

Thanks for buying this supplemental PDF update!

I wrote this 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 Velocity Based Training Template

We do more of our strength training in the speed-strength or power zone in the Pre-Competitive (pre-season) and Competitive (in-season or race-prep) training phases. This is the same system and rationale as using the “2:X” tempo from “Coaching Lowering and Lifting Tempo,” just with an objectively quantified target instead of “full explosive intent” subjective guidance.

One thing I found when we made this switch to power training with VBT is that the weights that rowers used for the 0.75-1.0m/s speed-strength zone were significantly lower than when we went by feel and 2:X tempo guidance. Actually measuring the bar velocity took about 10-30lbs off the average squat or deadlift in order to hit the target. This indicates to me that even with 2:X tempo guidance or explanation, rowers still tend to go heavier and slower, whether due to overestimating bar velocity or underestimating the importance of velocity for rowing or erging.

Something I did to demonstrate the importance of actually achieving the 0.75-1.0m/s zone, no matter how light the load needs to be, was attach the measuring device to the seat of a static ergometer for a 15-stroke piece from a dead start up to 2km race pace. You can read more about this in Part 4 of my VBT series on Substack, available at the link below. My average seat speed was 0.74m/s and everything after stroke #5 was between 0.75-0.85m/s. This is anecdotal, of course, but demonstrates the physical quality we’re training with lower body strength training to transfer to rowing and erging performance.

VBT Series Part 4: <https://rowingstronger.substack.com/p/vbt-series-part-4-strength-training>

As with the off-season VBT template, this can be the same basic training template and exercises from the pre-season phase template and programs, just with the 0.75-1.0m/s velocity range target for the A-series squat or deadlift main exercise. With the lighter weights, shorter duration sets, and greater number of sets, we reduce the rest to 1-2 minutes between sets as well. This is basically enough to rack the weight, take a few breaths or get a quick drink of water, adjust the load if needed, and then be ready to hit the A1 plyometric exercise again for the next set. I decrease the total volume of the B-series and C-series a bit during the pre-season and in-season phases as well, to account for more training time, energy, and recovery going toward the rowing and erging specific training for race prep.

If the racing schedule is short, with the important races condensed in a 4-6-week period, we usually run the pre-season phase for longer using the alternating strength-and-power design covered in the previous pre-season template. Follow those sets and reps and keep 0.5-0.75m/s as the target for the strength work and 0.75-1.0m/s as the target for the power work. If the racing schedule is long, with important races spread out every 1-3 weeks throughout the season, or lots of seat racing or training camps, then we shift into more of a power-only mode in the 0.75-1.0m/s range, with select departures down to 0.5-0.75m/s when the opportunity presents itself in the schedule.

See the VBT pre-season template on the following page.

Day 1	Sets x Reps (rest)	Day 2
Full-Body Warmup	10-15 mins to prepare	Full-Body Warmup
A1. Plyometric (Jump/Throw)	← 5-8 x 2-4 →	A1. Plyometric (Jump/Throw)
A2. Squat Main	← 5-8 x 2-4 at 0.75-1.0m/s (1-2' rest) →	A2. Hinge Main
B1. Horizontal Push	← 3-4 x 6-12 →	B1. Vertical Push
B2. Horizontal Pull	← 3-4 x 6-12 →	B2. Vertical Pull(down)
B3. Hinge Assistance	← 3-4 x 6-12 (2-3' rest) →	B3. Single-Leg Squat
C1. Lateral/Rotational Hip	← 2-3 x 10-20 →	C1. Lateral/Rotational Hip
C2. Shoulder	← 2-3 x 10-20 →	C2. Shoulder
C3. Core	← 2-3 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				