
How to increase strength
BREATHE EDUCATION

Learning goals

- 6-20RM / 2-3 reps from failure
- 1 set / week to maintain, 3-6 to build, 10+ to maximize
- Train movements not muscles: Push, pull, squat +
- Choose stable exercises that include long muscle lengths
- Lift fast, lower slower
- Progressively add load
- Eat ≥ maintenance calories + 2g protein / kg BW / day

You don’t need to get stronger to alleviate pain

Steiger, F., Wirth, B., de Bruin, E. D., & Mannion, A. F. (2012). Is a positive clinical outcome after exercise therapy for chronic non-specific low back pain contingent upon a corresponding improvement in the targeted aspect(s) of performance? A systematic review. European Spine Journal, 21(4), 575-598. doi:10.1007/s00586-011-2045-6 https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/Steiger-2012-Is+a+positive+clinical+outcome+af.pdf

So why learn how to get stronger?

Rehabilitation is...

Graded exercise to restore strength, ROM & control

Rehabilitation is...

Graded exercise to restore **strength**, ROM & control

Also, your clients want **results**

To build strength...

Work at 6-20RM

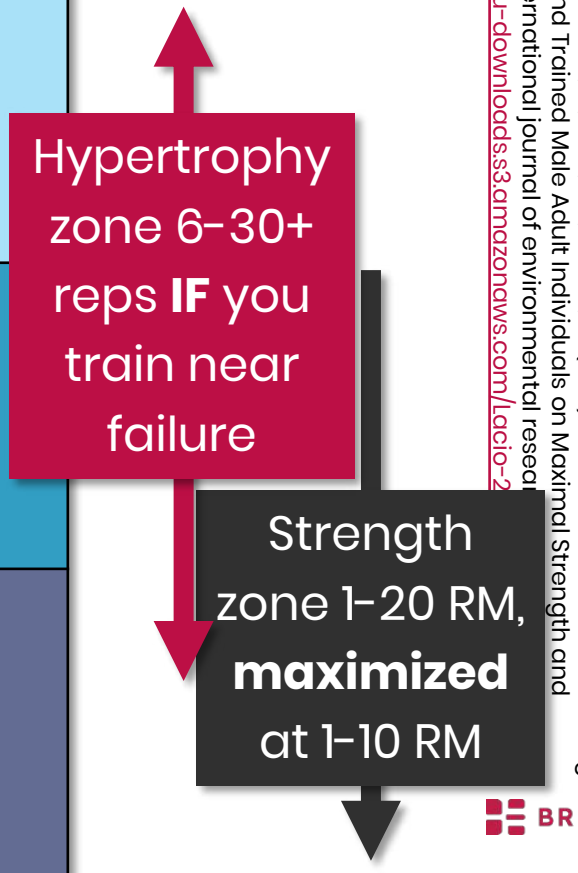
Push to within 2-3 reps of failure

To build strength work at 6-20RM

To **maximize** strength work at 1-10RM

Schoenfeld, B. J., Grgic, J., Ogborn, D., & Krieger, J. W. (2017). Strength and hypertrophy adaptations between low-vs. high-load resistance training: a systematic review and meta-analysis. The Journal of Strength & Conditioning Research, 31(12), 3508-3523. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/Schoenfeld-2017-Strength+and+hypertrophy+adapt.pdf

RM Max reps before failure	**% of your 1RM**	**Intensity**
51+	0-35%	Very light
21-50	40-55%	Light
11-20	60-75%	Moderate
1-10	80-100%	Heavy



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Lacio, M., Vieira, J. G., Trybulski, R., Campos, Y., Santana, D., Filho, J. E., ... Wilk, M. (2021). Effects of Resistance Training Performed with Different Loads in Untrained and Trained Male Adult Individuals on Maximal Strength and Muscle Hypertrophy: A Systematic Review. International journal of environmental resear 18(21), 11237. Retrieved from https://breathe-edu-downloads.s3.amazonaws.com/Lacio-2

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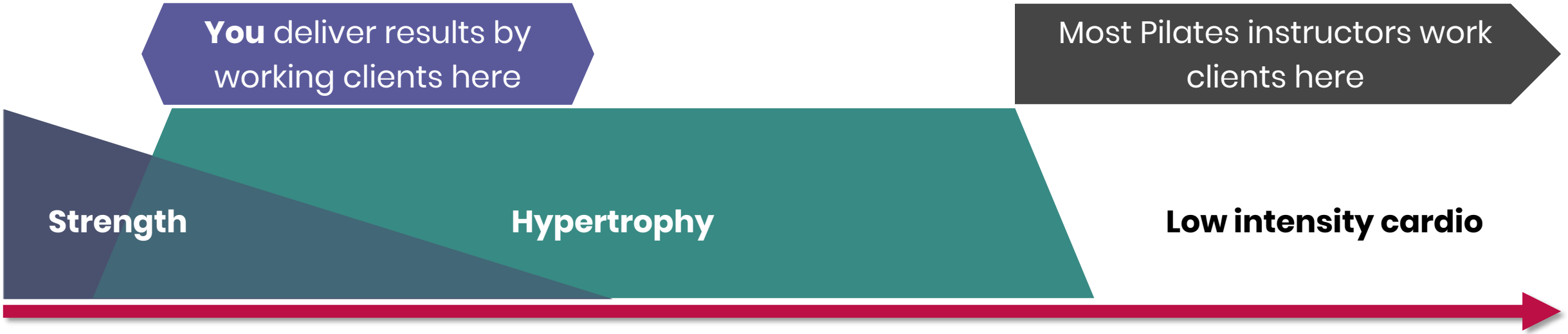

You deliver results by working clients here
Most Pilates instructors work clients here
Strength
Hypertrophy
Low intensity cardio
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35+
RM

Steele, J., Malleron, T., Har-Nir, I., Androulakis-Korakakis, P., Wolf, M., Fisher, J. P., & Halperin, I. (2022). Are Trainees Lifting Heavy Enough? Self-Selected Loads in Resistance Exercise: A Scoping Review and Exploratory Meta-analysis. Sports Medicine, 52(12), 2909-2923. https://breathe-edu-downloads.s3.amazonaws.com/Steele-2022.pdf

Robinson, Z., Pelland, J., Remmert, J., Refalo, M., Jukic, I., Steele, J., & Zourdos, M. (2023). Exploring the Dose-Response Relationship Between Estimated Resistance Training Proximity to Failure, Strength Gain, and Muscle Hypertrophy: A Series of Meta-Regressions. https://breathe-edu-downloads.s3.amazonaws.com/Robinson-2023.pdf

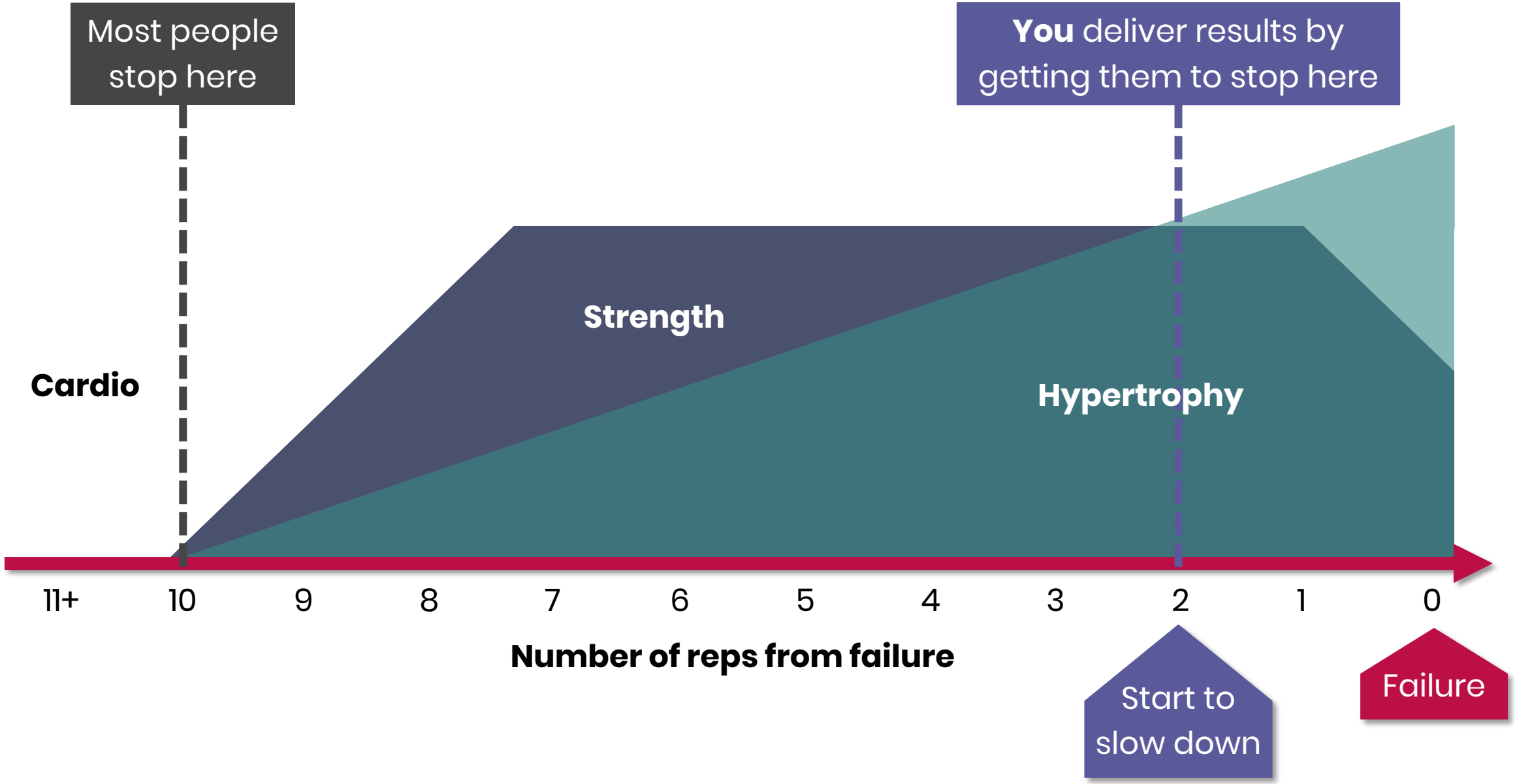
Grgic, J., Schoenfeld, B. J., Orazem, J., & Sabol, F. (2021). Effects of resistance training performed to repetition failure or non-failure on muscular strength and hypertrophy: a systematic review and meta-analysis. Journal of sport and health science. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/Grgic-2021-Effects+of+resistance+training+perf.pdf

Coleman, M., Burke, R., Benavente, C., Piñero, A., Augustin, F., Maldonado, J., . . . Schoenfeld, B. J. (2023). Supervision during resistance training positively influences muscular adaptations in resistance-trained individuals. Journal of Sports Sciences, 41(12), 1207-1217.

Push to within 2-3 reps of failure

When unsupervised, most people:

- Self-select loads that are too light to produce results
- Stop ~10 reps before failure
- **Supervised training results in more strength & hypertrophy**


Most people stop here
You deliver results by getting them to stop here
Strength
Cardio
Hypertrophy
11+
10
9
8
7
6
5
4
3
2
1
0
Number of reps from failure
Start to slow down
Failure

Self Test

- Why is it important to know how to increase strength?
- What rep range will significantly increase strength?
- How close to failure do we need to go to significantly increase strength?
- How can you tell when your clients are 2-3 reps from failure?

Learning goals

- 6-20RM / 2-3 reps from failure
- **1 set / week to maintain, 3-6 to build, 10+ to maximize**

1 hard set per week to **maintain** strength

3-6 sets per week to **build** strength

10+ sets per week to **maximize** strength

Just 1 hard set per week is enough to **maintain** strength

- If intensity is ≥10RM and you go within 2-3 reps of failure
- 4-6 sets pers week for the elderly

Spiering, B. A., Mujika, I., Sharp, M. A., & Foulis, S. A. (2021). Maintaining Physical Performance: The Minimal Dose of Exercise Needed to Preserve Endurance and Strength Over Time. The Journal of Strength & Conditioning Research, Publish Ahead of Print. doi:10.1519/jsc.0000000000003964 https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/Spiering-2021-Maintaining+Physical+Performance.pdf

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Schoenfeld, B. J., Ogborn, D., & Krieger, J. W. (2017). Dose-response relationship between weekly resistance training volume and increases in muscle mass: A systematic review and meta-analysis. Journal of Sports Sciences, 35(11), 1073-1082. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/Schoenfeld-2017-Dose-response+relationship+bet.pdf

3-6 hard sets/wk may **maximize** strength for beginners

- 3-6 hard sets/week per movement
- 6-20RM
- Stop 2-3 reps before failure

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3-6 hard sets/wk provide **solid** gains for int / advanced lifters

- Solid strength gains with 3-6 hard sets/week per movement
- 1-10RM
- Stop 1-3 reps before failure

Androulakis-Korakakis, P., Fisher, J. P., & Steele, J. (2020). The minimum effective training dose required to increase 1RM strength in resistance-trained men: a systematic review and meta-analysis. Sports Medicine, 50(4), 751-765. https://breathe-edu-downloads.s3.amazonaws.com/Androulakis-Korakakis-2020.pdf

10+ hard sets/wk may **maximize** for advanced lifters

- 10+ sets/week per movement
- 1-10RM
- Stop 2-3 reps before failure

Ralston, G. W., Kilgore, L., Wyatt, F. B., & Baker, J. S. (2017). The effect of weekly set volume on strength gain: a meta-analysis. Sports Medicine, 47(12), 2585-2601. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/Ralston-2017-The+effect+of+weekly+set+volume+o.pdf

Schoenfeld, B. J., Ogborn, D., & Krieger, J. W. (2017). Dose-response relationship between weekly resistance training volume and increases in muscle mass: A systematic review and meta-analysis. Journal of Sports Sciences, 35(11), 1073-1082. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/Schoenfeld-2017-Dose-response+relationship+bet.pdf

Self Test

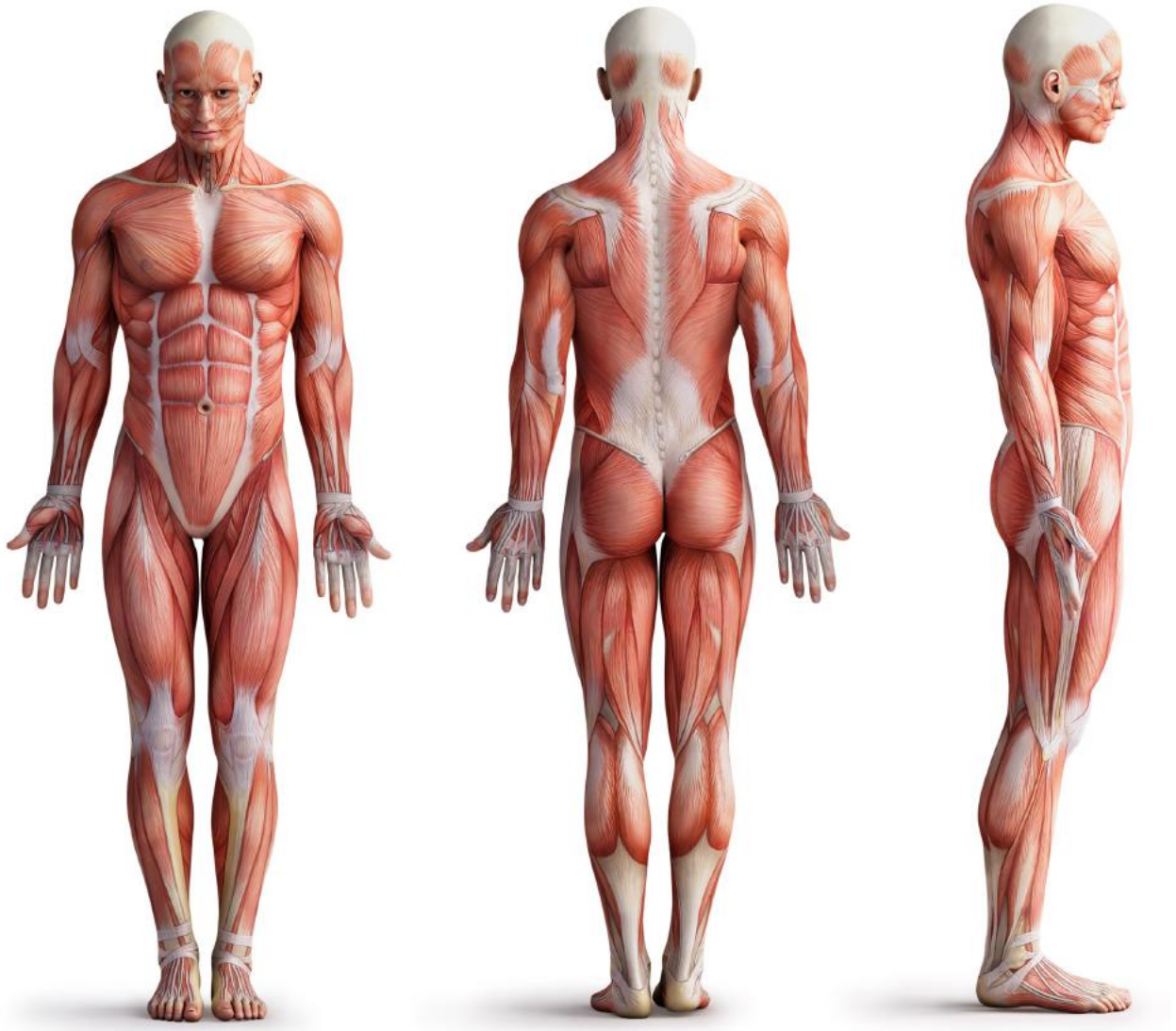
- What is a “hard set”?
- How many hard sets per movement per week to maintain?
- How many hard sets per week to maximize gains for newbies?
- How many hard sets per movement per week to build strength for int / advanced?
- How many hard sets per week to maximize gains for advanced?

Learning goals

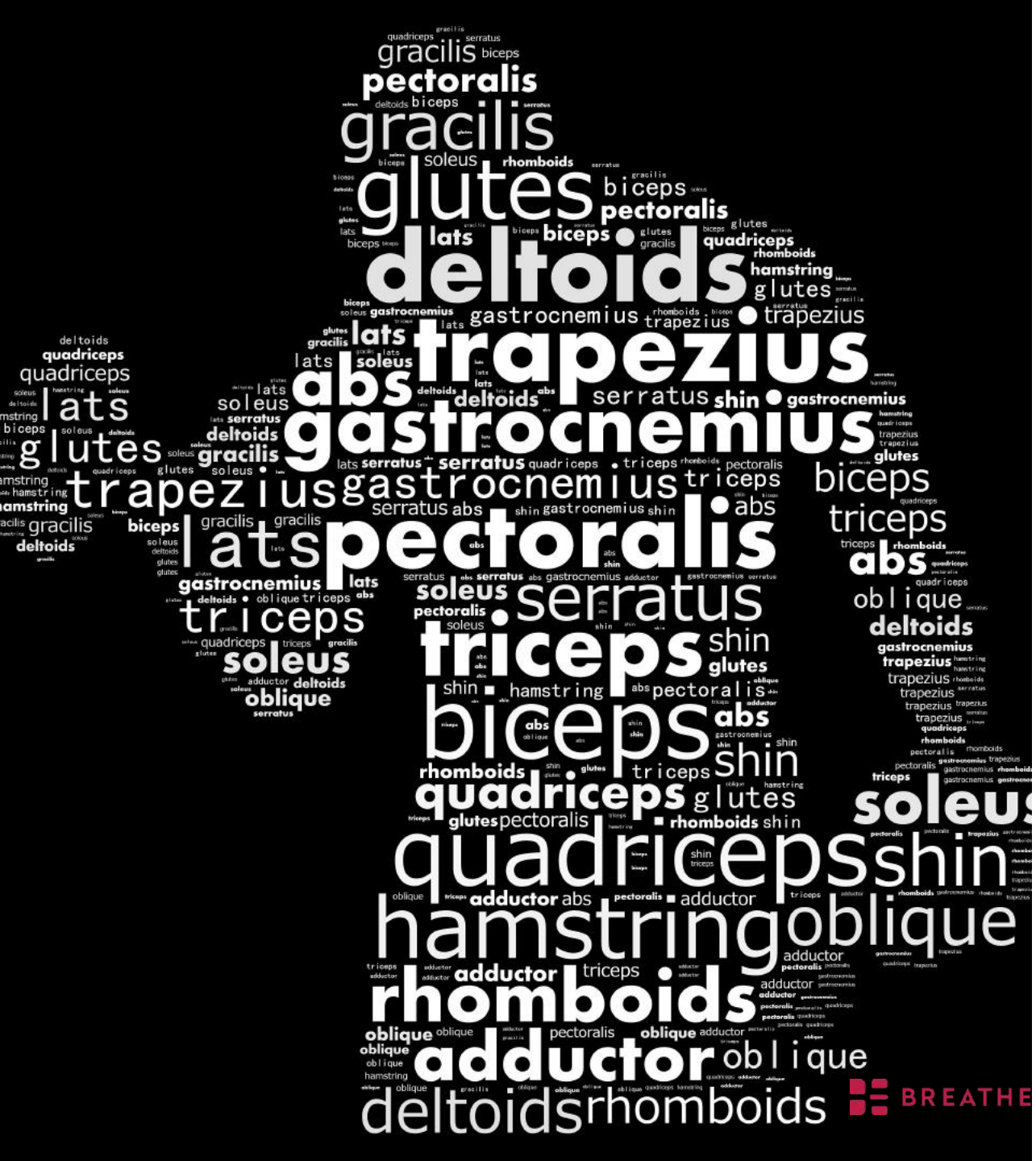
- 6-20RM / 2-3 reps from failure
- 1 set / week to maintain, 3-6 to build, 10+ to maximize
- **Train movements not muscles: Push, pull, squat +**

Train movements not muscles...

Push, pull, squat+



There are ~620 muscles in the human body



To train each one seperately would require ~620 exercises

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Push

Pull

Squat

Luckily, you can train all the muscles with just 3 basic movements

Push

Pull

How to strengthen all shoulder muscles

*And all torso muscles

Squat

How to strengthen all lower body & torso muscles

Push

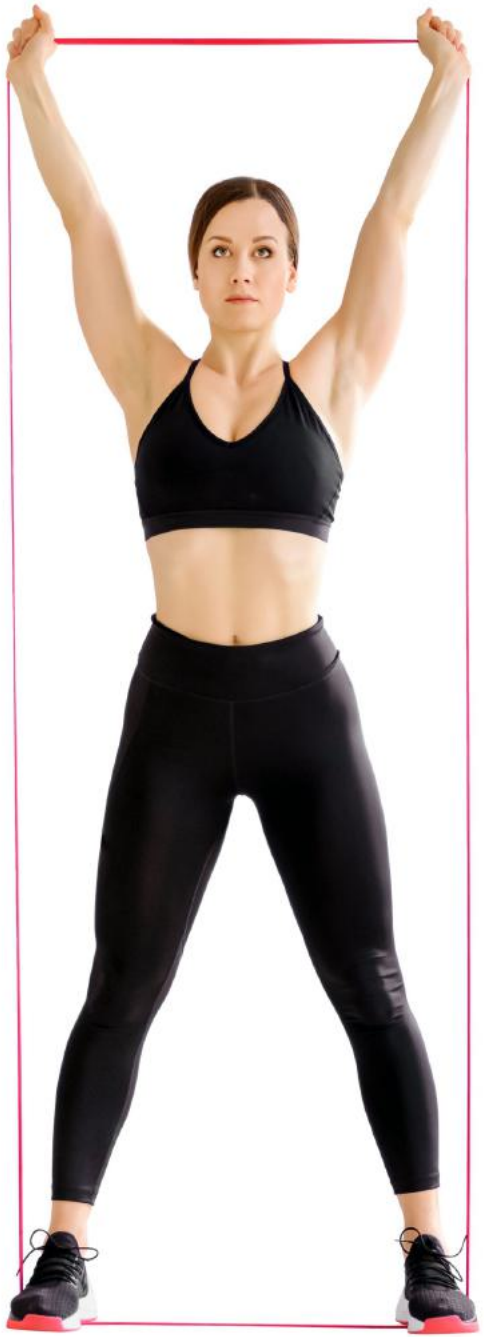
Pull

Squat

How to strengthen **all** the muscles*

*If you really want to target 2-joint muscles you need to add single joint isolation exercises e.g. hamstring curls

Example push exercises



Resistance band overhead press

- With a band heavy enough so you can only do 6-20 reps

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Contrology push-up

Teaser with resistance band

- With a band heavy enough so the shoulders are the limiting factor in the exercise within 6-20 reps

Snake

Prone press on long box

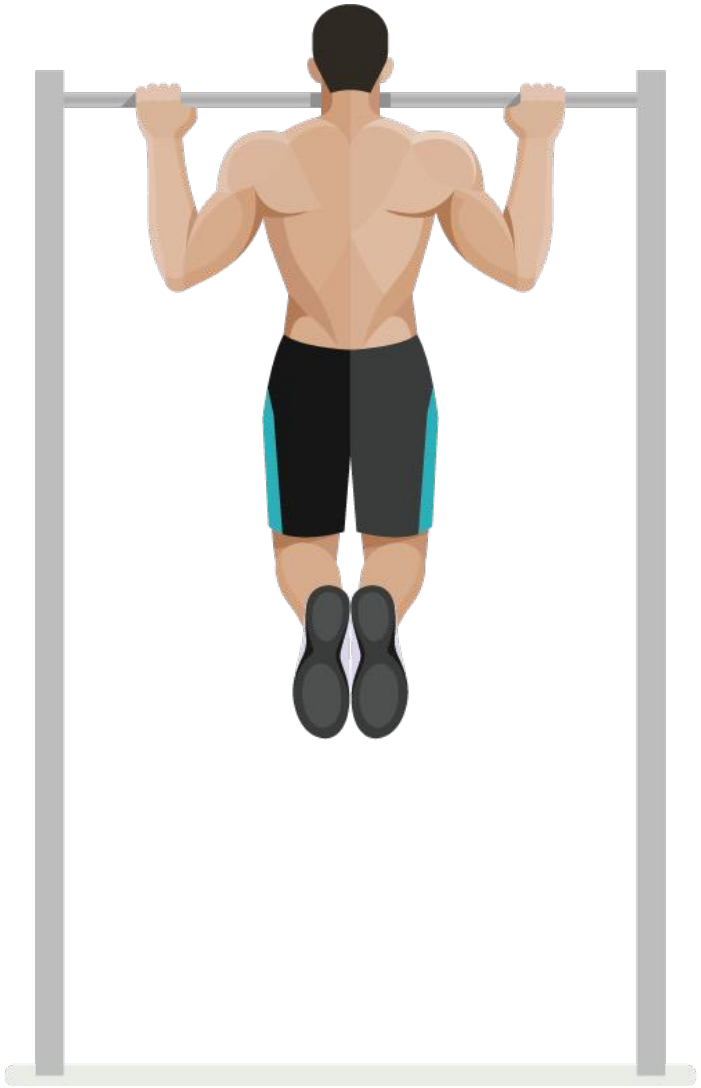
- With a spring heavy enough so you can only do 6-20 reps
- You'll probably need a sticky mat

Long stretch on heavy spring

- With a spring heavy enough so your shoulders are the limiting factor in the exercise within 6-20 reps

Band lateral raise

- With a band heavy enough so you can only do 6-20 reps



Example pull exercises

Supine arms pulling straps

- With a spring heavy enough so the arms are the limiting factor in the exercise in 6-20 reps

Supine band pull

- With a band heavy enough so the arms are the limiting factor in the exercise in 6-20 reps

Dips

- With a load heavy enough so you can only do 6-20 reps

Long stretch kneeling on light spring

- With a spring light enough so your arms are the limiting factor in the exercise in 6-20 reps

Ab wheel

- If your arms are the limiting factor in the exercise in 6-20 reps

Long box pulling straps

- With a spring heavy enough so you can only do 6-20 reps
- You'll need a sticky mat
- Pulling directly on the pulley stanchions is easier to get heavy resistance

Tendon stretch

- With a spring setting where you can only do 6-20 reps

Is tendon stretch push or pull?

- Can a single exercise work more than 1 movement?

What about abs?

- What rep range & proximity to failure will strengthen abs?
- Most Pilates ab series are 35+ reps and nowhere near failure
- If you load your arms and legs using full-body movements like tendon stretch, pushups and weighted squats your abs will get a good workout

Self Test

- How many muscles in the human body?
- How many exercises would you need to do to target each muscle individually?
- Which 3 movements in combination work (pretty much) all muscles?
- True/False: It's only an effective workout for a body part if that body part is the limiting factor in the movement
- True/False: It's important to add enough load so you can only do 6-20 reps
- True/False: It's important to work within a few reps of failure

Example programs

1 hard set per week to **maintain** strength

3-6 sets per week to **build** strength

10+ sets per week to **maximize** strength

Save time with supersets

- Antagonist Superset = do 2 exercises for opposing muscle groups with no rest in between
- Then rest
- E.g. Push immediately followed by pull, then rest

Souza, J., Paz, G. A., & Miranda, H. (2017). Blood lactate concentration and strength performance between agonist-antagonist paired set, superset and traditional set training. Archivos de medicina del deporte: revista de la Federación Española de Medicina del Deporte y de la Confederación Iberoamericana de Medicina del Deporte, 34(179), 145-150. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/Souza2017-ago-antagsupersetandtradlactate.pdf

Superset

Rest 3 min

Repeat 3x

3 sets

Rest 3 min each set

1 session / week,
3 sets per session

- Total 3 hard sets per movement per week
- 6-20RM (beginner), 1-10RM (int/advanced), 2-3 reps from failure
- Rest 3 min between sets
- Solid gains for beginner, maintain strength for intermediate / advanced

Superset

Rest 3 min

Repeat 3x

3 sets

Rest 3 min each set

2 sessions / week, 3 sets per session

- Total 6 hard sets per movement per week
- Intensity ≥10RM, 2-3 reps from failure
- Rest 3 min between sets
- Maximize gains for beginner, solid gains for intermediate / advanced

Superset

Rest 3 min

Repeat x 4+

4+ sets

Rest 3 min each set

3 sessions / week,

4+ sets per session

- Total 12+ hard sets per movement per week
- Intensity 1-10RM, 2-3 reps from failure
- Maximum gains for intermediate / advanced

Learning goals

- 6-20RM / 2-3 reps from failure
- 1 set / week to maintain, 3-6 to build, 10+ to maximize
- Train movements not muscles: Push, pull, squat +
- **Choose stable exercises that include long muscle lengths**
- **Lift fast, lower slower**

Choose stable movements that include long muscle lengths...

Lift fast, lower slower

Zemková, E. (2021). Stable to unstable differences in force-velocity-power profiling during chest presses and squats. J Biomech, 122, 110463. doi:10.1016/j.jbiomech.2021.110463 https://breathe-edu-downloads.s3.amazonaws.com/Zemkov%C3%A1-2021.pdf

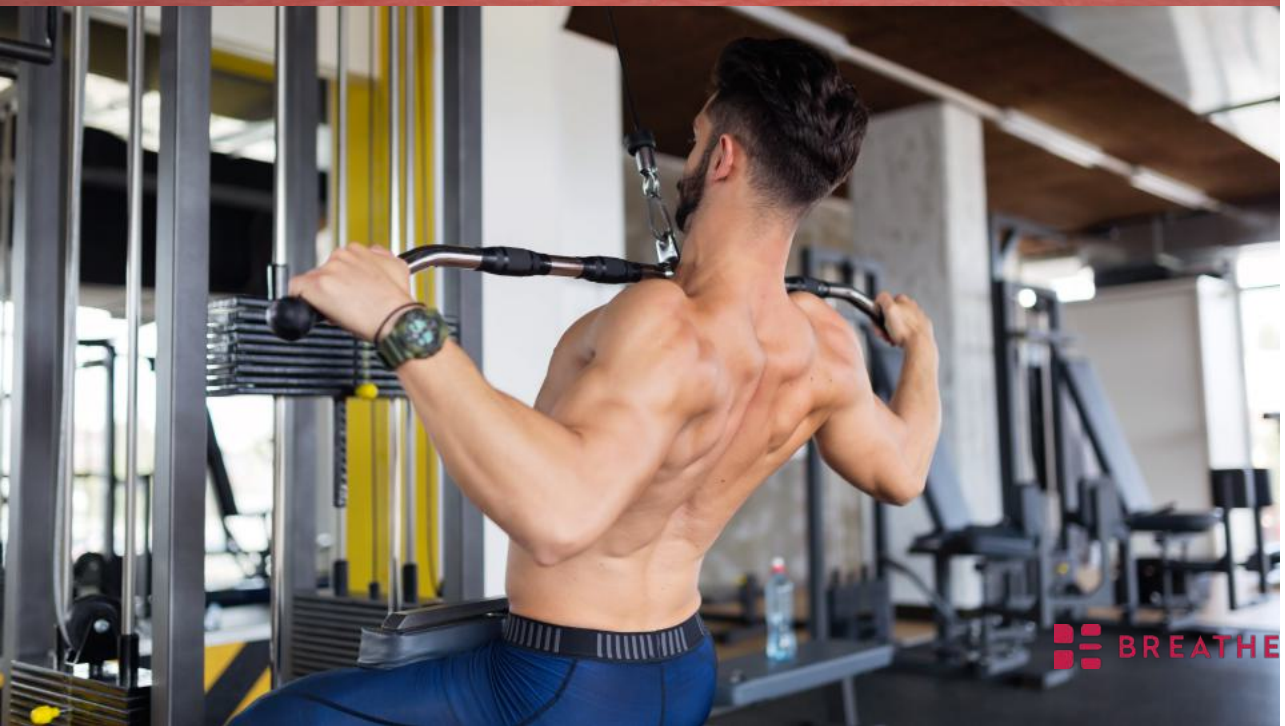
Choose stable movements

- Unstable movements are harder, but not because of strength – because of balance & instability
- As instability goes up, force production goes down
- The primary stimulus for strength gains is high tension on muscles
- More stable exercises allow you to produce more force, therefore applying more tension to the prime mover muscles

Include long muscle lengths

- Full range better than short range
- Lengthened partials better than full range
- Bottom line, emphasize loading at long muscle lengths as much as possible

Korakakis, P. A., Wolf, M., Coleman, M., Burke, R., Pinero, A., Nippard, J., & Schoenfeld, B. J. (2023). Optimizing resistance training technique to maximize muscle hypertrophy: A narrative review. https://breathe-edu-downloads.s3.amazonaws.com/Korakakis-2023.pdf



Which of these is loading at long muscle lengths?

This is what a loading a row at long muscle lengths looks like

Lift fast, lower slower

- Fast concentric
- 2-4 second eccentric
- Basically, lift as fast as you can then control the lowering phase

Korakakis, P. A., Wolf, M., Coleman, M., Burke, R., Pinero, A., Nippard, J., & Schoenfeld, B. J. (2023). Optimizing resistance training technique to maximize muscle hypertrophy: A narrative review. https://breathe-edu-downloads.s3.amazonaws.com/Korakakis-2023.pdf

Korakakis, P. A., Wolf, M., Coleman, M., Burke, R., Pinero, A., Nippard, J., & Schoenfeld, B. J. (2023). Optimizing resistance training technique to maximize muscle hypertrophy: A narrative review. https://breathe-edu-downloads.s3.amazonaws.com/Korakakis-2023.pdf

There is no research on how exercise technique affects strength or hypertrophy

"**There is no literature** directly examining the effect of strict versus non-strict repetition technique on hypertrophy"

All technique recommendations are based on theory

Self Test

- Why do stable exercises probably increase strength more?
- Which range of motion is most effective for hypertrophy?
- What movement speed is most effective for strength and hypertrophy?
- True/False: We don't know if strict alignment and movement patterns make any difference to strength or hypertrophy

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- Lift fast, lower slower
- **Progressively add load**

Progressively add load

To keep getting stronger...

You need to keep adding load

American College of Sports Medicine. (2009). American College of Sports Medicine position stand. Progression models in resistance training for healthy adults. Med Sci Sports Exerc, 41(3), 687-708. doi:10.1249/MSS.0b013e3181915670 https://breathe-edu-downloads.s3.amazonaws.com/ACSM-2009.pdf

When you get stronger you can do more reps with the same load

e.g., What used to be your 10RM is now your 12RM

At this point **you need to add more load** until you can only do 10 reps again

OR **add more reps** so you're still within 2-3 reps of failure

This is called **progressive overload**

Progressive overload is one of the foundational principles of strength science

Self Test

- What is the principle of progressive overload?
- Why do you need to progressively add load to build strength over time?
- What are 2 ways you can progress load?
- How do you know when to add more load?
- How much load should you add?

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- Lift fast, lower slower
- Progressively add load
- **Eat ≥ maintenance calories + 2g protein / kg BW / day**

To build strength you need adequate **calories & protein**

Building strength is much easier in a caloric surplus

- It is possible to build strength at maintenance calories, just harder
- 350-500kcal / day surplus will probably maximize strength gains

Slater, G. J., Dieter, B. P., Marsh, D. J., Helms, E. R., Shaw, G., & Iraki, J. (2019). Is an Energy Surplus Required to Maximize Skeletal Muscle Hypertrophy Associated With Resistance Training. Frontiers in Nutrition, 6. doi:10.3389/fnut.2019.00131 https://breathe-edu-downloads.s3.amazonaws.com/Slater-2019.pdf

Building strength requires protein

- 2g protein per kg bodyweight / day
- 1g protein per lb bodyweight / day
- That's quite a lot of protein
- Ideally 30g+ protein with every meal & snack (this is less important than total daily protein intake)

Slater, G. J., Dieter, B. P., Marsh, D. J., Helms, E. R., Shaw, G., & Iraki, J. (2019). Is an Energy Surplus Required to Maximize Skeletal Muscle Hypertrophy Associated With Resistance Training. Frontiers in Nutrition, 6. doi:10.3389/fnut.2019.00131 https://breathe-edu-downloads.s3.amazonaws.com/Slater-2019.pdf

Morton, R. W., Murphy, K. T., McKellar, S. R., Schoenfeld, B. J., Henselmans, M., Helms, E., . . . Phillips, S. M. (2018). A systematic review, meta-analysis and meta-regression of the effect of protein supplementation on resistance training-induced gains in muscle mass and strength in healthy adults. British Journal of Sports Medicine, 52(6), 376-384. doi:10.1136/bjsports-2017-097608 https://breathe-edu-downloads.s3.amazonaws.com/Morton-2018.pdf

Self Test

- True/False: It is easier to gain strength in a caloric surplus
- How much of a caloric surplus will probably maximize strength gains?
- Muscle is made of protein, therefore if you want to build muscle you must eat enough ___
- How much protein will maximize strength and muscle mass?

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Literally everything you need to know about strength training on 1 page

Do these 3 movements for a complete workout: Push, pull, squat / lunge	Sessions per week	Sets per movement each		Add more sets when…
		Session	Week	
Low volume 1. Beginner (<6 mo consistent training) 2. Stressed, fatigued, unusual aches & pains 3. Working through injury 4. Maintenance	1	3	3	1. Strength plateaus for 4+ weeks 2. Energy, stress or fatigue return to normal 3. Minimal pain with exercise 4. Desire to increase strength
Moderate volume • Maximize gains for beginner • Solid gains for intermediate / advanced	2	3	6	**Increase** weekly sets if gains plateau for 4+ weeks **Decrease** weekly sets if injured, unusual aches & pains, fatigued, stressed, or reduced performance
High volume Maximize gains for advanced (12+ mo consistent training)	3	4+	10+	

How to Train To Maximize Strength

- Warm-up with 2-3 progressively harder sets of the exercise you're about to do
- Hard sets at 6-20RM
- Stop 2-3 reps before failure
- Rest 3-5 minutes between sets
- Push, pull, squat/lunge variations
- Choose stable movements that emphasize long muscle lengths
- Lift fast, lower slower

How To Recover To Maximize Strength

- Eat 2g protein per kg of bodyweight per day (e.g., if you weigh 60kg eat 120g protein per day)
- Be in a 350-500 kcal/day surplus
- Do cardio at least 6 hours after strength or on a different day
- Sleep 7-8 hours / night consistently

How to get about 80% of all the benefits it's possible to get from strength training

How to train	How to recover
3-6 hard sets per week each of push, pull, squat	Maintenance calories, or even better slight surplus
Work at 6-20RM, stop 2-3 reps before failure	2g protein per kg body weight (that's a lot!)
Emphasize stable movements that load at long muscle lengths	Sleep 7-8h

Learning goals

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Questions?

Bonus content...

How to structure a session & week to maximize strength

- Dynamic loaded warm-up
- Do your highest priority execises first
- Work at 6-10RM
- Stop 2-3 reps before failure
- Save time with antagonist supersets
- Rest 3-5 min between sets
- Do strength before cardio or on a different day
- Train each movement on 1-3 non-consecutive days
- Total sets per week determines strength gains, regardless of how many sessions you do

Dynamic loaded warm-up

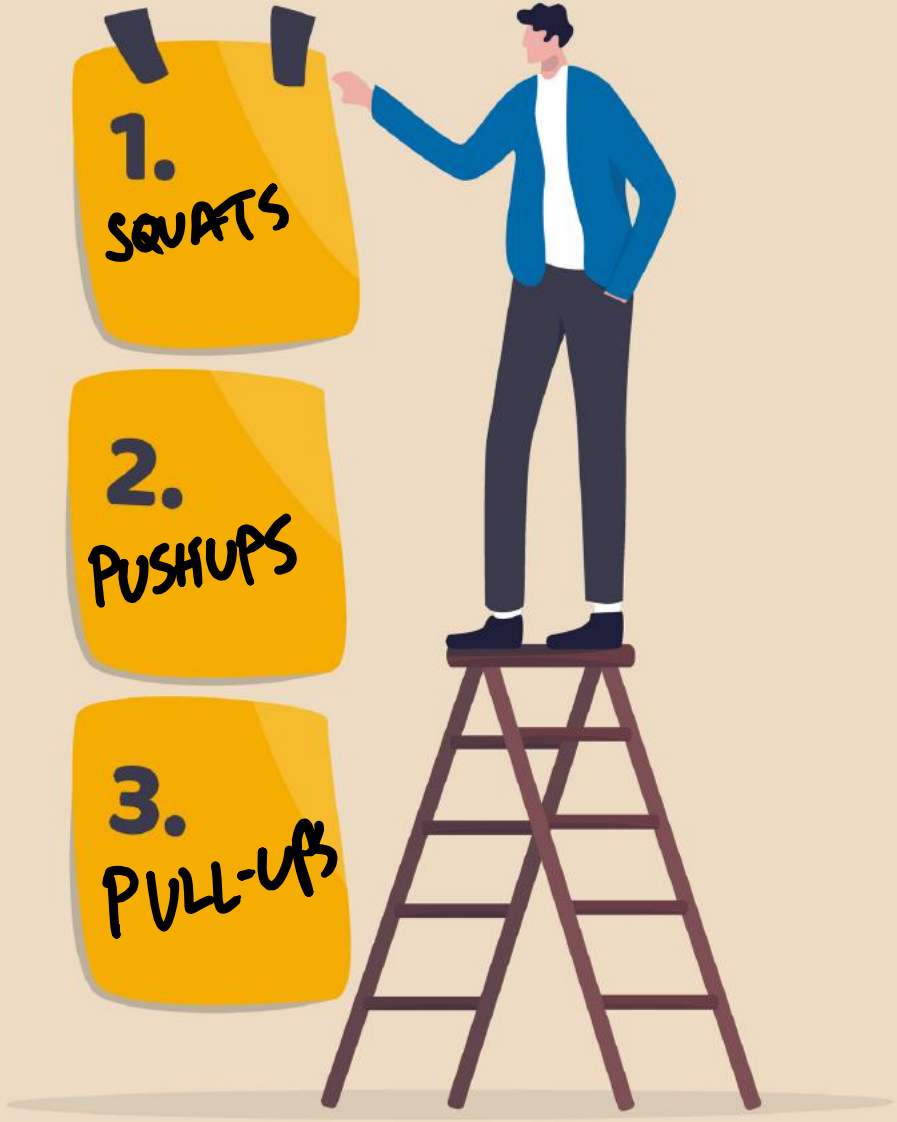
- Increases performance
- May reduce injury risk
- 2-4 sets of the movement you are warming up for
- Add load each set

McCrary, J. M., Ackermann, B. J., & Halaki, M. (2015). A systematic review of the effects of upper body warm-up on performance and injury. Br J Sports Med, 49(14), 935-942. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/McCrary-2015-A+systematic+review+of+the+effect.pdf

NOT needed in a warm-up

- Foam rolling
- Muscle “activation” exercises
- Core stability exercises
- Static stretching
- Unloaded movement practice

McCrary, J. M., Ackermann, B. J., & Halaki, M. (2015). A systematic review of the effects of upper body warm-up on performance and injury. Br J Sports Med, 49(14), 935-942. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/McCrary-2015-A+systematic+review+of+the+effect.pdf



Do your highest priority exercises first

Strength gains are biggest for exercises done at the start of a session

Nunes, J. P., Grgic, J., Cunha, P. M., Ribeiro, A. S., Schoenfeld, B. J., de Salles, B. F., & Cyrino, E. S. (2020). What influence does resistance exercise order have on muscular strength gains and muscle hypertrophy? A systematic review and meta-analysis. European journal of sport science, 1-9. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/de+Salles-2009-Rest+interval+between+sets+in+s.pdf

Rest 3-5 min between sets

Longer rest between sets enables you to lift more, which results in more strength gains.

de Salles, B. F., Simao, R., Miranda, F., da Silva Novaes, J., Lemos, A., & Willardson, J. M. (2009). Rest interval between sets in strength training. Sports Medicine, 39(9), 765-777. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/de+Salles-2009-Rest+interval+between+sets+in+s.pdf

Schoenfeld, B. J., Pope, Z. K., Benik, F. M., Hester, G. M., Sellers, J., Nooner, J. L., . . . Ross, C. L. (2016). Longer interset rest periods enhance muscle strength and hypertrophy in resistance-trained men. Journal of Strength and Conditioning Research, 30(7), 1805-1812. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/Schoenfeld-2016-Longer+interset+rest+periods+e.pdf

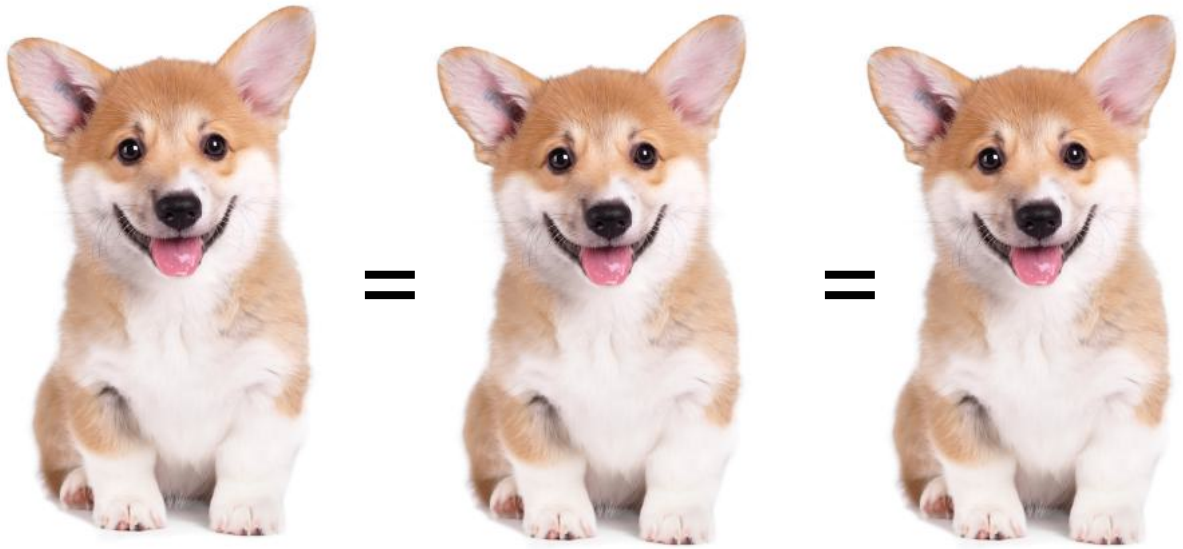
If you can do as many reps as you did the previous set,

You've rested long enough

Do strength before cardio

Or on a different day

Murlasits, Z., Kneffel, Z., & Thalib, L. (2018). The physiological effects of concurrent strength and endurance training sequence: A systematic review and meta-analysis. Journal of Sports Sciences, 36(11), 1212-1219. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/Murlasits-2018-The+physiological+effects+of+co.pdf



6 sets, 1x/week

Total 6 sets

3 sets, 2x/week

Total 6 sets

2 sets, 3x/week

Total 6 sets

Total sets per week determine strength gains

Regardless of how many sessions you spread the sets between

Grgic, J., Schoenfeld, B. J., Davies, T. B., Lazinica, B., Krieger, J. W., & Pedisic, Z. (2018). Effect of resistance training frequency on gains in muscular strength: a systematic review and meta-analysis. Sports Medicine, 48(5), 1207-1220. https://be-research-papers.s3.amazonaws.com/Diploma+lecture+research+papers/Lecture+8+Strength/Grgic-2018-Effect+of+resistance+training+frequ.pdf

How to structure a session & week to maximize strength

- Dynamic loaded warm-up
- Do your highest priority execises first
- Work at 6-10RM
- Stop 2-3 reps before failure
- Save time with antagonist supersets
- Rest 3-5 min between sets
- Do strength before cardio or on a different day
- Train each movement on 1-3 non-consecutive days
- Total sets per week determines strength gains, regardless of how many sessions you do