the secondary or maintenance quality.

Workouts written as (sets x reps, rest).

3 x 10, 60-90s means 3 sets of 10 with 60-90 seconds rest after each set.

If the exercises are listed as a circuit, for example B1-B3 3 x 10, 60-90s, you will perform one set of B1, one set of B2, one set of B3, then take the prescribed rest, then perform a second set of B1, B2, and B3, rest again, then perform a third set of B1, B2, and B3, then rest.

A typical template for the Specific Prep Block is below, followed by a sample program based on that template.

	Exercises	Week 1	Week 2	Week 3	Week 4
Day 1	Warmup A. Vertical Press B. Compound Hinge C1. Horizontal Press B2. Horizontal Row C1. Shoulder Assistance C2. Hinge Assistance C3. Core	Main Work Main Work Assistance Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance Assistance
Day 2	Warmup A. Compound Squat B1. Vertical Press B2. Squat Assistance B3. Horizontal Row C1. Shoulder Assistance C2. Hinge Assistance C3. Core	Main Work Assistance Assistance Assistance Assistance Assistance Assistance	Main Work Assistance Assistance Assistance Assistance Assistance Assistance	Main Work Assistance Assistance Assistance Assistance Assistance Assistance	Main Work Assistance Assistance Assistance Assistance Assistance Assistance

	Exercises	Week 1	Week 2	Week 3	Week 4
Day 1	Warmup A. 1/2 Kneeling OHP B. Trap Bar Deadlift C1. Alternating DB Bench C2. Batwing Row D1. Facepull D2. Band/Cable Pullthrough D3. Plank Variation	4 x 6, 3mins 3 x 5, 3-4mins 3 x 10, n/a 3 x 10, 60s 2 x 15, n/a 2 x 15, n/a 2 sets, n/a	5 x 5, 3mins 5-3-2, 3-4mins 3 x 12, n/a 3 x 12, 60s 3 x 12, n/a 3 x 12, n/a 3 sets, n/a	6 x 4, 3mins 6 x 1, 3-4mins 4 x 10, n/a 4 x 10, 60s 3 x 15, n/a 3 x 15, n/a 3 sets, n/a	8-5-3, 3mins 1 x 10, 3-4mins 4 x 12, n/a 4 x 12, 60s 2 x 20, n/a 2 x 20, n/a 2 sets, n/a

	Exercises	Week 1	Week 2	Week 3	Week 4
Day 2	Warmup				
	A. Front Squat	4 x 6, 3-4mins	5 x 5, 3-4mins	6 x 4, 3-4mins	8-5-3, 3-4mins
	B1. Alternating DB OHP	3 x 10, n/a	3 x 12, n/a	4 x 10, n/a	4 x 12, n/a
	B2. Rear Foot Elevated Split Squat	3 x 10, n/a	3 x 12, n/a	4 x 10, n/a	4 x 12, n/a
	B3. Landmine Row	3 x 10, 60s	3 x 12, 60s	4 x 10, 60s	4 x 12, 60s
	C1. YWT Raise (each letter)	2 x 15, n/a	3 x 12, n/a	3 x 15, n/a	2 x 20, n/a
	C2. DB Romanian Deadlift	2 x 15, n/a	3 x 12, n/a	3 x 15, n/a	2 x 20, n/a
	C3. Pallof Press or Dead Bug	2 sets, n/a	3 sets, n/a	3 sets, n/a	2 sets, n/a

Pre-Competitive Block

6-8 weeks before the first important race of the competitive season, we want to tune up the base strength, hypertrophy, and aerobic base developed in the Preparation Blocks of training into top-end boat-moving strength and power. We decrease volume, increase intensity, and increase specificity. The session pattern is typically 1-2 exercises for power development, performed for multiple sets of low reps at a moderate intensity with full explosive intent, then 1-2 exercises for strength development similar to the Specific Prep Block, then 1-3 exercises for muscular balance and maintaining hypertrophy. Percentages are listed as a general guide to ensure that athletes train power exercises at a weight that is adequately heavy, while still maximizing force production.

Workouts written as (sets x reps, rest).

3 x 10, 60-90s means 3 sets of 10 with 60-90 seconds rest after each set.

If the exercises are listed as a circuit, for example B1-B3 3 x 10, 60-90s, you will perform one set of B1, one set of B2, one set of B3, then take the prescribed rest, then perform a second set of B1, B2, and B3, rest again, then perform a third set of B1, B2, and B3, then rest.

A typical template for the Pre-Competitive Block is below, followed by a sample program based on that template.

	Exercises	Week 1	Week 2	Week 3	Week 4
Day 1	Warmup A. Hinge Assistance B. Compound Hinge C1. Horizontal Press C2. Horizontal Row D1. Shoulder Assistance D2. Core	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance
Day 2	Warmup A. Vertical Press B. Compound Squat C. Squat Assistance D1. Shoulder Assistance D2. Hinge Assistance D3. Core	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance

	Exercises	Week 1	Week 2	Week 3	Week 4
Day 1	Warmup A. Kettlebell Swing B. Trap Bar Deadlift @ 70%1RM C1. Alternating DB Bench C2. Batwing Row D1. Facepull D2. Any Plank Variation	5 x 5, 60s 6 x 2, 60s 4 x 8, n/a 4 x 8, 60-90s 3 x 10, n/a 3 sets, n/a	5 x 3, 60s 6 x 3, 60s 5 x 5, n/a 5 x 8, 60-90s 3 x 12, n/a 3 sets, n/a	6 x 4, 60s 8 x 2, 60s 4 x 6, n/a 4 x 10, 60-90s 3 x 10, n/a 3 sets, n/a	7 x 3, 60s 8 x 3, 60s 4 x 8, n/a 4 x 12, 60-90s 3 x 12, n/a 3 sets, n/a
Day 2	Warmup A. 1-Arm DB Push Press B. Front Squat @ 70%1RM C. Rear Foot Elevated Split Squat D1. Band Pullapart D2. DB Romanian Deadlift D3. Pallof Press or Dead Bug	5 x 5, 60s 6 x 2, 60s 4 x 8, 60-90s 3 x 10, 60s 3 x 10, n/a 3 sets, n/a	5 x 3, 60s 6 x 3, 60s 5 x 5, 60-90s 3 x 12, 60s 3 x 12, n/a 3 sets, n/a	6 x 4, 60s 8 x 2, 60s 4 x 6, 60-90s 3 x 15, n/a 3 x 15, n/a 3 sets, n/a	7 x 3, 60s 8 x 3, 60s 4 x 8, 60-90s 2 x 20, n/a 2 x 20, n/a 2 sets, n/a

Competitive Block and Basic Taper

The Competitive Block will be the most variable block of training, since it depends entirely on your individual rowing training and racing schedule. General session structure is the same as Pre-Competitive Block, but work can be added or subtracted depending on how far away you are from your priority competitive events.

In the sample program below, the athlete has a race at the end of Week 2, and at the end of Week 4. This demonstrates the residual sessions and the power maintenance sessions. Depending on the travel involved for the regatta, we often omit the second day of strength training. In this case, I encourage athletes to do the full-body warmup from their hotel room to revive stiff muscles from long hours in the car or plane.

This is how we train through racing season while accommodating specific competitive events, but not doing a full taper cycle for peak performance. The next sample program contains a taper cycle for peak performance.

Workouts written as (sets x reps, rest).

3 x 10, 60-90s means 3 sets of 10 with 60-90 seconds rest after each set.

If the exercises are listed as a circuit, for example B1-B3 3 x 10, 60-90s, you will perform one set of B1, one set of B2, one set of B3, then take the prescribed rest, then perform a second set of B1, B2, and B3, rest again, then perform a third set of B1, B2, and B3, then rest.

A typical template for the Competitive Block is below, followed by a sample program based on that template.

	Exercises	Week 1	Week 2	Week 3	Week 4
Day 1	Warmup A. Hinge Assistance B. Compound Hinge C1. Horizontal Press C2. Horizontal Row D1. Shoulder Assistance D2. Core	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance
Day 2	Warmup A. Vertical Press B. Compound Squat C. Squat Assistance D1. Shoulder Assistance D2. Hinge Assistance D3. Core	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance	Main Work Main Work Assistance Assistance Assistance Assistance

	Exercises	Week 1	Week 2	Week 3	Week 4
Day 1	Warmup A. Kettlebell Swing B. Trap Bar Deadlift C1. Alternating DB Bench C2. Batwing Row D1. Facepull D2. Any Plank Variation	5 x 5, 60s 6 x 2, 60s 4 x 8, n/a 4 x 8, 60-90s 3 x 10, n/a 3 sets, n/a	5 x 3, 60s 4 x 3, 60s 3 x 5, n/a 3 x 8, 60-90s 2 x 12, n/a 2 sets, n/a	6 x 4, 60s * See below 4 x 6, n/a 4 x 10, 60-90s 3 x 10, n/a 3 sets, n/a	5 x 3, 60s 4 x 3, 60s 2 x 8, n/a 2 x 12, 60-90s 2 x 12, n/a 2 sets, n/a
Day 2	Warmup A. 1-Arm DB Push Press B. Front Squat C. Rear Foot Elevated Split Squat D1. Band Pullapart D2. DB Romanian Deadlift D3. Pallof Press or Dead Bug	5 x 5, 60s * See below 4 x 8, 60-90s 3 x 10, 60s 3 x 10, n/a 3 sets, n/a	<i>Optional</i> 3 x 3, 60s 2 x 2 @ 70% 2 x 10, 60-90s omit omit omit	6 x 4, 60s 8 x 2, 60s 4 x 6, 60-90s 3 x 15, n/a 3 x 15, n/a 3 sets, n/a	<i>Optional</i> 3 x 3, 60s 2 x 2, 60s 2 x 10, 60-90s omit omit omit

** For the Week 1 and 3 residual sessions, take 4-5 small jumps in weight up to a heavy set of 2 or 3 reps with 85%1RM. For an athlete with a real or projected front squat 1RM of 205lbs, this might look like: 45 x 5, 95 x 5, 115 x 5, 135 x 3, 150 x 3, 165 x 3, 175 x 3. This achieves the goal of hitting heavier weights to maintain maximal strength and power, while developing power and power endurance with the other training sessions.*

Competitive Block: Advanced Taper

See the “Writing a Program” chapter for a description of the Competitive Block and concepts behind the strength training taper for peak rowing performance. I only aim for 1-2 actual peak performances in a training year, due to the amount of time and energy that peaking takes away from training. If you try to peak for 3-4 races, you can lose 8-12 weeks of productive training with all of the rest and recovery of multiple taper cycles. For spring 2km-rowers, we typically aim for 1-2 peaks in the late spring regional and national championship races. For masters rowers, we might peak once in the spring or summer and once again in the fall, depending on the calendar of competitive events and individual goals of the athlete.

The sample program below is a 3-week taper cycle for a peak performance at the end of Week 3. The athlete raced before Week 1, and will not race Week 1 or Week 2.

Workouts written as (sets x reps, rest).

3 x 10, 60-90s means 3 sets of 10 with 60-90 seconds rest after each set.

If the exercises are listed as a circuit, for example B1-B3 3 x 10, 60-90s, you will perform one set of B1, one set of B2, one set of B3, then take the prescribed rest, then perform a second set of B1, B2, and B3, rest again, then perform a third set of B1, B2, and B3, then rest.

	Exercises	Week 1	Week 2	Week 3
Day 1	Warmup A. Kettlebell Swing B. Trap Bar Deadlift C1. Alternating DB Bench C2. Batwing Row D1. Facepull D2. Band/Cable Pullthrough D3. Any Plank Variation	6 x 4, 60s 6 x 2, 60s 4 x 8, n/a 4 x 8, 60-90s 3 x 10, n/a 3 x 10, n/a 3 sets, n/a	5 x 5, 60s 6 x 3, 60s 5 x 5, n/a 5 x 8, 60-90s 3 x 12, n/a 3 x 12, n/a 3 sets, n/a	5 x 3, 60s 2 x 2, 60s <i>Stretch and do other recovery work during remaining time</i>

	Exercises	Week 1	Week 2	Week 3
Day 2	Warmup A. 1-Arm DB Push Press B. Front Squat C. Rear Foot Elevated Split Squat D1. Band Pullapart D2. DB Romanian Deadlift D3. Pallof Press or Dead Bug	5 x 5, 60s * See below 4 x 8, 60-90s 3 x 10, 60s 3 x 10, n/a 3 sets, n/a	3 x 3, 60s 4 x 2 @ 70% 2 x 10, 60-90s omit omit omit	Omit (travel/rest)

** For the Week 1 residual session, take 4-5 small jumps in weight up to a heavy set of 1 or 2 reps with 85%1RM. For an athlete with a real or projected front squat 1RM of 250lbs, this might look like: 45 x 5, 95 x 5, 115 x 5, 135 x 3, 155 x 3, 175 x 2, 190 x 2, 215 x 1. This achieves the goal of hitting heavier weights to maintain maximal strength and power, while maintaining power and muscle mass with the other training sessions.*

Appendix

- Please see “The Research on Low Back Pain and Rib Stress Injuries in Rowing” on RowingStronger.com
<https://rowingstronger.com/2018/09/10/low-back-pain-rib-stress-injuries-rowing/>
- Example of an annual periodized plan layout (p 150)
- Blank template for annual periodized plan (p 151)

[illegible]

Week	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Month	12	12	12	12	12	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	4	5	5	5	5
Day	3	10	17	24	31	7	14	21	28	4	11	18	25	4	11	18	25	1	8	15	22	29	6	13	20	27
Block	Specific Preparation									Pre-Competitive								Competitive								
Season	Winter									Early Spring								Late Spring								
Regatta														MIN		MIN		MIN		MAJ		MAJ	MAJ		NAT	
Time Testing																										
Other Factors		EX	H	H	H												EX	H								
Focus	Strength									Power								Performance								
Maintenance	Hypertrophy									Strength								Strength, Power, Hypertrophy								
Row Volume																										
Cross Training																										
Microcycle																					Taper					
Program Block	3									4								5								
Deload				D					D															D	D	
Transition										T																
Taper Training																		M	M	L	H	L	L	H		
Gym Testing																										
Notes	See: Specific Preparation									See: Pre-Competitive								See: Competitive, Taper								

Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Month																										
Day																										
Block																										
Season																										
Regatta																										
Time Testing																										
Other Factors																										
Focus																										
Maintenance																										
Row Volume																										
Cross Training																										
Microcycle																										
Program Block																										
Deload																										
Transition																										
Taper Training																										
Gym Testing																										
Notes																										
KEY																										

Week	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	
Month																											
Day																											
Block																											
Season																											
Regatta																											
Time Testing																											
Other Factors																											
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Row Volume																											
Cross Training																											
Microcycle																											
Program Block																											
Deload																											
Transition																											
Taper Training																											
Gym Testing																											
Notes																											

About the Author

I PLAYED SEVERAL SPORTS GROWING UP, but I come from a family of rowers and knew it was only a matter of time until I picked up an oar as well. I did my junior rowing in Olympia, WA, and then tried my hand at lacrosse when I came to college at Western Washington University (WWU). I majored in Kinesiology at WWU with an emphasis in Sport Psychology, and started getting involved with coaching during my junior year on a year-long internship with the varsity track and field team. I started coaching the men's rowing team in 2013 in small groups around my class and coaching schedule, before officially joining the coaching staff as team strength coach and on-water assistant coach. I will graduate from the University of Denver in 2019 with an MA in Sport Coaching. I have held strength training certifications with USA-Weightlifting (Level 1) and the National Strength and Conditioning Association (NSCA-CSCS), as well as US-Rowing (Level 2).

I started writing online in 2015 because I believe that strength training plays a significant role in getting the most out of rowing from a performance, injury reduction, and longevity standpoint. My goal is to help everyone get stronger so they can row faster, healthier, and longer. You can find more of my written work, podcasts, and videos online at my website, www.RowingStronger.com. I do training consultations, coach and athlete workshops, and online programming, and I am always happy to answer questions and talk about strength training for rowing. Please email me anytime via the contact information available on my website.

Thanks for buying my book!

I wrote this supplemental PDF in early 2024 as the Second Edition turned five years old. I published the First Edition in 2015 and the Second Edition in 2019. Based on that pattern, there was an understandable uptick in questions in 2023 about when the Third Edition would be coming. I've coached, written, and learned a lot since 2019, perhaps even more than in the four years after 2015. However, I don't have time in the foreseeable future to commit to the whole rewriting process. I hope this supplemental PDF will suffice for now on major things that I'm doing differently.

The basics are still important. I still think the information in the Second Edition is essentially good. There is nothing in the Second Edition that I don't do anymore, that I think rowers should not be doing, or that I would like to "undo." The updates you'll read ahead are additions only. I have not replicated any information from the Second Edition in the supplemental PDF.

I've continued to update my work as I've learned and found new things. You'll find longer articles on my website, shorter posts on Substack, instructional videos and recorded webinars available on Youtube, and you can see me live at Craftsbury workshops and some events throughout the year. Substack is the "one-stop-shop," where I send out notification of all new content, updates, and upcoming events, so follow me there to stay up-to-date. Links at the "contact" page below.

In this update, I've put the major changes and additions in one place with some more detail that I hope will be helpful for your training. The main areas of addition are as follows:

- Coaching the Lowering and Lifting Tempo
- Plyometric Exercises
- Velocity Based Training
- Hamstring Knee Flexion Exercises
- Lateral and Rotational Hip Exercises
- Core Exercises with Synchronized Breathing
- Updated Training Templates and Programs

In Strength,

Will Ruth

<https://rowingstronger.com/contact/>

Coaching Lowering and Lifting Tempo

I encourage rowers to lift by controlling the lowering phase of most exercises with a “two-count” down, and then accelerating the lifting speed to be visibly faster than the lowering speed. This “2:1 tempo” is our default setting unless noted otherwise. I did a video on this in late 2021, available below. I’ve continued to coach it heavily with all ages, types, and levels of rowers.

Strength Training Tempo video: https://youtu.be/IC0aeiFI_Jw

General anecdotal results include:

- Greater muscle gain, through increasing muscle tension and eccentric muscle action
- Better progress in strength training, through increasing muscle gain and improving exercise technique
- Fewer strength training injuries and less general joint pain, through improving exercise technique and decreasing forces at point of reversal
- Better carryover to rowing, through increased acceleration on lifting phase and maybe the connection to rowing technique and slide control with the lowering phase

A brief anatomy lesson can be helpful to understand the importance of this. Muscles have three main ways of acting to produce force. In a concentric action, muscles shorten to produce force. In an isometric action, muscles produce force without changing length. In an eccentric action, muscles lengthen while producing force, usually resisting gravity or force. There is very little eccentric muscle action in the rowing stroke. At almost every point in the rowing stroke, rowers’ muscles are either shortening to produce force (concentric) or static to transfer force (isometric). The recovery phase of the rowing stroke is unloaded, so while muscles are lengthening to reach full extension, they are not resisting any force and it is not an eccentric muscle action.

Every rep of almost every strength training exercise offers an opportunity to train eccentric muscle actions. The rower just needs to focus on controlling the lowering phase. Do not flop, fall, or drop down to the bottom position of the exercise without or with minimal tension. Reduce weights or reps as necessary to achieve this. Eccentric actions generate the greatest amount of muscular force and can increase gains in muscle strength and size. Strength training without attention to the eccentric phase misses these benefits. Rowers then miss these benefits again due to the minimal role of eccentric action in the rowing stroke. The gains from tempo training are there for those who want them. It requires no technology or cost beyond focus and discipline to continue doing it even when it’s hard.

Tempo control can be challenging on both the lowering and lifting phases of the movement, as well as the point of reversal between lowering and lifting. I see rowers struggle with all three phases. Lowering the weight under control is genuinely hard, and again, this is very undertrained because rowers miss eccentric muscle actions from rowing and erging training. Rowers who dive-bomb or flop to the bottom position of squats, hinges, and upper body pushes and pulls have to absorb and reverse all of that downward momentum before beginning the lifting phase. This also increases stress and strain on the joints that to absorb all of that falling

force. Controlling the lowering phase often helps with the point of reversal, reducing pain in rowers who have previously been unable to do an exercise without pain.

Rowers also often struggle to accelerate the lifting phase. This is related to the speed of the lowering phase, too. More downward force from a rapid, uncontrolled lowering phase means more challenge at the point of reversal. A hard point of reversal means less energy or strength remaining to accelerate the lifting phase. A secondary reason is that rowers tend to not be “explosive” athletes the way we see with other sports more dependent on sprint and power. The speed of the stroke is fast, but it is not as fast as a true sprint and power sport. In the 2020 study, “Technical Determinants of On-Water Rowing Performance” by Holt et al., researchers found that time to peak force was a critical factor for boat speed, and that elite rowers in small boats achieved peak force in approximately 0.4 of a second from the blade entering the water.

These are all trainable qualities through strength training. Focusing on tempo through lowering, reversal, and lifting phases offers numerous benefits. Controlling the lowering phase is how we harness the power of eccentric muscle actions for greater gains in strength and muscle size, filling this gap from rowing and erging training. Controlling the point of reversal reduces injury risk and improves acceleration on the lifting phase. Acceleration on the lifting phase improves power output and transfer to the fast, precise nature of power application in the rowing stroke.

The 2:1 tempo (two counts when lowering, one count when lifting) lays the foundation for power work with the “2:X” tempo for explosive intent power training. The “X” stands for explosive, or acceleration, or just as little time as possible on the lifting phase while still lifting a challenging weight. I don’t coach rowers to lift the lifting phase slower, but with the 2:X tempo we decrease the weight and specifically coach a lifting phase that is as fast as possible with good technique. I make the comparison of the 2:1 tempo is normal rowing, and 2:X tempo is a “power-10” stroke.

We use the 2:X tempo in the Pre-Competitive (pre-season) and Competitive (in-season or race-prep) phases of strength training to focus on rate of force development as a specific trainable factor. I found that rowers struggled with 2:X without enough time and attention to training the 2:1 tempo. We spend the General and Specific Prep (off-season) phases developing total force and laying the foundation with the 2:1 tempo. Then, we work to speed it up with rate of force development training and the 2:X tempo in the Competitive phases.

For rate of force development, we do between 5-8 sets of 2-4 reps, most often 5x3 or 6x2, using a weight that we would typically use for sets of 6-8 reps. The load has to be lighter and the duration has to be shorter in order to reach full power expression, instead of just training more elements of total force output with heavier weights lifted more slowly or lighter weights lifted for longer duration sets.

I generally use the same exercises that the rower has trained through the off-season for the power work and 2:X tempo training. I prefer the front squat and hex bar deadlift for the lower body, but the back squat and barbell deadlift or Romanian deadlift can be used as well if they’re a better fit for the rower. The push press, or overhead press with leg drive, is a good upper body power exercise that begins with force at the feet. Rowers newer to strength training use a 1-arm

push press with a dumbbell, while those more experienced and stronger in need of more challenge and load may use a 2-arm barbell push press.

I also include kettlebell swings, as a dynamic hinge, and plyometric exercises, detailed in the next section, if we aren't doing them already in off-season strength training. Push press, kettlebell swing, and plyometrics are all inherently done for higher rate of force development. The squat and hinge exercises can be done for total force or rate of force development, so they need some intentional programming and coaching depending on the phase of training and the 2:1 tempo versus the 2:X tempo.

We can use other tempo variations as well for different training effects. When rowers are learning strength training exercises, the 3:1 tempo of even longer lowering time can help ingrain the goal technique on the lowering phase. Adding a pause to the bottom position of squats and hinges, such as the 2:1:1 tempo of two seconds down, a one-second pause at the point of reversal, and a one-count lifting phase, is a helpful teaching tool to double-check technique and improve stability. Add a pause to the top position of a pulling exercise, such as a bodyweight row, for a more intense muscular stimulus and a simple way to teach the strong shoulders-down position. I have found longer lowering phases and pauses helpful for hypermobile rowers to improve stability and control of effective range-of-motion. We can then transfer this knowledge and ability back to rowing with effective length on ergs and on-water rowing.

Plyometric Exercises

I wrote an article about plyometric exercises in June of 2020, updated while writing this and available at the link below. I have continued using them in my strength training to improve rowers' athletic coordination and rate of force development.

Plyometrics for Rowers article: <https://rowingstronger.com/2020/06/01/plyometrics-for-rowers/>

I use plyos for a few main reasons. Most rowers seem to like to do plyos, so taking advantage of interest and engagement is usually good to make strength training more enjoyable and effective. Developing the coordination required to accelerate, absorb force, land, and redirect force from biomechanically sound positions is beneficial for general athleticism, even if these are not skills directly connected to the rowing stroke. There does seem to be a positive performance effect in increasing rate of force production, even though the speed of the propulsive phase of the stroke ("drive") is not as fast as a true plyometric movement.

Masters rowers should be particularly aware of these benefits. Rate of force development and ability to absorb force detract more quickly with age when untrained versus aerobic endurance and general muscular strength. Juniors also benefit from the coordination enhancements from plyometric training, especially during puberty when rapid growth and neuromuscular changes can interfere with coordination. Collegiate and high-performance rowers can focus plyometric training on increasing rate of force production to improve rowing performance.

I wasn't using plyometrics with rowers in 2019 because of my belief that rowing is not truly a plyometric sport. Unlike track and field (or "athletics" for European readers), court sports, and field sports, rowing has a slow propulsive force application and no reactive force element of absorbing and redirecting force. We generally want rowers to move smoothly into the catch, not dropping or landing on the footplate. While the early drive phase is accelerated, it is not at the faster speeds typically targeted with plyometric exercises.

I changed my mind in 2020 for two main reasons. One was pandemic-era experimentation from being forced to get more training stimulus from less available load and equipment. When rowers I was coaching didn't have the full array of gym equipment, plyometrics offered a way to still gain stimulus. They noted improved performance, especially on the heavier load, more stable static ergometer.

The other was a pair of good rowing research studies from 2017 and 2019. See my 2020 article for more details on the research, and go deeper with the full text of the studies by Egan-Shuttler and colleagues: "Beyond Peak, a Simple Approach to Assess Rowing Power and the Impact of Training: A Technical Report [2017]," and "The Effect of Concurrent Plyometric Training Versus Submaximal Aerobic Cycling on Rowing Economy, Peak Power, and Performance in Male High School Rowers [2019]."

I did a video in January of 2024 with the latest variations, progressions, and cues from my coaching. My favorite plyos for rowers include the backwards overhead medicine ball throw and the seated vertical jump, detailed below. We also use the more standard countermovement (squat) jump and non-countermovement (paused) jump. We can do these with one leg or two legs. We can also do them laterally (side-to-side) and broad (jumping forward).

Plyometrics for Rowers video: https://youtu.be/aif-g_-yUDc

In the backwards overhead throw, rowers work on the long power chain of propulsion from hip extension directed through the arms. This is highly transferrable to rowing, especially to the more patient drive phase of a small boat. Rowers can do backwards overhead throws with the back against a wall. Stand a few steps away from the wall and throw back-and-up, aiming at the intersection of the wall and ceiling. Move out of the way of the falling ball and don't try to catch it on the way down. Rowers can also throw outdoors. Two rowers can throw to each other to add a fun competitive element. One rower can take active rest during the walk to retrieve the ball. Use a medicine ball or sandbag weight that is heavy enough to challenge the athlete to accelerate the load, while not being so heavy that the athlete cannot actually accelerate the load. This may be around 5-10 pounds for a weaker, newer athlete, and up to 30 pounds for a stronger, more experienced athlete.

In the seated jump, rowers improve the ability to engage leg drive with minimal movement at the torso and shoulders. Hold a forward body angle and avoid rocking-in to the jump or picking the feet up to preload before jumping. Just like when rowing, the goal is to accelerate from a stable foot position with minimal momentum or countermovement from other bodyparts. This is a more specific skill than jumps with countermovement or momentum. Rowers will first be challenged by the physical control more than the pure power output. These are the coordination gains!

There are some basic safety concerns with plyos. Rowers need to learn how to land well before progressing in more challenging jump variations. We also need a landing surface that is not hard concrete. This rules out most boathouse floors or asphalt driveways as safe options. We have had a few rowers miss training sessions due to missed landings on box jumps. I always encourage a vertical jump without a box, or at least using the soft-topped plyo boxes instead of the wooden ones with hard edges. Masters rowers and those with knee pain should always use a soft-topped box or gym mats to minimize lower leg impact from landing. If jumps are not tolerable and mats or a soft-topped box not an option, then consider using a throwing plyo for similar benefits. When throwing, make sure the area around the athlete is clear. A medicine ball can slip mid-flight or launch in a different direction than intended. We have a throwing area in the gym that we try to keep clear of obstacles and other athletes.

The National Strength and Conditioning Association (NSCA) offers good concise guidance to implementing plyometric exercise in their 2017 book, "Developing Power:" *"Low frequency (2-3 sessions per week) and low volume (3-6 sets of 2-5 repetitions) are most appropriate. It is not necessary to perform myriad plyometric exercises. Getting the most out of a program requires mastering the movements of the exercises themselves. For most athletes, two or three*

plyometric exercises at any one time is sufficient for attaining movement mastery and obtaining considerable benefit."

Avoid making common errors of using too wide a variety of plyos, performed for too many repetitions per set, at too great a total volume or duration. Doing sets of 20+ sloppy squat jumps or burpees is not making athletes more coordinated or powerful. It's more likely doing the exact opposite, ingraining poor movement patterns and teaching athletes to conserve energy by reducing rate of force development for prolonged endurance.

We use plyos at least in the pre-season and in-season phases when we're focused on rate of force development. We often use them year-round to enhance athletic coordination more than rate of force development. Consider using more varied, athleticism-oriented plyos in the off-season, and then focus on more specific, power-oriented plyos in the pre-season for racing.

The most common way we use plyos in strength training is in a superset with our main lower body squat or deadlift exercise. Do the plyometric exercise first, then the lower body exercise, and then take the rest after finishing the lower body exercise. Don't rush from the jump or throw to the squat or deadlift, but don't waste time or intentionally add rest between them. The full power expression of the high-speed plyometric exercise seems to enhance power output in the high-force strength exercise. This effect fades with increasing the amount of time between the plyo and the lift.

I like to pair types or planes of plyos with the main strength training exercise. I typically use a countermovement jump or forwards overhead throw with a squat exercise, focusing on the squat pattern and knee extension. I typically use a non-countermovement jump or backwards overhead throw with a deadlift exercise, focusing on the hinge pattern and power production from a position of no momentum. I find this helps connect physical skills for the athletes and achieves greater enhancement from the plyo to the strength exercise.

If supersetting doesn't work for some reason, then just start the training session with about 10 minutes of one or two plyo variations following the warmup. This often works well in a boathouse training scenario, when suitable flooring is available. It's also great when doing something like the backwards overhead throw outdoors, away from the gym-based strength training. Do the warmup, then the plyometric power work done with at least a 1:4 work-to-rest ratio (minimum 5 seconds of rest per rep). If this is a strength training session, move into the main squat or deadlift strength work, then the assistance work of higher fatigue specific muscle or bodypart training. If this is an aerobic training session, do the plyometrics first and then whatever erging, rowing, or cross-training second.

I use up to about a dozen total jump and throw variations when we consider all the combinations of 1-leg or 2-leg jumps and using countermovement or non-countermovement jumps and throws. There are some plyos that I generally don't use with rowers due to my doubts about their safety and/or relevancy for rowing. One is the drop jump or depth jump, in which the athlete jumps down off of a box or step, lands, and then jumps. This significantly increases

landing forces and effort to redirect force into the jump. This can be an injury or overuse risk from hard-contact landings. Since the rowing stroke doesn't have a force absorption and redirection phase like that, I don't think it's relevant enough to be worth that risk. I see the tuck jump or any kind of repeating jump similarly, in which the athlete goes straight from jumping to landing to jumping again. We may do this with a non-countermovement jump: jump, land and work to descend slowly (ratio), hold the bottom position for a second, and then jump again with no break between jumps. Just jumping up and down with quick descents and rapid reversals is, again, not how we row and therefore not relevant to rowing. Finally, I understand that medicine ball slams are fun, and I won't take that away if that's the reason for doing them. However, the rowing stroke has no explosive flexion component, so slams aren't relevant to stroke technique or power the way the backwards or forwards overhead throw are.

I have a short rant about box jumps visualized in the plyo video. The takeaway message is to use a lower box height and focus on maximizing hip height through extension, rather than a high box maximizing foot height through hip flexion. As I mentioned earlier, we have had some injuries from rowers missing the landing on hard wooden boxes. This is a lame and annoying reason to miss training time. Part of this problem is the hardness of the box and the consequences for a miss. This can be solved by using mats or a soft-topped box. The other part of the problem is using too high of a box due to a fixation on foot height. This increases the risk of a missed landing. The purpose of plyos for rowers is maximizing hip-and-knee extension power. As with medicine ball slams, explosive hip flexion is irrelevant and even directly conflicting with the goals of rowing. Box jumps that emphasize bringing the feet up to land on the box are missing the point. Jump for hip height instead. The athlete can reach just as high of a hip height and land on a lower box with less of a knee angle. This increases efficacy and improves safety. It also means that we don't have to keep finding higher and higher boxes, or the charade of stacking unsafe objects on top of boxes to get even higher. As with medicine ball slams, I understand that high box jumps can be fun. If this is the reason for doing them, pick the time wisely knowing the increased risk from a missed landing.

Velocity-Based Training

Rowers often ask about how much weight to use or how hard to strain on an individual rep or set of a strength training exercise or in a strength training session overall. This is hard to communicate. There's a sweet spot of enough strain to challenge the athlete and encourage physiological adaptation, without so much strain that we risk overtraining, injury from poor technique, or simply unsustainable training intensity.

In the Second Edition, I wrote about strength training with percent-of-1-repetition-maximum (1RM) and rate of perceived exertion (RPE). These were the combinations that I was using at the time. I still use RPE in many cases, and I recommend that rowers generally use RPE instead of percent-1RM. I wrote an article in 2020 about these systems, the research behind them for endurance athletes, and how I try to overcome limitations in practice, available at the link below.

Article: <https://rowingstronger.com/2020/03/02/percent-1rm-vs-rpe-for-rowing-training/>

In early 2023, I began using velocity-based training (VBT) with the Green Racing Project teams and have found it a huge improvement in prescribing and communicating ideal strain of individual reps, sets, and training sessions overall. VBT systems use technology to measure movement speed. We can then use this data to target a specific rate of force development to achieve the general physiological adaptations. This does add some cost in purchasing the technology and learning how to use it. The reward for doing so is greatly clarifying the communication around what weight to use. I have also found VBT to improve athlete understanding of progress as more than just reps or weight on the bar. VBT also helps transfer strength and skill to the performance environment by quantifying rate of force development.

This also relates to the discussion of lifting tempo and power training. The 2:1 tempo and 2:X tempo guidance works to get rowers thinking about acceleration and the speed of movement. This is sufficient for many rowers and training situations. I've found big improvements in measuring, quantifying, and presenting this to athletes as a number as opposed to a feeling.

I have been writing an ongoing series on Substack about my use of VBT. This will eventually make its way into a full-length website article and certainly feature heavily in future resources. Spending around \$400 on strength training technology is not for every rower or program, but the performance gains are great for those whose budget and priorities it does fit. VBT is affordable enough to be one of my top recommendations for rowing strength training after a barbell, hex bar, squat or power rack, and plate weights. It represents a good value decision in the question of adding equipment versus getting more benefit from basic equipment.

See the "Updated Training Templates" section ahead for velocity-based training templates, sample programs, and more information on VBT. Read the VBT series for even more.

VBT series: <https://rowingstronger.substack.com/p/velocity-based-strength-training>

Hamstring Knee Flexion Exercises

Knee flexion is the motion of drawing the ankle toward the backside. Resisted knee flexion isn't much of a factor in rowing, and exercises for this motion fell into a blind spot for me. Knee flexion does happen as the rower comes up the slide into the catch, but it's essentially unloaded as part of the recovery. We don't really want this to be an active, forceful movement such that we'd expect to gain hamstring strength and muscle mass from it. We also would not expect that gaining strength would transfer to improved performance. Despite this, training both concentric and eccentric knee flexion seems to have significant benefits for rowers.

Perhaps it is just that the motion is undertrained in rowing and the hamstring muscles are underdeveloped as a result. Correcting this weakness may help from a holistic strength perspective. It could also be something about the interaction of the two-joint hamstrings muscles. We can add work for the distal end to flex the knee, instead of always working more on the proximal end to extend the hip when rowing and doing hip hinge strength training exercises. Another possibility is improvement through motor learning. The rower may improve coordination and control between the low back and hips, and then transfer this skill back to rowing.

Rowers report feeling "lower" when erging and rowing after doing more resisted knee flexion work. They mean more connected between the legs and the hips, and more able to keep stroke force in the lower body instead of the upper body. We've also seen reduced low back pain since regularly incorporating these exercises with rowers who previously experienced low back pain. Our low back pain incidents in other rowers have decreased as well. This finding is supported by a 2017 study on elite rowers, "The Effects of Nordic Hamstring Exercise on Pain and Performance in Elite Rowers with Low Back Pain." I wrote about this study in a 2021 article available at the link below, after bringing the Nordic hamstring curl to my strength training.

Article: <https://rowingstronger.com/2021/10/18/nordic-hamstring-curl-rowing>

Rowers can use the Nordic hamstring curl (NHC) to emphasize eccentric hamstring muscle strength, the glute-ham raise (GHR) for both eccentric and concentric strength of the entire posterior chain, and direct hamstring knee flexion exercises like leg curl variations using a physioball or slider. I use them in this order, with Nordic hamstring curl as the introductory exercise, the glute-ham raise as the advanced exercise, and leg curl variations as a minor supporting exercise (often in the C-series hip assistance work in the training template).

Nordic Hamstring Curl video: <https://youtu.be/u8CEMBYXYkU>

Glute-Hamstring Raise video: <https://youtu.be/GLrn2pN6WVE>

Slider Hamstring Curl video: <https://youtu.be/qc8I7eXMerU>

The GHR is harder than the lowering-only NHC, because it trains both the lowering and lifting phases with a challenging point of reversal. I typically begin athletes with the NHC to teach

hamstring tension. We use a progression to build up the hamstring muscles and get through the initial phase of high muscle soreness from eccentric training on a neglected muscle group. Progress to GHR variations if desired and if the machine is available. We may stay with the full-range, eccentric NHC. D 3-4 sets of 3-5 reps with a 3-4-second lowering phase. This is a great minimal-equipment, boathouse-friendly strengthening option. I do not expect rowers to be able to do an unassisted concentric NHC, lifting the body back up to the starting position from the floor without the arm pushup. It's possible with training and time, but not a direct goal compared to training the eccentric NHC for the hamstring strengthening benefits.

I am always coaching rowers with the phrase, "ribs down," to keep the lower torso engaged. Rowers often begin the NHC or GHR in a position of back extension, arching the back or tilting the ribcage upward. They may also shift into this position under strain. This limits recruitment of the hamstring and glute muscles that are the target of the exercise, shifting the load to the low back spinal erector muscles. We want to keep the core braced and the hip in a neutral or slightly posteriorly tilted position to engage glutes and hamstrings. Learning and training this braced position with increased hamstring and glute action, instead of low back action, may be a major part of the benefit of these exercises for back pain and rowing performance. See my demonstration videos for these errors, and be on the lookout when training the NHC and GHR.

I also use slider hamstring curl variations to train resisted knee flexion with more emphasis on the distal end, moving the legs with the torso stable instead of moving the torso around the stable legs. There is more tension in the NHC and GHR exercises, and I don't consider slider curls a substitute for either. Slider curls are more like a lateral or rotational hip exercise, covered in detail in the next section.

Here is my five-week introduction phase of NHC training. If desired, we follow this with a gradual progression of band-assisted GHR, semi-assisted GHR (some with band, some without), and then unassisted GHR.

- Week 1: 3 sets of 3 reps with a 2-second lowering phase
- Week 2: 3 x 3 with a 3-second lowering phase
- Week 3: 3 x 3 with a 4-second lowering phase
- Week 4: 3 x 4 or 4 x 3 with a 4-second lowering phase
- Week 5: 4 x 4 with a 4-second lowering phase
- Week 6: Deload (no NHC or just 3 x 3 with 2-second lowering)
- Week 7 and Beyond: 2-4 x 6-10 reps with band-assisted, semi-assisted, and then unassisted GHR

See my demonstration video for how to set up the band-assisted GHR. Athletes will use a heavy band at first for all sets and reps. Use a lighter band next. Then, begin doing some reps of the set unassisted to near technical failure before adding the band to complete the set. Then, do one full set unassisted, and subsequent sets fully or partially assisted. Gradually increase unassisted reps until doing all reps and sets unassisted. The strongest athletes at this point could put hands behind the head to make the exercise harder, or hold a small weight plate at the chest, or put a band stretched from the floor to behind the neck (band-resisted).

I use either the NHC or the GHR in almost all of my training programs, unless the rower has knee pain or some other complication that prevents its use. With a few yoga mats or knee pads (hardware store “gardening pads” work well), the NHC works well in a boathouse strength training program of bodyweight and low-load exercises. Instead of doing the ubiquitous “20-minute core circuit” of continuous high-rep spinal flexion, extension, and twisting exercises, include the NHC and other exercises for the shoulders, lateral and rotational hip, and core together. Take a broader definition of “the core” to include the lower torso and intersection with the hip, as well as the upper torso and intersection with the shoulders. More about these exercises in the next section.

Lateral and Rotational Hip Exercise Variations

My training templates in the Second Edition use the phrase “hinge assistance,” where now I use “lateral/rotational hip.” I previously did a lot of hinge exercises to support the hinge movement of rowing. I have since found that this can overtrain the sagittal plane flexion-extension movements of the lower body. This also led to undertraining for the transverse plane rotational (twisting) movements and the frontal plane lateral (side-to-side) movements. It has been a beneficial compromise to do more hinge work for main work or primary assistance, and then stay away from the hinge and do lateral and rotational hip exercises in the minor assistance work.

These movements have been especially helpful for rowers with low back pain. I learned many of them from physical therapy resources to target smaller supporting muscles of the hip. The key seems to be learning how to distribute load over many supporting muscles, instead of more isolated on just the prime movers of the hip hinge. These exercises also challenge coordination of hip muscles commonly missed by rowing, erging, and essentially any aerobic cross-training other than skating and Nordic skiing. If the rower can regularly skate or ski, lateral and rotational hip exercises may not be as necessary.

Watch, experiment with, and enjoy training the below exercises, available in my Youtube playlist: https://www.youtube.com/playlist?list=PLeHemdr7XRKkOURZ_nDAAJEX7IcY_W5bd

- Glute marching
- Copenhagen plank variations
- Hip airplane progression
- Band standing abduction
- Band standing adduction
- Side-lying hip abduction
- Mini band walks
- Lateral step-up
- Lateral lunge and side-sliding lunge

These exercises mostly focus on the motions of hip abduction and hip adduction. Hip abduction is the movement of drawing the leg away from the midline of the body. Hip adduction is the movement of drawing the leg towards the midline of the body. The hip abductor muscles are mostly the glutes: gluteus medius and minimus. Athletes will feel these exercises primarily working the upper outside hip area. The hip adductor muscles are helpfully called adductors: adductor longus, brevis, magnus, as well as the gracilis. Athletes will feel these exercises primarily working the inside thigh area.

We often alternate one day of abductor emphasis, drawing the leg away from the midline of the body, and the other day of adductor emphasis, drawing the leg toward the midline of the body. See the table on the following page. We use a variety of these exercises in the C-series of the training template, covered in the training template section ahead. I typically suggest several options of exercises and rowers choose which they want to do. If I see someone doing the same

one session after session, I check in and ask their plan. If they're doing it for a specific reason and feel they are getting benefit from focusing on the exercise, then great. If they just haven't explored other exercises, I encourage them to do so and offer a demonstration or tutorial.

These bodyweight and low-load lateral and rotational hip exercises also go well with the knee flexion exercises like Nordic hamstring curl, as well as shoulder and core exercises to improve the ubiquitous "20-minute core circuit" of continuous high-rep spinal flexion, extension, and twisting exercises. Take a broader definition of "the core" to include the lower torso and intersection with the hip, as well as the upper torso and intersection with the shoulders.

Hip Abduction Emphasis		Hip Adduction Emphasis
Glute marching		Copenhagen plank
Hip airplane		Band standing adduction
Band standing abduction		Lateral/side-sliding lunge
Side-lying hip abduction		
Mini band walks		
Lateral step-up		

Core Exercises with Synchronized Breathing

The core exercises I use most heavily in my present coaching are not in the Second Edition at all. These are the seated rockback and the gymnastics rings or TRX suspension trainer exercises. Both have many variations to keep the exercises challenging, engaging, and effective for rowers of all ages, types, and levels. I've heavily updated my original 2016, "Core Training for Rowing" article linked below, with explanations, research on how the core works in rowing, and video demonstrations of these exercise variations with voiceover tutorial.

Core Training for Rowing article: <https://rowingstronger.com/2016/05/02/core-training-for-rowing/>

Seated rockback video: <https://youtu.be/qgPflK29jb0>

Suspension trainer video: <https://youtu.be/3D0iR8uy4DY>

The seated rockback and suspension trainer exercises intend to train the specific trunk muscle demands of the rowing stroke. Most rowers' core training is too far in the "anti-specificity" direction, training qualities of core strength that do not at all relate to the rowing stroke. We then wonder why rowers do so much core training, yet rowers and coaches still complain so frequently of low back pain and stroke technique errors due to "weak core." There's a problem if the core is both the most heavily trained area of the body, and yet also so persistently weak that it fails to contribute to stroke technique and protect the athlete from injury.

The seated rockback trains the specific, perhaps unique, demand of rowing to maintain a mobile hip in flexion with a stabile spine. The phrase that rowing researchers use to describe ideal trunk function is, "a rigid lever on which to transfer force." For example, see the 2009 study on Canadian National Team rowers, "Electromyography and Kinematics of the Trunk During Rowing in Elite Female Rowers." I've found the seated rockback invaluable for teaching rowers how to achieve this in the stable environment of land training, develop the muscle coordination and strength required to do so, and then transfer this ability to erging and rowing.

Ironically, the abdominal muscles are one of the few areas where we do see eccentric action in the rowing stroke. The abdominals act as the "braking system" to slow torso swing on the drive phase into the release, before reversing this momentum into the unloaded recovery phase. However, rowers almost always train abdominal muscles with only concentric or isometric exercises. We then wonder why we still have "core problems" despite so much core training.

I begin rowers with timed holds at the layback position, progress to slow-tempo rocking, then faster tempo rocking. We can also add load and variation by manipulating arm position. The strongest athletes will hold a light medicine ball overhead. The absolute key point in the seated rockback is to maintain similarity to the rowing stroke. We want downward foot pressure into the floor the entire time, and exactly the amount of layback and rock-forward that we want to use in the rowing stroke. I have found it effective to go from the seated rockback to an available erg to check and connect this for the rower. I refer to the seated rockback as the core training

equivalent of the feet-out rowing drill. I use the seated rockback in strength training for all the same reasons rowing coaches use feet-out rowing in rowing training.

The suspension trainer exercises add the mobile shoulder element that seated rockbacks largely miss. I regularly see rowers utterly fall apart with even the simplest suspension trainer exercise, despite being able to do long static plank holds and many reps of crunch exercises. Begin with the hands-in-rings plank hold. Progress with time under tension, from 10 seconds to 15 seconds to 20 seconds and so on up to 3-4 sets of 45 seconds per set. Increase challenge by adding movement in the variation from the static plank hold up to the stir-the-pot and fallouts.

Static plank exercises are fine for developing general trunk strength and control, but the stroke is not static. We should not rely on planks alone or for a majority of rowers' core training. I still do not use repetitive spinal flexion-and-extension exercises (eg. situps, crunches, scullers, etc.) and rotational twisting exercises ("Russian twists" and the like). I encourage rowers to minimize use of these exercises due to increased stress and strain on the low back. The low back is far too often injured in rowing already, and we do not need to add yet more stress to this area.

Crunches, situps, and twisting exercises also don't contribute to the ideal technique of the rowing stroke with mobile hips and shoulders and a stable spine. In fact, they may directly conflict with it by teaching and training rowers to bend, flex, and twist the spine under load when this movement is undesirable for rowing. Again, if we train these exercises for hours each week and still wonder why rowers continue to have "weak cores" that don't support rowing technique or prevent low back pain, we should look to change our training rather than double-down on the efforts that aren't working.

A key that I've really come into since returning to in-person coaching with the Green Racing Project teams is coaching core exercises with breathing synchronization. I find that a lot of rowers hold their breath during abdominal training or breathe shallowly into the chest. This is a lose-lose problem. First, we do an aerobic sport, so we definitely don't want to race with breath-holding or shallow breathing, and therefore we don't want to train that way either. Second, breath-holding and shallow breathing reduces engagement of the core muscles that we actually do use during rowing and erging. Holding the breath while strength training teaches the rower to lock everything together to create stability. This fails to develop stability without locking everything together. We then have no stability when we try to go to the performance environment where things cannot be locked together.

When in doubt, just make sure to breathe deeply while doing core exercise. Avoid the extremes of "belly breathing," only filling the lower torso with air, and of holding the breath or breathing very shallowly into the upper torso only. When coaching, I look for athletes to maintain a braced torso, drawing the belly button more into the torso rather than pushing it out as though they were about to take a punch to the gut, or as a powerlifter might before a maximal squat attempt. I use the cue of "one-piece torso" to describe a connection from hips to shoulders, with no "leaks" due to upward-tilting ribs or arched or flexed lumbar spines. I look for the shoulders to stay down and the face to stay relaxed. Shoulders shrugging up and face contorting or turning

red typically indicates breath-holding or shallow breathing. Reset, decrease time under tension, or use a simpler exercise variation. The body should stay very still other than the areas that we want to move in the exercise. This is a transferrable skill to rowing!

The first stage is to maintain torso, hip, and shoulder stability with deep breathing and minimal off-target movement. We can then progress to rhythmic breathing aligned with the rowing stroke technique, and adding elements of movement. On the seated rockback, for example, rowers commonly “reverse-breathe” by inhaling when rocking back and exhaling when rocking forward. This is backwards from the typical breathing technique of rowing, in which we exhale on the drive (rocking back in the exercise) and inhale on the recovery (rocking forward in the exercise). You may have a different breathing pattern, and the breathing pattern may change depending on the intensity conditions, so modify accordingly for your own technique. In general, I coach rowers to exhale on the rock-back of the exercise and inhale on the rock-forward of the exercise. This aligns exhalation with the drive and inhalation with the recovery.

The suspension trainer exercises are a bit more arbitrary due to being outside the rowing stroke technique compared to the more similar seated rockback. On suspension trainer exercises, I simply coach to pick one direction to be the inhale cycle and the other to be the exhale cycle. We then train that rhythmically. For example, on the stir-the-pot exercise, the first half of the rotation might be the inhale, and the other half the exhale. We could also do one rotation one way as the inhale, and the other rotation the other way as the exhale. The point is to get rowers engaging with breathing as a controllable technique, rather than a totally automatic, thoughtless action. The ultimate goal is for rowers to be able to choose when and how they focus on breathing, and to what extent they exert conscious control versus automatic control based on the performance needs.

Updated Training Templates

Here is how all of the above concepts come together in practice. The majority of my training programs look like this basic template below, with details or changes depending on the individual athlete, specific goals, equipment, or preferences, and the timeline or phase of training. I think most rowers of any age, type, or level can structure their strength training approximately like this and enjoy the benefit in improved sport performance and life and fitness beyond. Use my exercise index available at the link below to see examples and select exercises for each category, and see my additional notes below.

Exercise Index page: <https://rowingstronger.com/exercise-index/>

Day 1	Sets x Reps (rest)	Day 2
Full-Body Warmup	10-15 mins to prepare	Full-Body Warmup
A1. Plyometric (Jump/Throw)	← 3-6 x 2-4 →	A1. Plyometric (Jump/Throw)
A2. Squat Main	← 3-5 x 3-8 (2-3' rest) →	A2. Hinge Main
B1. Horizontal Push	← 3-4 x 8-15 →	B1. Vertical Push
B2. Horizontal Pull	← 3-4 x 8-15 →	B2. Vertical Pull(down)
B3. Hinge Assistance	← 3-4 x 8-15 (2-3' rest) →	B3. Single-Leg Squat
C1. Lateral/Rotational Hip	← 2-4 x 10-20 →	C1. Lateral/Rotational Hip
C2. Shoulder	← 2-4 x 10-20 →	C2. Shoulder
C3. Core	← 2-4 x 10-20 (0-1' rest) →	C3. Core

The letter indicates a grouping of exercises, and the number provides the order in which to do the exercises. I generally sequence this with most stressful exercise last in the grouping, to get the most out of the easier exercises and then rest after the final exercise. Do the first exercise, then the next, then the next if applicable, and then take the rest time indicated in parentheses.

Yes, it is important to do the groupings in order, ie. A then B then C. We train the biggest exercises with the highest outputs first for strength and power with minimal fatigue, and then exercises for muscular development and specific bodyparts next for moderate fatigue, and then the smallest exercises last when systemic fatigue matters less. There are some occasions when this might not matter, such as when an athlete is intentionally reducing output in A-series exercises due to injury or retraining, but these are the exception to the rule.

It's also important that exercises in the same series overlap minimally so that the effort of one does not significantly affect the effort of the next. For example, I do not pair a bent-over row with a hinge or a squat exercise due to overlap on the low back. If the supersets or circuits don't work for you, that's fine. Split the same work up in the rest of the session as desired.

Yes, it is important to take rest between sets. Highly aerobically fit athletes like rowers won't necessarily feel like they need the rest at an aerobic, "breathing hard" level, and will often try to push the reps up or reduce rest intervals until they achieve this level of perceived effort. However, recovery between sets is important to maximize strength and power output and to focus on this kind of effort instead of "feels hard" effort like 500-meter intervals. The highly trained cardiovascular system might be able to handle no or very little rest, but the central nervous system and muscular systems need more recharge time to sustain high force output. If the amount of reps or amount of weight used declines sharply from one set to the next, this is a sign of insufficient recovery between sets.

The sets and reps are intentionally broad, as this is a template not a program. See following programs for more details depending on the phase of training. For the purposes of the template, rowers with more recovery, time, and energy to spend on strength training might be on the higher side of the total volume (sets multiplied by reps), while those with less recovery, time, and energy for strength training might be on the lower side. This also varies within the same rower based on phase of training and goals for that phase. In general, start out on the lower side of the recommendations and gradually progress to the higher side as you need additional stimulus to make progress. Rowers can often progress with a lower workload than expected, which leaves us room to grow as the athlete gains experience and strength.

The sets and reps do not need to be identical throughout the session. You'll see mostly "straight sets" in the Second Edition programs, for example "4x6 or 4 sets of 6 reps," but I often use more creative schemes too. For example, we often "wave load" by doing a set of 6 at one weight, increasing slightly for the next set of 6 reps, increasing slightly for the next set of 6 reps, and so on, building up to a max near-max final set of 6 reps. I find that less experienced athletes benefit more from straight set training to practice technique, while athletes more advanced in strength training can benefit from this working-up approach. Note that I write all sets and reps as "working sets," ie. sets that are within the strain range. Athletes should take at least 2-5 sets warming up and gradually working up to their working weights for the given sets and reps. These work-up sets do not count toward the sets that I write in the program.

We also do sets of varying reps within the general range. This is often referred to as "ramp loading," or, depending on the design, "ascending-rep" or "descending-rep" sets. For example, we might do our A-series squat or deadlift for a descending-rep session of, "8 - 6 - 4." This is one set of 8 reps, one set of 6 reps, and one set of 4 reps. When the athlete gets this just right, the first set is hard, but not maximal, still leaving room to increase weight for the second set, and then the third (final) set is done at a near-maximum. However, if the first set is too hard, at the top of or even above the intended strain range, the athlete can just stay at the same weight for the next set of reduced reps, and then decide what to do with the third set. I often set up a

12-week training cycle around a session of these descending-rep sets every fourth week, with straight sets on the three weeks in-between. This is how I have designed the 2x/wk off-season program on the following page. The athlete gets in solid practice during the straight set weeks, and then works up to a max or near-max set on the fourth week. A standard off-season approach is to go from a fourth week of “8 - 6 - 4” to an eighth week of “7 - 5 - 3” and then a 12th week of “5 - 3 - 2,” getting progressively heavier over the training cycle. We can look for progress as cumulative weight across all three sets, or more significant increases in the final, near-max set of 4, then 3, then 2.

I often use ascending-rep sets in the assistance work. For example, “8 - 10 - 12” or “10 - 12 - 15.” The athlete might keep the weight the same for each set, working up to higher levels of strain as the reps increase. We can also start an ascending-rep set at the heaviest load, and then decrease the weight slightly as the reps increase. I find this works very well for bodyweight exercises such as pushup, chin-up, and glute-ham raise, in which the first set is done very manageably, the second set is quite challenging, and then the third set is max or near-max.

Whatever you choose to do, I highly encourage making some recording of your training sessions in whatever logbook type of technology works for you. I print fillable spreadsheets, keep them in a team binder in the gym, and encourage rowers to at least note the weight they use or how many reps they perform. More engaged athletes have their own notebooks or systems where they add additional details and things they learn or feel are important to remember. The most engaged athletes take video every so often to compare quality of movement beyond the quantity of work performed. Recording at least the exercises you did and the weight you used helps with the next session’s efficiency, as you have some idea of what you did last time, and should also help with long-term accountability and motivation to see continual progress.

The next pages are a 12-week strength training program to demonstrate how all of these concepts come together in a training program. I’ve designed this for a rower training twice per week. It fits best in the off-season phase, either General Prep or Specific Prep, when the rower is not pursuing specific rowing performance goals (race prep) and is at a reduced rowing and erging training load with generally more cross-training.

Each page is one four-week wave, with any change in assistance work exercises occurring every four weeks. This is just one way I like to do it. You can rotate B-series and C-series assistance work exercises more or less frequently if you prefer. As long as we keep the A-series consistent for progression, I’m fine with rowers who prefer more variation rotating each week and with rowers who prefer less variation sticking with the same assistance exercises for whole waves or entire programs. I have written this program without deloads, but you can take a deload week of no or reduced strength training after each of the four-week waves, after the second four-week wave only, or after completing all 12 weeks. This depends on your preferences, schedule, and fatigue, and how you’re managing the strength training in combination with aerobic training.

Off-Season 2x/wk, Weeks 1-4

Day 1	Week 1	Week 2	Week 3	Week 4
Full-Body Warmup				
A1. Countermovement Jump	5 x 3	6 x 2	5 x 3	6 x 2
A2. Front Squat	4 x 8 (2')	5 x 5 (2')	4 x 6 (2')	8 - 6 - 4 (3')
B1. Pushup	3 x 10	3 x 12	4 x 10	4 x 12
B2. Bodyweight Row	3 x 10	3 x 12	4 x 10	4 x 12
B3. Nordic Hamstring Curl (2s lower)	3 x 3 (2')	3 x 4 (2')	4 x 3 (2')	4 x 4 (2')
C1. Glute Marching	4 x 10	4 x 12	3 x 15	12 - 15 - 20
C2. Band Pullapart	4 x 10	4 x 12	3 x 15	12 - 15 - 20
C3. Seated Rockback (hold position)	4 x 10s (1')	4 x 12s (1')	3 x 15s (1')	12 - 15 - 20s (1')

Day 2	Week 1	Week 2	Week 3	Week 4
Full-Body Warmup				
A1. Backwards OH Throw	6 x 2	5 x 3	6 x 2	5 x 3
A2. Hex Bar Deadlift	5 x 5 (2')	4 x 6 (2')	3 x 8 (2')	8 - 6 - 4 (3')
B1. Half-Kneeling OH Press	4 x 8	3 x 10	8 - 10 - 12	4 x 10
B2. Chin-Up (any grip)	4 x 8	3 x 10	8 - 10 - 12	4 x 10
B3. Rear-Foot-Elevated Split Squat	4 x 10 (2')	3 x 12 (2')	10 - 12 - 15 (2')	4 x 12 (2')
C1. Lateral Step-Down	3 x 10	4 x 10	4 x 12	10 - 12 - 15
C2. Band/Cable Facepull	3 x 10	4 x 10	4 x 12	10 - 12 - 15
C3. Gym Ring/TRX Core	3 x 10s (1')	4 x 10s (1')	4 x 12s (1')	10 - 12 - 15s (1')

Off-Season 2x/wk, Weeks 5-8

Day 1	Week 5	Week 6	Week 7	Week 8
Full-Body Warmup				
A1. Non-Countermovement Jump	5 x 3	6 x 2	5 x 3	6 x 2
A2. Front Squat	4 x 6 (2')	5 x 4 (2')	4 x 5 (2')	7 - 5 - 3 (3')
B1. Pushup	3 x 12	3 x 15	4 x 12	4 x 15
B2. Bodyweight Row	3 x 12	3 x 15	4 x 12	4 x 15
B3. Nordic Hamstring Curl (3s lower)	3 x 3 (2')	3 x 4 (2')	4 x 3 (2')	4 x 4 (2')
C1. Side-Lying Hip Abduction	4 x 10	4 x 12	3 x 15	12 - 15 - 20
C2. Band Pullapart	4 x 12	4 x 15	3 x 20	12 - 15 - 20
C3. Seated Rockback (slow rocks)	4 x 12 (1')	4 x 15 (1')	3 x 20 (1')	12 - 15 - 20 (1')

Day 2	Week 5	Week 6	Week 7	Week 8
Full-Body Warmup				
A1. Medball Squat Throw	6 x 2	5 x 3	6 x 2	5 x 3
A2. Hex Bar Deadlift	5 x 5 (2')	4 x 4 (2')	3 x 6 (2')	7 - 5 - 3 (3')
B1. Half-Kneeling OH Press	4 x 6	3 x 8	6 - 8 - 10	4 x 8
B2. Chin-Up (any grip)	4 x 6	3 x 8	6 - 8 - 10	4 x 8
B3. Rear-Foot-Elevated Split Squat	4 x 8 (2')	3 x 10 (2')	8 - 10 - 12 (2')	4 x 10 (2')
C1. Mini Band Walk (reps = steps)	3 x 10	4 x 10	4 x 12	10 - 12 - 15
C2. Band/Cable Facepull	3 x 12	4 x 12	4 x 15	12 - 15 - 20
C3. Gym Ring/TRX Core	3 x 12s (1')	4 x 12s (1')	4 x 15s (1')	12 - 15 - 20s (1')

Off-Season 2x/wk, Weeks 9-12

Day 1	Week 9	Week 10	Week 11	Week 12
Full-Body Warmup				
A1. Seated Vertical Jump	5 x 3	6 x 2	5 x 3	6 x 2
A2. Front Squat	4 x 5 (2')	5 x 3 (2')	4 x 4 (2')	5 - 3 - 2 (3')
B1. Dumbbell Bench/Incline Bench	3 x 12	3 x 10	4 x 8	4 x 15
B2. 1-Arm Row (DB/Landmine)	3 x 12	3 x 10	4 x 8	4 x 15
B3. Nordic Hamstring Curl (4s lower)	3 x 3 (2')	3 x 4 (2')	4 x 3 (2')	4 x 4 (2')
C1. Lateral Lunge	4 x 8	4 x 10	3 x 12	10 - 12 - 15
C2. Kneeling Shoulder Raise	4 x 8	4 x 10	3 x 12	10 - 12 - 15
C3. Seated Rockback (faster rocks)	4 x 12 (1')	4 x 15 (1')	3 x 20 (1')	12 - 15 - 20 (1')

Day 2	Week 9	Week 10	Week 11	Week 12
Full-Body Warmup				
A1. Backwards OH Throw	6 x 2	5 x 3	6 x 2	5 x 3
A2. Hex Bar Deadlift	4 x 5 (2')	5 x 3 (2')	3 x 5 (2')	5 - 3 - 2 (3')
B1. 1-Arm Standing Press	4 x 5	3 x 6	10 - 8 - 6	4 x 4
B2. Chin-Up (any grip)	4 x 5	3 x 8	10 - 8 - 6	4 x 4
B3. Rear-Foot-Elevated Split Squat	4 x 6 (2')	3 x 8 (2')	6 - 8 - 10 (2')	4 x 6 (2')
C1. Standing Band Adduction	3 x 10	4 x 10	4 x 12	10 - 12 - 15
C2. Band/Cable Facepull	3 x 15	4 x 15	3 x 20	12 - 15 - 20
C3. Gym Ring/TRX Core	3 x 15s (1')	4 x 15s (1')	3 x 20s (1')	15 - 20 - 25s (1')

3x/wk Upper-Lower-Full Template

Twice-per-week strength training is sufficient for nearly all rowers. Some rowers may need or want to pursue strength training three times per week with the goal of making greater gains in strength or muscle size. I mention the “upper/lower/full” training split in the book and should have gone into more detail. This is a design I frequently use with rowers in the General Prep or Specific Prep off-season phase. We reduce strength training back to twice per week once we get into the Pre-Competitive (pre-season) phase, focusing on more peak power and increasing rowing and erging workload. Here is a training template for a 3/wk upper-lower-full strength training program, with notes below on program specifics.

Upper Body	Lower Body	Full-Body
Full-Body Warmup	Full-Body Warmup	Full-Body Warmup
A1. Horizontal Push	A1. Plyometric (Jump/Throw)	A1. Plyometric (Jump/Throw)
A2. Horizontal Pull	A2. Squat Main	A2. Hinge Main
B1. Vertical Push	B. Hinge Assistance	B1. Vertical/Horizontal Push
B2. Vertical Pull	C1. Lateral/Rotational Hip	B2. Vertical/Horizontal Pull
C1. Biceps Curl	C2. Shoulder	B3. Single-Leg Squat
C2. Triceps Extension	C3. Core	C1. Lateral/Rotational Hip
C3. Shoulder		C2. Shoulder
		C3. Core
		D. Optional Biceps/Triceps

The A/B/C-series instructions are the same for the lower body and full body days as in the main training template at the start of this program section. For upper body, do both A-series and B-series exercises for 3-4 sets of 8-15 reps with 2-3 minutes of rest. You could flip the order of these as well and do the vertical plane exercises before the horizontal plane exercises, with no real difference in efficacy. A rower who really wants to push upper body strength in a specific upper body exercise could do the sets and reps from “A2” in the training template: 3-5 sets of 3-8 reps with 2-4 minutes of rest.

We can do the three days in any order. We sometimes do the upper body and lower body days on back-to-back days if that works best for the training schedule. The full-body day should have one day of no strength training before and after it. A schedule of Mon/Tue/Fri or Tue/Thu/Sat or anything similar works well. We will sometimes have the full-body day first in the week, such as

on Monday following a Sunday rest day and a Tuesday easier aerobic training day, and then the upper and lower body days later in the week.

The upper body day usually feels almost like a rest day for rowers used to heavy, fatiguing full-body exertion. It's muscle-gaining stimulus without much systemic fatigue. We often combine this session with an aerobic cross-training session, such as stationary cycling that only impacts the legs. We may do this in the same training session (2-3 hours of total training), or even better, on the same day split apart by at least six hours with nutrition, hydration, rest, and recovery between the two training sessions.

The lower body day is short and punchy, usually complete in 45-60 minutes including warmup. Rowers often feel like they should add more to it, and those who feel very strongly about it can add some barbell hip thrusts, a single-leg squat variation, or perhaps leg press or belt squats as a "D-series" exercise. If chosen, these additions should be focused on the legs or hips with low impact on the lower back. If you do a glute-ham raise or Nordic hamstring curl in the B-series, you could do another hinge exercise with a little more low back impact, such as a Romanian deadlift or good morning. We may combine this with another short and punchy higher intensity interval training session on ergs, one in the morning and one in the afternoon or evening, ideally split apart by at least six hours of recovery time.

The full-body day is the longer and harder one of the week. I try to make this the only training of the day, ideally with a rest day before and/or after, or at least just aerobic cross-training rather than prolonged or intense erging or rowing. The "D-series" optional biceps and triceps exercises should be 2-4 sets of 10-20 reps. Nothing too fatiguing, but still productive for gaining strength, muscle mass, and strengthening the long kinetic chain from ankles to wrists required for rowing performance. Any variations of biceps curls and triceps extensions will do. Barbell or dumbbell curls, alternating arms or doing both arms together, seated or standing, or machine-based curls all work fine. A band or cable triceps pressdown, using any grip or handle style, or any barbell or machine-based triceps extension also works.

The following pages are an upper-lower-full 12-week program. This is a rigorous three months of strength training. Rowers should have at least one year of strength training experience and be proficient in all exercises. This program fits best during an off-season phase of reduced erging and rowing training, such as "Specific Prep" after rowers have laid a foundation in "General Prep." This approach has worked especially well with masters rowers focusing on the 1km sprint distance, as well as rowers seeking to gain strength and muscle mass and supported by adequate calories and good nutritional practices. Begin each session with the full-body warmup, the same as in the 2x/wk program. The program runs in three three-week waves, with a written-in fourth-week deload of reduced volume and intensity. You could omit the fourth-week deloads to make this a nine-week program, as long as you manage the training load well. On the final week, take 5-8 sets gradually working up to a 3-5-rep max. With how the volume builds, most sets should be RPE7-8, leaving 2-3 reps left in reserve on each set, occasionally RPE9.

Off-Season 3x/wk, Weeks 1-4

Day 1 (upper)	Week 1	Week 2	Week 3	Week 4
A1. Bench Press (DB/BB, Flat/Incline)	2 x 10	3 x 10	4 x 10	3 x 5
A2. 1-Arm Row (DB/Landmine)	2 x 10 (2')	3 x 10 (2')	4 x 10 (2')	3 x 5 (2')
B1. Strict Overhead Press (1 or 2-arm)	3 x 8	4 x 8	5 x 8	2 x 8
B2. Chin-Up or Lat Pulldown	3 x 8 (2')	4 x 8 (2')	5 x 8 (2')	2 x 8 (2')
C1. Pullapart, Kneeling Raise, or Facepull	12 - 15 - 20	3 x 15	4 x 12	2 x 15
C2. Any Biceps Curl	12 - 15 - 20	3 x 15	4 x 12	2 x 15
C3. Any Triceps Extension	12 - 15 - 20	3 x 15	4 x 12	2 x 15
Day 2 (lower)				
A1. Any Jump Plyo	5 x 3	6 x 2	5 x 3	3 x 2
A2. Front Squat	2 x 8 (3')	3 x 8 (3')	4 x 8 (3')	3 x 5 (2')
B. Romanian Deadlift (DB/BB)	3 x 8 (2')	4 x 8 (2')	5 x 8 (2')	2 x 8 (2')
C1. Lateral/Rotational Hip	3 sets	4 sets	3 sets	2 sets
C2. Pullapart, Kneeling Raise, or Facepull	3 x 12	4 x 12	3 x 15	2 x 12
C3. Core (TRX/Gym Ring Exercises)	3 sets	4 sets	3 sets	2 sets
Day 3 (full)				
A1. Any Throw Plyo	6 x 2	5 x 3	6 x 2	3 x 3
A2. Hex Bar Deadlift	2 x 6 (3')	3 x 6 (3')	4 x 6 (3')	3 x 5 (2')
B1. Push Press (1 or 2-arm)	3 x 8	4 x 8	5 x 8	2 x 8
B2. Bodyweight Row Variation	3 x 8	4 x 8	5 x 8	2 x 8
B3. Rear-Foot-Elevated Split Squat	3 x 8 (2')	4 x 8 (2')	5 x 8 (2')	2 x 8 (2')
C1. Lateral/Rotational Hip	4 sets	3 sets	4 sets	2 sets
C2. Pullapart, Kneeling Raise, or Facepull	4 x 10	12 - 15 - 20	3 x 20	2 x 15
C3. Core (Seated Rockback)	4 sets	3 sets	4 sets	2 sets

Off-Season 3x/wk, Weeks 5-8

Day 1 (upper)	Week 5	Week 6	Week 7	Week 8
A1. Bench Press (DB/BB, Flat/Incline)	2 x 8	3 x 8	4 x 8	3 x 5
A2. 1-Arm Row (DB/Landmine)	2 x 8 (2')	3 x 8 (2')	4 x 8 (2')	3 x 5 (2')
B1. Strict Overhead Press (1 or 2-arm)	3 x 6	4 x 6	5 x 6	2 x 6
B2. Chin-Up or Lat Pulldown	3 x 6 (2')	4 x 6 (2')	5 x 6 (2')	2 x 6 (2')
C1. Pullapart, Kneeling Raise, or Facepull	15 - 12 - 10	3 x 12	4 x 10	2 x 12
C2. Any Biceps Curl	15 - 12 - 10	3 x 12	4 x 10	2 x 12
C3. Any Triceps Extension	15 - 12 - 10	3 x 12	4 x 10	2 x 12
Day 2 (lower)				
A1. Any Jump Plyo	5 x 3	6 x 2	5 x 3	3 x 2
A2. Front Squat	2 x 6 (3')	3 x 6 (3')	4 x 6 (3')	3 x 5 (2')
B. Romanian Deadlift (DB/BB)	3 x 6 (2')	4 x 6 (2')	5 x 6 (2')	2 x 5 (2')
C1. Lateral/Rotational Hip	3 sets	4 sets	3 sets	2 sets
C2. Pullapart, Kneeling Raise, or Facepull	3 x 12	4 x 12	3 x 15	2 x 12
C3. Core (TRX/Gym Ring Exercises)	3 sets	4 sets	3 sets	2 sets
Day 3 (full)				
A1. Any Throw Plyo	6 x 2	5 x 3	6 x 2	3 x 3
A2. Hex Bar Deadlift	2 x 5 (3')	3 x 5 (3')	4 x 5 (3')	3 x 3 (2')
B1. Push Press (1 or 2-arm)	3 x 8	4 x 8	5 x 8	2 x 8
B2. Bodyweight Row Variation	3 x 8	4 x 8	5 x 8	2 x 8
B3. Rear-Foot-Elevated Split Squat	3 x 8 (2')	4 x 8 (2')	5 x 8 (2')	2 x 8 (2')
C1. Lateral/Rotational Hip	4 sets	3 sets	4 sets	2 sets
C2. Pullapart, Kneeling Raise, or Facepull	4 x 12	15 - 12 - 10	3 x 15	2 x 12
C3. Core (Seated Rockback)	4 sets	3 sets	4 sets	2 sets

Off-Season 3x/wk, Weeks 9-12

Day 1 (upper)	Week 9	Week 10	Week 11	Week 12
A1. Bench Press (DB/BB, Flat/Incline)	2 x 6	3 x 6	4 x 6	Work up to RM
A2. 1-Arm Row (DB/Landmine)	2 x 6 (2')	3 x 6 (2')	4 x 6 (2')	3 x 5 (2')
B1. Strict Overhead Press (1 or 2-arm)	3 x 5	4 x 5	5 x 5	2 x 5
B2. Chin-Up or Lat Pulldown	3 x 5 (2')	4 x 5 (2')	5 x 5 (2')	2 x 5 (2')
C1. Pullapart, Kneeling Raise, or Facepull	8 - 10 - 12	3 x 10	4 x 8	2 x 10
C2. Any Biceps Curl	8 - 10 - 12	3 x 10	4 x 8	2 x 10
C3. Any Triceps Extension	8 - 10 - 12	3 x 10	4 x 8	2 x 10
Day 2 (lower)				
A1. Any Jump Plyo	5 x 3	6 x 2	5 x 3	6 x 2
A2. Front Squat	2 x 5 (3')	3 x 5 (3')	4 x 5 (3')	Work up to RM
B. Romanian Deadlift (DB/BB)	3 x 5	4 x 5	5 x 5	2 x 5
C1. Lateral/Rotational Hip	3 sets	4 sets	3 sets	2 sets
C2. Pullapart, Kneeling Raise, or Facepull	3 x 10	4 x 10	3 x 12	2 x 10
C3. Core (TRX/Gym Ring Exercises)	3 sets	4 sets	3 sets	2 sets
Day 3 (full)				
A1. Any Throw Plyo	6 x 2	6 x 2	6 x 2	6 x 2
A2. Hex Bar Deadlift	2 x 4 (3')	3 x 4 (3')	4 x 4 (3')	Work up to RM
B1. Push Press (1 or 2-arm)	3 x 8	4 x 8	5 x 8	2 x 8
B2. Bodyweight Row Variation	3 x 8	4 x 8	5 x 8	2 x 8
B3. Rear-Foot-Elevated Split Squat	3 x 8 (2')	4 x 8 (2')	5 x 8 (2')	2 x 8 (2')
C1. Lateral/Rotational Hip	4 sets	3 sets	4 sets	2 sets
C2. Pullapart, Kneeling Raise, or Facepull	4 x 10	10 - 12 - 15	3 x 15	2 x 15
C3. Core (Seated Rockback)	4 sets	3 sets	4 sets	2 sets

Pre-Season Alternating Strength and Power Template

In the Second Edition, I write the Pre-Competitive (pre-season) phase as a wholesale shift to power training focused on rate of force development about 6-8 weeks before the important races of the season, followed by assistance work targeted to strength and muscle balance of specific muscles. I still think this is a fine approach, especially for rowers who are stronger and need more focus on fitness, rowing time, and rate of force development strength training. I've used an additional Pre-Competitive program design to success with rowers who still need more base strength work, as well as for those with different in-season racing schedules.

If the upcoming in-season racing schedule is short, with important races condensed in a 4-6-week period, I often use this alternating strength-and-power design. Think of it as a hybrid of Specific Prep (off-season) and Pre-Competitive (pre-season). Instead of making a wholesale shift to power training with the 2:X tempo or full explosive intent, we simply alternate weeks of one exercise focused on strength and the other focused on power. We can use the same basic training template from the start of this section, with modifications to the sets and reps of the A-series squat or deadlift as below.

Week A		Week B	
Day 1		Day 1	
A1. Plyo (Jump/Throw)	5-6 x 2-3	A1. Plyo (Jump/Throw)	5-6 x 2-3
A2. Squat	5-8 x 2-3, 2:X (1-2')	A2. Squat	3-5 x 3-8, 2:1 (2-3')
Day 2		Day 2	
A1. Plyo (Jump/Throw)	5-6 x 2-3	A1. Plyo (Jump/Throw)	5-6 x 2-3
A2. Deadlift	3-5 x 3-8, 2:1 (2-3')	A2. Deadlift	5-8 x 2-3, 2:X (1-2')

The A2 exercises are “sets x reps, tempo (rest).” On Week A, the rower focuses on rate of force development on Day 1 with the A2 squat performed for the power training 2:X tempo and 1-2-minute rest intervals. The rower focuses on total force development on Day 2 with the A2 hinge performed for the basic strength 2:1 tempo and 2-3-minute rest intervals. This pattern flips for Week B, with basic strength squats on Day 1 and power training hinges on Day 2.

Use the same template guidance from the basic template for the B-series and C-series assistance work. This can be the same as the off-season, or with slightly lower total volume if needed due to increased rowing and erging workload. For example, one fewer set or slightly lower reps such as 6-12 instead of 8-15 to manage total training volume.

This allows us to spend more time building the foundation of strength and muscle mass before making the shift to power training later in the in-season phase, but not so much time that the off-season General and Specific Prep phases become stale. After 12-16 weeks of General Prep and 6-12 weeks or even another 12-16 weeks of Specific Prep, the rower needs a change from so much base strength work. The alternating sessions provides this change without making the wholesale shift too early and risking lost total force and muscle mass.

Building this bigger base also earns us more flexibility later in the season. If the late-season racing schedule is very intensive, such as multiple important races back-to-back or a lot of seat-racing before actual racing, or requires a lot of travel, we can worry less about fitting in strength training because we know we built up more before reaching this point.

If the in-season schedule is long, with multiple important races spread out over 8-12 weeks of racing season, rigorous training or selection camps, or seat-racing every 1-3 weeks over the racing season, then we will use the design more like what I wrote in the book. Focus on sharpening up the base strength and muscle mass with peak power work for 6-8 weeks, then come into the Competitive phase of racing ready to go. This is also what I still do with rowers who are preparing for just a single race, such as an indoor erging event or Head of the Charles, without a phase of multiple races leading up to the one big race.

In-Season “1-and-1” Training Template

Strength training once per week often works well in the in-season phase for those limited on time, energy, or recovery. I often use this design with in-season juniors and masters rowers, as well as collegiate and post-collegiate rowers who can deprioritize strength training to focus more on another element of training, especially during head race season when the longer duration races don't require as much strength and training volume is higher for longer duration racing.

One day of loaded strength training exercise is enough to maintain strength for some weeks, even up to two or three months. The problem is that just doing strength training movements on one day per week often results in movement coordination detraining. The major movements can feel awkward after six days away, so I've found that a key is to have a second lighter session on another day during the week. This provides a light stimulus for the major movements, just enough to set up the “loaded” day, and makes room for the small movements for muscle balance and injury prevention. The low-load day can likely be done at home or at the boathouse.

Day 1 (Loaded)	Sets x Reps (rest)
A1. Seated Jump (vertical or box)	5-6 x 2-3
A2. Front Squat	3-5 x 3-8 (2-3')
B1. Push Press (1-arm DB or 2-arm BB)	3-5 x 3-8
B2. Hex Bar Deadlift or Romanian Deadlift	3-5 x 3-8 (2-3')
C1. Lateral/Rotational Hip	2-4 x 10-20
C2. Shoulder	2-4 x 10-20
C3. Core	2-4 x 10-20 (0-1')
Day 2 (Low-Load)	
A1. Plyometric (Jump/Throw)	5-6 x 2-3
A2. Rear-Foot-Elevated Split Squat	3-4 x 8-15 (1-2')
B1. Nordic Hamstring Curl or Glute-Ham Raise	3-4 x 3-4 (NHC, 3-4s lowering) or 3-4 x 8-15 (GHR)
B2. Horizontal or Vertical Pull	3-4 x 8-15
B3. Horizontal Push	3-4 x 8-15 (2-3')
C1. Lateral/Rotational Hip	2-4 x 10-20
C2. Shoulder	2-4 x 10-20
C3. Core	2-4 x 10-20 (0-1')

Off-Season Velocity-Based Training (VBT) Template

A key point of my VBT series on Substack (see link in the earlier VBT section) is that implementing VBT does not need to be very complicated or a drastic departure from rowers' non-VBT strength training. We can use the exact same training template that I presented first as the "Basic Training Template," with a velocity zone target instead of a fixed weight or rate of perceived exertion (RPE) target. The athlete and coach can then focus on getting the most out of the technology, data, and feedback, instead of complexities of programming.

We focus our General Prep and Specific Prep (off-season) strength training on total force production and building the base of general strength and muscle mass for the Pre-Competitive (pre-season) and Competitive (in-season) phases ahead. I use a three-zone velocity system below. As with cardiovascular training zones, there are more VBT zones and more ways to break this down, but I find three zones to be a good compromise of clear difference between zones and clear communication with athletes.

	Max Strength	Accelerated Strength	Speed-Strength (Power)
Zone (lifting speed)	< 0.5 m/s	0.5-0.75 m/s	0.75-1.0 m/s
Training Intent	Max force production	Base strength development	Rate of force development
Training Phase	Off-Season (if at all)	Year-Round, especially Off-Season	Pre-Season and In-Season (race prep)

With the off-season goals of general strength and muscle mass, we can just add the 0.5-0.75m/s velocity range as the target for the A-series main work squat or deadlift exercise. I've bolded this in the template below. We don't need to make any further modifications to our training template. The rower warms up, works up to their working weight, and then uses the VBT feedback from each set to guide the load for the sets and reps as written.

One important thing to note and perhaps coach is that the rower should always be trying to lift the weight basically as fast as possible. On the work-up sets when the weights are light, the velocity may be above the target zone. We adjust the load to achieve the zone, while the rower's lifting speed intent remains essentially the same.

I typically coach with VBT based on the average of all reps in the set. Sometimes I will coach based on boundaries, with all reps above the bottom of the range and below the top of the range. When coaching based on average, a set with an average velocity of 0.51m/s would be acceptable given a target of 0.5-0.75m/s, even if some reps were below 0.5m/s. When coaching based on boundaries, a set only counts as a successful working set if all reps are within the

target range. We would reduce the weight if any reps are below the bottom of the zone, and increase the weight if any reps are above the top of the zone.

There are reasons for both systems depending on the athlete, goals of training, and phase of the season. I use average speed more often in the off-season and encourage athletes to understand the feedback and make training decisions for themselves based on the feedback. I use boundaries more often in the pre-season and in-season, especially when we are working on the 0.75-1.0m/s power zone to increase rate of force development, and when we want to be mindful of overtraining with the increased recovery impact from straining below 0.5m/s.

We rarely intentionally train the max strength zone below 0.5m/s. Even when we do something like a 3-rep max, we often set it with a 0.5m/s minimum velocity (average or boundary). I mostly want rowers to know the max strength zone so that they know how to avoid it with good acceleration on the lifting phase of 2:1 tempo strength training. However, there are rowers who can benefit from the bigger stimulus of max strength training, when we can do this in a way that manages recovery in the bigger picture of training and doesn't interfere with subsequent aerobic training. A rower with more strength training experience and more to gain from heavier stimulus could do a true 3-rep max with no minimum, and we'd expect this to be more like 0.25-0.3m/s.

A final note is that I typically only use VBT for A-series squat and deadlift exercises, and then use RPE for B-series assistance work and upper body exercises. However, as with the 3x/wk upper-lower-full template, a rower very interested in increasing upper body strength such as max output in a bench press or overhead press exercise might take more of an A-series approach using VBT for that exercise.

Day 1	Sets x Reps (rest)	Day 2
Full-Body Warmup	10-15 mins to prepare	Full-Body Warmup
A1. Plyometric (Jump/Throw)	← 3-6 x 2-4 →	A1. Plyometric (Jump/Throw)
A2. Squat Main	← 3-5 x 3-8 at 0.5-0.75m/s (2-3' rest) →	A2. Hinge Main
B1. Horizontal Push	← 3-4 x 8-15 →	B1. Vertical Push
B2. Horizontal Pull	← 3-4 x 8-15 →	B2. Vertical Pull(down)
B3. Hinge Assistance	← 3-4 x 8-15 (2-3' rest) →	B3. Single-Leg Squat
C1. Lateral/Rotational Hip	← 2-4 x 10-20 →	C1. Lateral/Rotational Hip
C2. Shoulder	← 2-4 x 10-20 →	C2. Shoulder
C3. Core	← 2-4 x 10-20 (0-1' rest) →	C3. Core

Pre-Season Alternating Strength and Power VBT Template

We can follow the same alternating strength-and-power design from the earlier pre-season template, just with VBT ranges or targets instead of using 2:1 or 2:X tempo and RPE.

I have found this design very effective with the Green Racing Project rowers. We tend to have a race, test, or selection event every 3-4 months, so we don't have quite the same annual design as on the collegiate or junior schedule with one main racing season. Our general pattern is 4-6 weeks in the off-season Specific Prep mode of training (0.5-0.75m/s accelerated strength range), 3-4 weeks of alternating strength-and-power training with approximately the template below, and then 3-4 weeks before the race or event focused on power-only in the 0.75-1.0m/s range and tapering for the event.

This same system and design may be applicable for masters rowers with more varied competitive schedules as well. For example, if you go from CRASH-B or World Indoor Rowing Championships in February, to a late-spring race or two (such as Masters Regionals in the US) or an early or mid-summer main event (international race like Henley Masters or US Masters Nationals), a late-summer or early fall event like the World Masters Regatta, and a fall head race like Head of the Charles, you essentially have the same schedule with races every 3-4 months.

I have added velocity ranges to the earlier template to make clear how this works. All of the information from the earlier template applies for B-series and C-series exercises and so on.

Week A			Week B	
Day 1			Day 1	
A1. Plyo (Jump/Throw)	5-6 x 2-3		A1. Plyo (Jump/Throw)	5-6 x 2-3
A2. Squat	5-8 x 2-3 (1-2') at 0.75-1.0m/s		A2. Squat	3-5 x 3-8 (2-3') at 0.5-0.75m/s
Day 2			Day 2	
A1. Plyo (Jump/Throw)	5-6 x 2-3		A1. Plyo (Jump/Throw)	5-6 x 2-3
A2. Hinge	3-5 x 3-8 (2-3') at 0.5-0.75m/s		A2. Hinge	5-8 x 2-3 (1-2') at 0.75-1.0m/s

The “VL10” Velocity Based Training Program

There are plenty of additional ways to use VBT that are different from just swapping in velocity ranges to an existing strength training program. The “VL10” program stands for “velocity loss 10%.” This requires a VBT system that measures and provides notification of velocity loss from fastest rep. The VBT system that I currently use has an audible tone for this, which makes it easy to set up the training protocol.

In VL10, we train each set to as many reps as possible before the system records one rep that is at least 10% slower than the fastest rep of that set. At this point, we terminate the set and begin resting for the next set. Athletes need to be experienced and skilled enough with the basic exercises to stay within the range of good technique while pushing for max or near-max reps with a heavy load.

The VL10 protocol was featured in a 2021 study on German National Team rowers by Held and colleagues (“Improved Strength and Recovery After Velocity-Based Training: A Randomized Controlled Trial”). The athletes in that study did power clean, squat, bench row, conventional deadlift, and bench press for four sets at 80%1RM with 2-3 minutes of rest between each set. A control group did max reps at 80%1RM to voluntary failure. The VBT group improved their max strength significantly more than the non-VBT group, and equivalently improved their VO2 max and power at VO2 max measured on ergs. The big win was that the VBT group made this progress while doing fewer total repetitions and experiencing faster recovery and lower training stress versus the control group. In summary, less training (fewer total reps) and lower training stress (faster recovery) for better strength outcomes and equal erg outcomes in just eight weeks. This was one of the resources that put VBT high on my training to-do list.

I have used VL10 as a protocol just on squat and deadlift A-series exercises and seen similar results. We usually continue B-series and C-series strength training as normal in my basic training template, rather than doing all five exercises with the VL10 protocol only. I have found that rowers often lift a little slower doing max reps at 80%1RM, so I like to use VL10 in the off-season or pre-season, for either 6-8 weeks straight or as two 3-4-week blocks with a 1-week deload week in-between, and then follow it with 4-8 weeks of more speed-strength power zone training at the 0.75-1.0m/s range for rate of force development. This builds max strength, and then gets the lower body ready again for fast power demands of erging and rowing.

On the next page is some rower data from a 3-week VL10 run for an example of how each set works and how to assess progress. The final rep on each set is more than 10% slower than the fastest rep of each set, so this marks the point of termination. Our rower started off getting 15 total reps on front squat with 160lbs and then got 18 total reps on the third week. She achieved 30 total reps with 245lbs on hex bar deadlift during the first week and then 34 total reps on the third week. I ran the averages for all sets separately for my own analysis, which revealed that her front squat average fastest rep velocity dropped over the three weeks, but her hex bar average fastest rep velocity stayed pretty similar, while adding reps to both exercises.

This was during a pre-season phase when we were still rowing intensively and beginning race prep training, so our rower got more reps on the days when she came in more rested without a lot of prior rowing fatigue, and did fewer reps on days when she had done more in rowing training and was carrying greater fatigue. The goal is to equal out the recovery burden on the athlete, managing the training load to improve long-term progress. The overall rep speed declining was fine for total force development, but is why we follow the VL10 protocol with power training to regain rate of force development for race performance.

Session 1 Front Squat						Session 2 Hex Bar Deadlift													
160	0.62	0.6	0.57	0.45		245	0.51	0.47	0.48	0.45	0.46	0.49	0.41						
160	0.62	0.58	0.58	0.51		245	0.52	0.49	0.51	0.49	0.52	0.53	0.48	0.45					
160	0.59	0.54	0.54	0.43		245	0.52	0.51	0.5	0.48	0.5	0.5	0.45						
160	0.6	0.58	0.54			245	0.49	0.49	0.46	0.48	0.46	0.47	0.45	0.37					
Session 3 Front Squat						Session 4 Hex Bar Deadlift													
160	0.55	0.53	0.54	0.48		245	0.5	0.49	0.46	0.46	0.47	0.49	0.47	0.41					
160	0.56	0.58	0.55	0.44		245	0.49	0.5	0.5	0.46	0.47	0.46	0.48	0.45					
160	0.58	0.55	0.52			245	0.49	0.51	0.5	0.5	0.51	0.48	0.43						
160	0.59	0.54	0.53			245	0.52	0.52	0.48	0.52	0.48	0.5	0.51	0.41					
Session 5 Front Squat						Session 6 Hex Bar Deadlift													
160	0.53	0.52	0.51	0.48	0.4	245	0.47	0.47	0.46	0.46	0.46	0.45	0.45	0.47	0.44	0.44	0.36		
160	0.5	0.5	0.48	0.47	0.37	245	0.42	0.5	0.46	0.47	0.45								
160	0.53	0.51	0.48	0.43		245	0.45	0.48	0.47	0.48	0.47	0.45	0.46	0.46	0.43				
160	0.44	0.45	0.43	0.33		245	0.49	0.45	0.48	0.45	0.47	0.46	0.46	0.47	0.43				