ESS 424 Applied Exercise Physiology
Fitness Assessment and Exercise Prescription
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Client: Zachary Phillips
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With growing rates of disease such as cardiovascular disease, diabetes, and cancer, as well as other health concerns such as obesity and hypertension, it is more important than ever to live a healthy lifestyle. The unhealthy lifestyle of many Americans is leading to increasing mortality rates and decreasing quality of life day by day. There are many aspects that go into living a healthy lifestyle, including diet and mental health, among others. Along with these characteristics, one must be physically healthy. In order to be physically healthy, one needs to exercise and be physically active. However, many people continually make excuses as to why they cannot exercise. Often, these excuses fall under the categories of “I’m too busy” or “I just do not want to exercise.” One very common excuse as to not exercising is “I do not know how to exercise.” More often than not, people do not know much about exercising. These individuals possibly do not want to hurt themselves or look like they do not know what they are doing. This simple excuse plays a large role as to why people do not exercise.

Sometimes, not knowing the correct way to exercise does not deter people from being physically active. This fact is great, but it can also be dangerous. If a person is not exercising correctly, they are at a high risk for injury. Injury is a big turn-off, and can often prevent individuals from returning to an exercise routine, especially if they do not know the correct technique or how to create a proper program. Once an individual becomes injured, it is very easy for them to abandon their previous exercise program and stop being physically active. This event can be very dangerous and ultimately debilitating.

Exercise has been found to show great improvements in special populations, such as those with cardiovascular disease and diabetes. There are many programs, such as cardiac and pulmonary rehabilitation, that have been created to help rehabilitate those that have undergone severe heart surgery or experienced various cardiac events. For these special populations, which often are elderly, exercise can play a huge role in their rehabilitation back to health. It is important for these people to exercise; however, it is very risky for many of them to be physically active. These populations are at a much higher risk for events such as falls and other cardiac events. For this reason, it is important for these people to be supervised while exercising and have their programs monitored, so they do not increase their intensity or duration too quickly. If their exercise is prescribed and they are monitored, they are at a much lower risk for health implications and will most likely return to health at a faster pace.

For these reasons, among others, exercise prescriptions serve a very important purpose. An exercise prescription is a guided exercise program prescribed by a certified fitness specialist that is based on an individual’s health and fitness. Various aspects of health and fitness, such as body composition, cardiovascular health, flexibility, and muscle strength and endurance are taken into consideration when prescribing exercise. In order to obtain an individual’s health and fitness, an instructor leads the individual through a personal fitness evaluation. This evaluation is a series of tests that, once completed, provide information such as VO$_2$ max, various one repetition maximums, and peak anaerobic power, among others. The information provided by personal fitness evaluations can then be used to create a personalized exercise prescription based on an individual’s goals. These prescriptions can become fairly accurate, because with the information provided the specialist can design a program that progress at a proper rate based on heart rate reserve and VO$_2$ reserve. Without a personal fitness evaluation, exercise prescriptions can turn into a shot in the dark and are not as accurate. Throughout this binder, a personal fitness evaluation for the client, Zachary Phillips, is laid out and explained.
Subject Information

The client’s name is Zachary Phillips. He is a 22 year old male who is 68.75 inches and 172 pounds (78.18 kilograms). He has a resting heart rate of 65 beats per minute and resting blood pressure of 98/54. Zachary has a fasting glucose of 80 mg/dL and cholesterol of 119 mg/dL. His HDL is 38 mg/dL and his LDL is 70 mg/dL. He has various goals, including being able to bench 200 lbs., improve his flexibility, and maintain his current cardiovascular fitness. Overall Zachary seems like a fairly healthy individual. However, there are some aspects of his basic information, such as HDL, that could be improved.

What are 3 potential sources of error in measuring heart rate by palpation?

- Palpation can be very subjective – up to the discretion of the clinician
- Sometimes heart rate can be hard to distinguish – easy to miss a beat, possibly leading to concern over abnormal heart rates
- Palpation is not completely accurate – Various timings and mathematics can be used to determine heart rate via this method, leaving plenty of room for mistakes

Were your clients HR responses to exercise normal? Explain.

- For the most part, yes, my client’s heart rate responses to exercise were normal
- Normal responses to exercise include an increase of heart rate correlated with an increase in intensity
- A plateau (steady state) can be seen if a duration at a certain intensity is long enough
- The only time steady state was at least close to being achieved for my client was during submaximal testing such as the YMCA test, towards the end of each workload. However, during other tests such as the graded exercise test, his heart rate only increased because he was not at a workload long enough for his HR to plateau and his body to reach steady state

What are 3 potential sources of error in measuring blood pressure at rest and during exercise?

- Outside artifact
  - Rest: noise of the lab and other people
  - Exercise: Too much movement, clinical equipment clanging together, etc.
- Subjective
  - At both rest and exercise, blood pressure taken via stethoscope can be very subjective
- Blood pressure at rest might not be actual resting blood pressure – various factors, such as stress, and whether or not the client has actually rested for long enough

What is your clients resting BP classification?

- My clients resting BP is classified as normal, but closer to the lower side of normal

Were your clients BP responses normal?

- During most exercise tests, my client’s systolic BP increased significantly with only a slight increase in diastolic BP
- This is a common response to exercise
- Systolic BP should increase significantly, and diastolic BP should increase only slightly, if at all
Risk Stratification

Zachary seems to be a fairly healthy individual. When his risk stratification was analyzed, he only has one risk factor: he has an immediate family member that has been diagnosed with hypertension. For this reason, family history is a positive risk factor for Zach. He does not smoke, does not have hypertension or hypercholesterolemia, his fasting glucose is good, he is not obese, and he does not lead a sedentary lifestyle. His BMI is on the cusp of being overweight, but Zach is obviously not an overweight individual. He is very fit, so it is likely that most of his weight is accounted for by muscle, not fat. Zach also does not have any major signs or symptoms of CVD or PVD. For these reasons, Zach can be classified as low risk. Since he is at low risk, he does not need a medical examination or graded exercise test supervised by a medical professional before he begins physical activity.

His PAR-Q survey also came up negative, since he answered “no” to all of the questions. On the PAR-Q, if the client answers yes to any of the prompts, they must speak with their doctor before beginning and exercise program. Since Zach is low risk and had a negative PAR-Q, he can begin exercise once he has completed the personal fitness evaluation. Zach also had a BMI of 25.5 and a waist-to-hip ratio of 0.85. Zach’s BMI classification was previously mentioned, and his waist-to-hip ratio puts him in the category of very low risk for cardiovascular disease.

What does this predict for their risk of heart disease?

- Zach’s risk stratification puts him at a low risk for heart disease
- His family history of hypertension is the only slightly worrisome part of his risk stratification
- Zach’s BMI and waist-to-hip ratio also put him at low risk for heart disease
- His waist-to-hip ratio is very healthy, and his BMI is on the cusp between being overweight and having a healthy weight
- Zach’s BMI is still healthy, because he has a high muscle mass, and low fat mass
- According to Flint et al. (2010), BMI and waist-to-hip ratio are highly positively correlated with various forms of cardiovascular disease. Since Zach has a healthy BMI and waist-to-hip ratio, he is at low risk for CVD.

Based on PARQ and Medical History, what category are they in and will you need doctor’s clearance to proceed with testing and an exercise program?

- Zach is low risk
- Zach does not need a doctor’s clearance
Body Composition

Zach underwent various body composition tests in order to determine some aspects of his health. He took part in a 3 site skinfold test and 7 site skinfold test, as well as used the bioelectrical impedance analysis analyzer (BIA). Both the 3 site skinfold test and BIA determined his body fat percentage to be 8.3%, while the 7 site test determined his fat percentage to be 10.6%. Both of these percentages fall within a healthy range for adults. Healthy adult males have a body fat percentage between 6%-24%. Zach is on the lower end of the acceptable range of body fat. If the BIA and 3 site skinfold tests are correct, Zach has a fat free mass of 157.72 lbs. (71.69 kg), and a fat mass of 14.28 lbs. (6.49 kg). These numbers are in a very good range, and indicate somebody who is fairly active and healthy. Zach’s BMI, as mentioned in the previous section is 25.5, and his waist-to-hip ratio is 0.85, both which are healthy. If Zach wants to stay healthy, he should aim to keep the same body weight and fat mass he currently has. However, if he is to achieve his goal of benching 200 lbs., and increase in his body weight is inevitable. It is alright if he increases his weight, as long as his fat mass only fluctuates slightly. However, Zach is healthy enough that he has some room to move in terms of gaining some fat mass.

Which value would you report to your clients and from which technique did you get this value? Why, specifically, did you choose this technique as the one to report?

- I would report my client’s result of 10.6% body fat
- This percentage was achieved using 7 site skinfold
- BIA has some possible errors and can under-score certain individuals
- 3 site skinfold does not include as many sites as 7 site skinfold, making it less accurate
- Although the fat percentage for 3 site skinfold and BIA came out the same, 7 site skinfold tests are still more accurate than those two tests, making them more reliable

What category does this place them in?

- Zach is placed in the lower end of the acceptable range for adults

Why is it important to be within the healthy range?

- Body fat, especially around the abdomen, has been correlated with cardiovascular heart disease and diabetes
- With a healthy amount of fat, Zach is at less risk for various diseases
- A client with an unhealthy amount of fat is at risk for various deficiencies that can be life-threatening

How close were the assessments of body composition?

- The assessments were fairly close. Two of them were equal, while the only one was just barely larger than the other two. Although the larger of the three was collected using the most reliable test, it still is not very far from the other two percentages
- Considering the possibility of big errors, these results seem fairly accurate

What factors could account for the discrepancies?

- Technician error can be present for skinfold tests
  - Muscle could be measured as well as fat, which would provide a large number
  - Not enough fat could be measured
  - Wrong placement
- Order of testing
  - If graded exercise test was performed before body composition, body composition could be lower
  - If overheated, shift in body fluids can swell near the skin, inflating skin fold
Skin temperature can change after exercise, affecting BIA results
- BMI can be considered overweight even if an individual just has a high lean muscle mass
- Moist skin can inhibit skin folds

Would hydration status affect the test results? How?
- BIA measures how quickly current runs through the body, as well as the resistance the current faces
- A lesser hydrated individual will be less conductive, leading to more resistance and a higher body fat percentage reading

Would body position/room temperature affect body composition measures? How?
- With the BIA, the speed and resistance of the current can be affected by body position, changing the result – more resistance, more fat – less resistance, less fat
- Body temperature can shift fluid position and also cause changes in fluid volume within the body, ultimately affecting BIA measurement

What are some possible sources of measurement error using the skinfold and BIA method?
- According to the various factors previously mentioned, BIA and skinfold can vary compared to each other. Both user and technician error can account for these mistakes

Based on the WHR, is your client apple or pear-shaped? Is your client at risk for diseases associated with upper-body obesity? Explain
- My client is apple shaped. Pear-shaped individuals have a very high amount of abdominal fat which, based on storage location, is very dangerous and is associated with various forms of diseases, especially CVD. Apple shaped individuals are the most healthy
- My client is not at risk for diseases associated with upper-body obesity, because he is not obese
Cardiovascular

There are many pieces of data that are encompassed by the cardiovascular fitness testing. This data includes various VO\textsubscript{2}max prediction tests, such as submaximal tests and non-exercise tests. All of these tests attempt to predict an individual’s VO\textsubscript{2}max, which is a fairly good representation of an individual’s cardiovascular health. Cardiovascular data also includes calculations of heart rate reserve and VO\textsubscript{2} reserve, as well as a Wingate test, which is a predictor of anaerobic power. All of the VO\textsubscript{2} max prediction tests Zach completed yielded very different results. He received a relative VO\textsubscript{2} max of 46 ml/kg/min during a graded exercise test, 34.84 ml/kg/min during the submaximal treadmill test, 47.83 ml/kg/min during the YMCA submaximal cycle ergometer test, 39.93 ml/kg/min during the step test, and 51.27 ml/kg/min based on calculations using the non-exercise test. His performance on the graded exercise test was classified as average, while his performance on the submaximal treadmill test was classified as poor, the step test results were below average, the YMCA submaximal test results were above average, and the non-exercise test results were in between above average and good. The results Zach received from the Wingate test were somewhat above average. His peak power ranked in 69\textsuperscript{th} percentile while his relative peak power was just slightly lower.

Why is it important/beneficial to be physically fit?
- Being physically fit/active provides many health benefits, especially cardiovascular
- According to Minder et al. (2014), low levels of physical activity are correlated with high levels of cardiovascular disease and lower quality of life, while high levels of physical activity are closely correlated with a decreased risk for cardiovascular disease
- Being physically fit can decrease resting heart rate, decrease resting blood pressure, lower one’s risk for hypertension, and increase cardiac output and stroke volume

What does this predict for their risk of heart disease?
- All of those aspects previously listed contribute to protection from heart disease
- With lower blood pressure and heart rate, the heart is under a lot less stress, which means it does not need to work as hard to carry oxygen to the required areas of the body
- With the heart not working as heart and less plaque and blood clots, risk for heart disease decreases

Was there a lot of difference in the predicted VO\textsubscript{2}max from the different tests?
- Yes, there was a lot of variation in the predicted VO\textsubscript{2}maxes received from the different tests

How accurate do you think these tests were? Which test was most accurate? Why? What might account for these differences? List some of the potential sources of error for each task.
- Some of these tests were fairly accurate, while others were not as accurate
- It should me mentioned that the graded exercise test was completed fairly early on, with decent results. At Zach’s VO\textsubscript{2}max, his heart rate was 195 bpm. Despite this result, Zach continued the submaximal testing using his age predicted max heart rate (198 bpm). Although his age predicted max is only three beats faster, he still should have completed the tests using 195 bpm.
- The graded exercise test was probably the most accurate test
- While submaximal tests are good for predicting VO\textsubscript{2}max, it could be determined from the graded exercise test data that Zach reached his true VO\textsubscript{2}max, making this test the most accurate
If the graded exercise tests is the most accurate test, the YMCA submaximal test is also fairly accurate, just for the fact that it’s predicted VO\textsubscript{2}max was only approximately 1 ml/kg/min higher than the graded exercise test.

The step test and submaximal treadmill tests were probably not completed correctly, especially since probably not all of the criteria of submaximal tests were reached.

Since the tests were completed by students with fairly limited previously knowledge, not all of the tests are completely accurate.

Some tests might be accurate, while others might have been completed incorrectly, which would account for such a variation.

Also, Zach might have had very little or two much to eat previously to performing various tests.

He could have gotten very little sleep the night before.

Zach might have worked his legs out at the gym or gone for a long run one or two days previously.

**What factors should be considered when choosing test protocol?**

- Orthopedic limitations
- Previous exercise tests
- Risk stratifications and possible risk factors
- Lifestyle – sedentary or active
- Time constraints
- Equipment availability

**How closer were the client’s estimated VO\textsubscript{2}max values calculated/graphed between the cycle test and treadmill test? Why were there differences?**

- First of all, the graphed and calculated VO\textsubscript{2}max predicted values for the YMCA cycle test were slightly different. The calculated VO\textsubscript{2}max seems fairly accurate, being 47.83 ml/kg/min, while the graphed value is slightly higher. This difference could be due to graphing errors.
- Second, both of those values were higher than the value achieved during the treadmill submaximal test.
- This difference could be seen for a few reasons.
- The submaximal cycle test went for much longer than the treadmill test did.
- Zach went all the way until he reached the certain percentage of his age predicted heart rate for the YMCA cycle test, while he was stopped at a certain point prior to his predicted heart rate, making the cycle test slightly more accurate instead of trying to predict Zach’s progression as much, which is what was done with the treadmill submaximal test.

**Did the participant reach LT/VT and at what point?**

- Zach did reach LT/VT, which occurred around the point where his RER on the graded exercise test exceeded 1.0.
- Lactate threshold is the point during exercise where lactate begins to accumulate at a rapid pace throughout the body for multiple reasons, including an increase in hydrogen ions released from the bioenergetics pathways as well as the body’s inability to remove the lactate.
- In order to buffer the sudden drop in pH, the body uses the bicarbonate buffering system, which causes and increase in VCO\textsubscript{2}.
• Zach reached lactate threshold around the 8th minute of the graded exercise test

**Did the participant reach his/her true VO\textsubscript{2}max? Explain using the criteria**

- Although Zach did not reach his age predicted heart rate (missed by 3bpm) he did manage to reach his true VO\textsubscript{2} max
- Zach’s RER was well above 1.15, which is the required value
- Zach had reached anaerobic threshold
- He had also reached a very high RPE
- Zach’s heart rate, although not at his max, was still rising steadily throughout the test

**Describe the advantages and disadvantages of predicting VO\textsubscript{2}max with the tests used**

- Submaximal exercise tests are great for those with orthopedic limitations and various heart disease risk factors
  - Submaximal tests are exactly as they sound – the individual performing the test does not reach their true VO\textsubscript{2}max, so they are not worked as hard, avoiding potential injuries and cardiac events
- Since submaximal tests are not maximal, their results are only predicted, meaning there is a large room for error. A slight mistake can cause a massive change in their predicted VO\textsubscript{2}max
- The various versions of submaximal tests provide many different ways in order to predict VO\textsubscript{2}max based on various constraints, including time
  - The step test takes very little time and not much work, although it can be limiting based on orthopedics
- Graded exercise tests can help predict true VO\textsubscript{2}max
  - However, can be difficult to reach true VO\textsubscript{2}max, as there are many requirements in order for the value found to be called the true VO\textsubscript{2}max

**Choose the results from one of these tests to use in your Fitness Evaluation and Prescription Project. Explain why you chose this test.**

- I will use the results from the graded exercise test (46 ml/kg/min). I believe Zach reached is true VO\textsubscript{2}max during this test, and it seems to be one of the most accurate out of any of the other tests

**Wingate Test Discussion**

**Explain the bioenergetics of ATP production during short term intense exercise to exhaustion**

- During the beginning of short term intense exercise to exhaustion, the ATP-PC pathway is generally used to produce ATP. During this time, ADP joins with a phosphate from phosphocreatine to form ATP, which is then used as energy. Once this energy pathway is used up, which is generally very quickly, the glycolytic pathway is utilized, which is where glucose stores are used to produce ATP. The glycolytic pathway generally lasts 30-90 seconds, which is the duration of the Wingate test

**Describe and discuss physiological factors that would have caused a decline in power of the 30-second Wingate test. Explain.**

- One of the main factors that cause a decline in power is the build-up of hydrogen ions and the production of lactate due to lack of oxygen. Although this is a very short time, rapid us of power and energy can lead to a build-up of hydrogen ions. This build-up can interfere with muscular contractions, causing fatigue
Why is it recommended to express peak power relative to body mass or more correctly to LBM?

- Power is often related to body mass. Larger people are generally able to produce more power than those that are smaller and have less mass. However, if a smaller individual produces the same amount of peak power as somebody who weighs 50 more pounds than them, then, in relation to their body mass, the smaller individual produced more power.

How would one train to become a better Wingate test performer?

- Anaerobic training would be the most beneficial in order to become a better Wingate test performer. For this reason, endurance training such as long distance running would not be beneficial. However, power lifts for the lower body such as squats would be very beneficial, since they would work on power and strength. Also, sprint workouts could potentially be beneficial as well.
Muscular Strength and Endurance

Zach had fairly skewed results in terms of muscular strength and endurance. His one repetition maximum (1RM) for bench press was 185 lbs., or approximately 107.6% of his body weight. This 1RM fell around the 41st percentile, which is fair for his age and weight. However, Zach’s leg press 1RM was through the roof. He pressed 660 lbs., which was an astonishing 383.7% of his body weight, which is well above the normal 99th percentile for his age and weight. In other results, the majority of his muscular endurance scores were also quite high. The majority of his scores were within the above average/excellent range, except for his bench press result. He managed 9 repetitions at the prescribed weight, which only came out to be classified as average. However, his pushup and sit-up tests were successful, since he generally performed above average in those two categories. His handgrip strength was around the 68th percentile.

Why is it important/beneficial to have good muscle strength and endurance?
- It is important/beneficial to have good muscular strength and endurance because it can help in many areas of life
- Quality of life of those with good strength and endurance often is elevated
- Resistance training, which leads to strength and endurance, helps prevents osteoporosis and osteopenia
- Most muscular strength and endurance, especially lower limb, can lead to improved performance in other areas of fitness

How do the results of various strength/endurance assessments compare across different muscle groups?
- For Zach, the muscle groups in his lower limbs performed superiorly to those of his upper body, both on muscular strength and endurance. Both his hamstrings and quadriceps were classified as excellent for muscular endurance in their respective exercises, while Zach’s 1RM for leg press was outstanding.
- In Zach’s upper body, his chest seemed to perform worse than his other muscle groups in terms of body weight and classification
- However, the muscular endurance classifications seem to be set to a different population than physically active young adults, since Zach finished well above the 90th percentile in many exercises

Why a single test cannot be used adequately assess your client’s overall strength?
- Overall strength cannot be determined by just one muscle group, which is what one test would measure
- Multiple muscle groups, both upper and lower body, need to be taken into consideration when completing fitness tests in terms of muscular strength

If you score in a high percentile in a lower body strength test, will you also score similarly in an assessment of abdominal or upper body strength?
- That is not the case, because muscle specificity finds that just because one muscle is strong it does not mean all of the other muscles are strong
- Each muscle needs to be trained in order to gain strength – some exercises train multiple muscle groups

How can this testing be used to develop a resistance training program?
- Since I now know Zach’s 1RM and predicted 1RM’s for various exercises, I can prescribe certain exercises and weights based on weaknesses and strengths. I can have him train at a certain percentage of his 1RM and then increase periodically in order to
progress his 1RM. I can also figure out which muscle group needs to most training in order to improve

**Explain what is occurring physiologically when a muscle fails to lift a weight after several successful repetitions?**

- Since muscle fibers are recruited periodically throughout a lift, fatigue occurs when fibers can no longer be recruited to their maximum capacity

**How does the muscular system adapt, physiologically, to regular resistance training?**

- More nuclei are produced along the muscle
  - Increase in nuclei allows for an increase in protein synthesis
- Due to hypertrophy, the volume of the muscle cells increase, specifically due to building up of stacks of sarcomeres, making the muscle larger and more readily available
- Neural pathways are strengthened, leading to faster recruitment of motor units and muscle fibers
Flexibility and Balance

Zach Phillips is a very flexible individual, especially in his lower body. His ankle flexibility and trunk extension were incredible, with results of 71 degrees and 91.67 respectfully, each either above average or way above average of the norms for males his age. He also passed the straight-leg-raise test and the shoulder flexibility test, as well as the Thomas test. His sit and reach and shoulder elevation test were both within the average classification, but could be improved upon considering how flexible his is otherwise. Zach also has decent balance. When balancing on his right foot, his balance is slightly better than on his left. His overall balance as well as anterior/posterior were classified as above average on his right now, while his medial/lateral was classified as average. All three categories were classified as average when balancing on his left foot.

How did they do compared to norms?
- Zack was between average and above average/excellent on many of his flexible tests.
  Overall, Zach is a very flexible individual (comparison to norms was done in the summary)

What are the benefits of flexibility?
- Flexibility is very important for many aspects of life, including quality of life
- Goncalves et al (2010) determined that improving flexibility in older adults improved their quality of life
- Improving flexibility can also improve range of motion
- With an increase in flexibility, there could also be an increase in performance

How did your partner score?
- Ankle Flexibility Test: 71 degrees
- Shoulder Elevation Test: 72.92
- Sit and Reach: 16.75 inches
- Trunk Extension Test: 91.67
- Thomas Test: Pass
- Straight-leg-raise Test:
  - R: 108 degrees
  - L: 103 degrees
- Shoulder Flexibility – R: pass; L: pass

Was your partner satisfied with his/her current assessment?
- My client was fairly satisfied with his current assessment. He was very excited to have achieved such high scores on most of the flexibility tests, but he would still like to improve his flexibility even more in order to reach optimum health

Was the score in the range for good health?
- Yes, his scores were in the range for good health

How does physical activity and inactivity affect flexibility?
- Inactivity can reduce flexibility
- If the joints and muscles are not used and loosened every so often, they become very tight, and that posture and form can then become the norm over time
- Also, stretching after physical activity can help improve flexibility
  - Carries more blood to the recently worked muscle to help improve recovery
Which method of stretching is best for improving ROM? Why?
- Dynamic stretching is the most beneficial for improving ROM
- With static stretching, the movement is held in one position for an extended period of time, which can be debilitating in some cases
- Dynamic stretching allows for a complete warm up of the body, as well as movement through the entire range of motion. Not only is the whole joint being warmed up and loosened, but heart rate is increased and oxygen is being carried to the rest of the body at an increased rate

What type of training would improve single leg stability?
- Balance, in general, can be applied by increasing abdominal and lower body strength
- The abdominals are activated for balance constantly, so stronger abdominals leads to greater balance
- Stronger legs can also increase balance, especially single leg balance – if muscles do not fatigue as quickly, they will be able to stay activated for longer and balance will be maintained

What are the benefits of single leg stability training?
- Increased quality of life – better overall stability and decrease in injury, which can lead to better quality of life, especially in the older population
- Many tasks can become easier
Client Report

Zachary Phillips is a 22 year old male who attends college at Elon University in North Carolina. Zach is a fairly healthy individual. He has fairly stable cholesterol, blood pressure (98/54), and heart rate (65 bpm), as well as a low risk factor for exercise. Zach also has an average VO$_2$max, according to the VO$_2$ maximal exercise test (46 ml/kg/min). The client has pretty great flexibility, coming up with many values such as 71 degrees for ankle flexibility and 91.67 for trunk extension, which were both above average and well above average, respectively. Zach also is in the average/above average range for much of his muscular strength/endurance testing. All of these values suggest Zach is a fairly healthy and in shape individual. However, an exercise prescription is still necessary.

Zach is not sedentary; he exercises fairly regularly, for about 30-45 minutes at a time. However, Zach still has goals he would like to meet. Although not very daring goals, they are goals nonetheless. Zach would like his body fat % to get down to 10% (Zach’s current body fat is about 10.6%), bench 200 lbs. (current 1RM is 185 lbs.), maintain his cardiorespiratory fitness, and improve flexibility, which are all not unreasonable and should be very easy for him, as long as he actually exercises and he does not skip a workout. For this reason, if Zach wants to meet these goals, it is important that he sticks to an exercise program. This is why prescribing exercise is important for Zach. He has mentioned that he is not always the best at maintaining an exercise regimen – if he is given an exercise program and is pushed, he will stick to it and meet the few goals that he has.

Overall, Zach has a fairly simple, but still productive, exercise prescription. In order to increase his bench press, he will need to increase his overall strength. To increase his overall strength, Zach will participate in resistance training 4 days per week. Two of those days will be upper body resistance training, and the other two days will be lower body resistance training. Each day of the same muscle groups will be separated by 48 hours, since the ACSM guidelines suggest at least 48 hours between resistance training bouts of the same muscle groups. Zach will also participate in aerobic exercise three days per week. Zach’s goal is to maintain his cardiorespiratory fitness, which only requires he exercise three days per week for approximately 30 minutes at vigorous intensity. Zach will do just that – with this exercise prescription, he might even increase his cardiorespiratory fitness slightly.

Zach has also been prescribed very simple stretching exercises. He will spend 10-15 minutes after every workout stretching out the muscles he just trained. On the lower body days, he will stretch his lower body, and vice versa. He will also participate in yoga on the weekend. Zach had stellar flexibility scores on some of the tests completed in the lab, while the rest were average/above average, so once again not a lot of work has to be done in this regard. However, the yoga and constant stretching should allow him to increase his flexibility slightly. Also, by being very active and eating right, Zach should be able to lose the just over a pound needed to reduce his body fat to 10%.

It will be fairly obvious when Zach has met his goals. Through the log Zach will keep as well as future testing, we should be able to monitor much of the changes that occur. We would like to see Zach stay at his current VO$_2$max, blood pressure, and resting heart rate. However, if his VO$_2$max happens to increase, or his resting blood pressure and heart rate happen to decrease, it would be great. Other measurements, such as his bench press reaching 200 lbs. 1RM, his body fat decreasing to 10%, and his scores increasing by one standard deviation on the flexibility tests that he is already not in the above average category for, will show that Zach has been successful.
Zach will do most of his cardiorespiratory training on cycles and running outdoors. He enjoys running outdoors, and dislikes running on treadmills. There will be two days when he is in the gym lifting as well as participating in cardiorespiratory training, so it is convenient for him to cycle for his cardio. He also enjoys lifting weights, hence him participating in resistance training 4 days a week. Overall, Zach should enjoy this exercise prescription, and hopefully he will be able to meet his goals.

**Cardiovascular/Aerobic Exercise**

**Recommend a frequency of exercise (how many days per week)**

I recommend that Zach participates in aerobic exercise 3-4 times per week. This frequency applies best to his goals and ACSM guidelines for healthy adults. Zach’s main goals are based on muscular strength, while his only cardiorespiratory goal is to maintain his cardiorespiratory health. Since Zach’s relative VO$_{2\text{max}}$ is 46 ml/kg/min, which is in the average range for his age group, he is already in decent cardiorespiratory health. ACSM recommends that adults participate in aerobic exercise 3 days per week at vigorous intensity or 5 days per week at moderate intensity. For these reasons, if he participates in aerobic exercise 3-4 days per week, Zach will maintain his cardiorespiratory fitness and achieve his goal. I will prescribe him moderate-vigorous aerobic exercises in order to keep him in shape.

**Recommend duration of the exercise (minutes per day/session)**

I recommend that Zach participates in aerobic exercise for 30-40 minutes per session. ACSM also recommends that, if the individual is exercising at vigorous intensity, they should exercise for greater than or equal to 75 minutes per week. If Zach exercises for 30-40 minutes each time he has an aerobic exercise session, he will exercise for approximately 90-120 minutes per week, which if he continues to do at moderate-vigorous exercise, he will maintain his cardiorespiratory fitness, which is his goal.

**Recommend a specific intensity for the exercise session**

If Zach exercises at a moderate-vigorous pace, he will exercise at a variety of intensities throughout his prescribed exercise program. Although Zach is already decently conditioned and exercises fairly regularly, I will start him off participating in aerobic activity at the moderate level. However, I will progress him fairly quickly, so he will end up exercising around the vigorous level. For this section, I will give a few different ranges based on his progression. If he eventually exercises at vigorous intensity for the given duration and frequency, he should even see some improvements despite his goal only being to maintain cardiorespiratory fitness. For all of the equations, I will use 195 bpm as Zach’s heart rate max, since during the VO$_{2\text{max}}$ test, while all of the other values suggested he reached true VO$_{2\text{max}}$, his heart rate was at 195 bpm, suggesting that value is his true heart rate max.

**Predicted Heart Rate Max (HR max)**

When Zach first begins his aerobic exercise, I will start him off exercising between 70-77% of his HR max. However, he will only exercise at this intensity for the first 1-2 weeks of his program. Zach is already in fairly good shape, which is the reason for this short initial stage. If Zach exercises at 70-77% of his HR max, he will be exercising within a range of 137-150 bpm. This range can be categorized as approximately moderate-vigorous intensity. Once the first 1-2 weeks have passed, I will steadily increase Zach until he has reached 73-84% HR max. Once he
reaches this range, he will be exercising between 142-164 bpm. This range can be classified as fairly vigorous exercise

195 bpm * 0.7 = 136.5 = **137 bpm** – Lower Bound
195 bpm * 0.77 = 150.15 = **150 bpm** – Upper Bound

195 bpm * 0.73 = 142.35 = **153 bpm** – Lower Bound
195 bpm * 0.84 = 163.8 = **164 bpm** – Upper Bound

**Heart Rate Reserve (HRR)**

When Zach first begins his aerobic exercise, I will start him off exercising between 55-65% HRR. This range is equivalent to 137-150 bpm. This range can also be categorized as moderate-vigorous exercise, with most of the values falling in the vigorous exercise category. After approximately 1-2 weeks, I will increase him to exercising between 60-75% HRR. This range is equivalent to 143-163 bpm, which can be categorized as vigorous exercise.

\[(195 \text{ bpm} - 65 \text{ bpm}) \times 0.55 + 65 \text{ bpm} = 136.5 = \textbf{137 bpm} – \text{Lower Bound} \]
\[(195 \text{ bpm} - 65 \text{ bpm}) \times 0.65 + 65 \text{ bpm} = 149.5 = \textbf{150 bpm} – \text{Upper Bound} \]

\[(195 \text{ bpm} - 65 \text{ bpm}) \times 0.60 + 65 \text{ bpm} = 143 \text{ bpm} – \text{Lower Bound} \]
\[(195 \text{ bpm} - 65 \text{ bpm}) \times 0.75 + 65 \text{ bpm} = 162.5 = \textbf{163 bpm} – \text{Upper Bound} \]

**VO₂ Reserve (VO₂R)**

When Zach first begins his aerobic exercise, I will start him off exercising between 55-65% VO₂R. Although the values vary slightly, VO₂R has been proven to almost equate with HRR, so the same percentage ranges as HRR will be used. Also, during the VO₂max test, Zach’s resting VO₂ reading was 4.0 ml/kg/min, so that value will be used instead of 3.5 ml/kg/min. If he exercises at 55-65% VO₂R, he will exercise within the range of 27.1-31.3 ml/kg/min. Once his intensity is increased to 60-75% VO₂R, he will be exercising at 29.2-35.5 ml/kg/min.

\[(46 \text{ ml/kg/min} - 4.0 \text{ ml/kg/min}) \times 0.55 + 4.0 \text{ ml/kg/min} = 27.1 \text{ ml/kg/min} – \text{Lower Bound} \]
\[(46 \text{ ml/kg/min} - 4.0 \text{ ml/kg/min}) \times 0.65 + 4.0 \text{ ml/kg/min} = 31.3 \text{ ml/kg/min} – \text{Upper Bound} \]

\[(46 \text{ ml/kg/min} - 4.0 \text{ ml/kg/min}) \times 0.60 + 4.0 \text{ ml/kg/min} = 29.2 \text{ ml/kg/min} – \text{Lower Bound} \]
\[(46 \text{ ml/kg/min} - 4.0 \text{ ml/kg/min}) \times 0.75 + 4.0 \text{ ml/kg/min} = 35.5 \text{ ml/kg/min} – \text{Upper Bound} \]

**Cycle Ergometry Exercise**

For all of these calculations, I will use a constant of 60 rpm. For the most part, 60 rpm is an average rate at which to pedal, so when plugged into the work rate equation it should produce a reliable value for resistance. For this reason, I will first find the work rate using the estimated VO₂, then use that value to find the resistance required to achieve that work rate.

**Lower Bound**

If Zach is exercising at 55% VO₂R, which is 27.1 ml/kg/min, he will need to work at a work rate of 872.12 kg/m/min, which equates to 145.35 W. In order to exercise at this work rate, he will have to pedal at a rate of 60 rpm with a resistance of 2.42 kg.
27.1 ml/kg/min = (x * 1.8) / 78.18 kg + 7
x = 872.12 kg/m/min

872.12 kg/m/min / 6 = 145.35 W

872.12 = (x * 6 m * 60 rpm)
x = 2.42 kg

**Upper Bound**

If Zach is exercising at 65% VO₂R, which is 31.3 ml/kg/min, he will need to work at a work rate of 1055.43 kg/m/min, which equates to 175.91 W. In order to exercise at this work rate, he will have to pedal at a rate of 60 rpm with a resistance of 2.93 kg.

31.3 ml/kg/min = (x * 1.8) / 78.18 kg + 7
x = 1055.43 kg/m/min

1055.43 kg/m/min / 6 = 175.91 W

1055.43 = x * 6 m * 60 rpm
x = 2.93 kg

**Higher Intensity Lower Bound**

If Zach is working at 60% VO₂R, which is 29.2 ml/kg/min, he will need to work at a work rate of 964.22 kg/m/min, which equates to 160.7 W. In order to exercise at this work rate, he will have to pedal at a rate of 60 rpm with a resistance of 2.68 kg.

29.2 ml/kg/min = (x * 1.8) / 78.18 kg + 7
x = 964.22 kg/m/min

964.22 kg/m/min / 6 = 160.7 W

964.22 kg/m/min = x * 6 m * 60 rpm
x = 2.68 kg

**Higher Intensity Upper Bound**

If Zach is exercising at 75% VO₂R, which is 35.5 ml/kg/min, he will need to work at a work rate of 1237.85 kg/m/min, which equates to 206.31 W. In order to exercise at this work rate, he will have to pedal at a rate of 60 rpm with a resistance of 3.44 kg.

35.5 ml/kg/min = (x * 1.8) / 78.18 kg + 7
x = 1237.85 kg/m/min

1237.85 kg/m/min / 6 = 206.31 W

1237.85 kg/m/min = x * 6 m * 60 rpm
\[ x = 3.44 \text{ kg} \]

**Treadmill Exercise**

**Lower Intensity Lower Bound**

If Zach is exercising on the treadmill at 55\% VO\(_2\)R, which is 27.1 ml/kg/min, he will need to run at a speed of 4.4 mph at a 0\% grade. If he ran with any grade, the speed would be very low.

\[
27.1 \text{ ml/kg/min} = x \times 0.2 + 3.5 \text{ ml/kg/min} + 0 \times x \times 0.9 \\
x = 118 \text{ m/min} / 26.8 = 4.4 \text{ mph}
\]

**Lower Intensity Upper Bound**

If Zach is exercising on a treadmill at 65\% VO\(_2\)R, which is 31.3 ml/kg/min, he will need to run at a speed of 5.19 mph at a 0\% grade. If he ran with any grade, the speed would be very low.

\[
31.3 \text{ ml/kg/min} = x \times 0.2 + 3.5 \text{ ml/kg/min} + 0 \times x \times 0.9 \\
x = 139 \text{ m/min} / 26.8 = 5.19 \text{ mph}
\]

**Higher Intensity Lower Bound**

If Zach is exercising on a treadmill at 60 \% VO\(_2\)R, which is 29.2 ml/kg/min, he will need to run at a speed of 4.8 mph at a 0\% grade.

\[
29.2 \text{ ml/kg/min} = x \times 0.2 + 3.5 \text{ ml/kg/min} + 0 \times x \times 0.9 \\
x = 128.5 \text{ m/min} / 26.8 = 4.8 \text{ mph}
\]

**Higher Intensity Upper Bound**

If Zach is exercising on a treadmill at 75\% VO\(_2\)R, which is 35.5 ml/kg/min, he will need to run at a speed of 5.97 mph at a 0\% grade.

\[
35.5 \text{ ml/kg/min} = x \times -0.2 + 3.5 \text{ ml/kg/min} + 0 \times x \times 0.9 \\
x = 160 \text{ m/min} / 26.8 = 5.97 \text{ mph}
\]

**Stepping Exercise**

For all of these equations, I will use 24 steps per minute for step rate. I decided to use this cadence because it is what is used for men during the exercise step test that can be used to estimate VO\(_2\)max. So, for most of these equations I will be solving for step height.

**Lower Intensity Lower Bound**

If Zach is completing a step workout and is exercising at 55\% VO\(_2\)R (27.1 ml/kg/min), he will need to step at a rate of 24 steps per minute and use a step height of 0.33 m.

\[
27.1 \text{ ml/kg/min} = 0.2 \times (24 \text{ steps per minute}) + (1.33 \times 1.8) \times x \times 24 \text{ steps per minute} + 3.5 \text{ ml/kg/min} \\
x = 0.33 \text{ m}
\]

**Lower Intensity Upper Bound**
If Zach is completing a step workout and is exercising at 65% VO₂R (31.3 ml/kg/min), he will need to step at a rate of 24 steps per minute and use a step height of 0.4 m.

\[
31.3 \text{ ml/kg/min} = 0.2 \times 24 + (1.33 \times 1.8) \times x \times 24 + 3.5 \text{ ml/kg/min}
\]

\[x = 0.4 \text{ m}\]

**Higher Intensity Lower Bound**

If Zach is completing a step workout and is exercising at 60% VO₂R (29.2 ml/kg/min), he will need to step at a rate of 24 steps per minute and use a step height of 0.36 m.

\[
29.2 \text{ ml/kg/min} = 0.2 \times 24 + (1.33 \times 1.8) \times x \times 24 + 3.5 \text{ ml/kg/min}
\]

\[x = 0.36 \text{ m}\]

**Higher Intensity Upper Bound**

If Zach is completing a step workout and is exercising at 75% VO₂R (35.5 ml/kg/min), he will need to step at a rate of 24 steps per minute and use a step height of 0.47 m.

\[
35.5 \text{ ml/kg/min} = 0.2 \times 24 + (1.33 \times 1.8) \times x \times 24 + 3.5 \text{ ml/kg/min}
\]

\[x = 0.47 \text{ m}\]

**Caloric Expenditure**

Similar to when calculating VO₂R, I will use 4.0 ml/kg/min for resting VO₂, since that was the number I acquired when Zach participated in the VO₂max test. In order to determine net VO₂, I reworked the VO₂R equation to be just \((\text{VO₂max} – \text{VO₂rest}) \times \%\), without the (+ 4.0) at the end of the equation. This equation gave me the net VO₂ instead of the gross VO₂. Net VO₂ is used to determine weight loss and calorie expenditure.

**Lower Intensity Lower Bound**

If Zach exercises at a VO₂R of 55%, then his net VO₂ will be 23.1 ml/kg/min. His absolute net VO₂ will be 1.81 L/min. If he works at 1.81 L/min for the duration of the workout, Zach will burn 9.03 kcal/min. If this is the case, it will take Zach 44.3 minutes to burn 400 kcal.

\[
\text{Net VO₂} = (46 \text{ ml/kg/min} – 4.0 \text{ ml/kg/min}) \times 0.55 = 23.1 \text{ ml/kg/min } \times 78.18 \text{ kg} / 1000 = 1.81 \text{ L/min}
\]

\[1.81 \text{ L/min } \times 5 = 9.03 \text{ kcal/min}
\]

\[400 \text{ kcal } / 9.03 \text{ kcal/min} = 44.3 \text{ min}\]

**Lower Intensity Upper Bound**

If Zach exercises at a VO₂R of 65%, then his net VO₂ will be 27.3 ml/kg/min. His absolute net VO₂ will be 2.13 L/min. If he works at 2.13 L/min for the duration of the workout, Zach will burn 10.67 kcal/min. If this is the case, it will take Zach 37.48 minutes to burn 400 kcal.

\[
\text{Net VO₂} = (46 \text{ ml/kg/min} – 4.0 \text{ ml/kg/min}) \times 0.65 = 27.3 \text{ ml/kg/min } \times 78.18 \text{ kg} / 1000 = 2.13 \text{ L/min}
\]
2.13 L/min * 5 = 10.67 kcal/min
400 kcal / 10.67 kcal/min = **37.48 min**

**Higher Intensity Lower Bound**

If Zach exercises at a VO2R of 60%, then his net VO2 will be 25.2 ml/kg/min. His absolute net VO2 will be 1.97 L/min. If he works at 1.97 L/min for the duration of the workout, Zach will burn 9.85 kcal/min. If this is the case, it will take Zach 40.61 minutes to burn 400 kcal.

Net VO2 = (46 ml/kg/min – 4.0 ml/kg/min) * 0.60 = 25.2 ml/kg/min * 78.18 kg / 1000 = 1.97 L/min
1.97 L/min * 5 = 9.85 kcal/min
400 kcal / 9.85 kcal/min = **40.61 min**

**Higher Intensity Upper Bound**

If Zach exercises at a VO2R of 75%, then his net VO2 will be 31.5 ml/kg/min. His absolute net VO2 will be 2.40 L/min. If he works at 2.40 L/min for the duration of the workout, Zach will burn 12.31 kcal/min. If this is the case, it will take Zach 32.49 minutes to burn 400 kcal.

Net VO2 = (46 ml/kg/min – 4.0 ml/kg/min) * 0.75 = 31.5 ml/kg/min * 78.18 kg / 1000 = 2.40 L/min
2.40 L/min * 5 = 12.31 kcal/min
400 kcal / 12.31 kcal/min = **32.49 min**

Assuming my client would like to burn 400 kcal in one session, as long as he works until he burns 400 kcal the duration of the workout will not matter, just some sessions may be longer based on the intensity. Based on this assumption, it should take Zach 8.75 sessions to burn one pound. Zach’s body fat percentage was 10.6%, and he had a goal to have a body fat percentage of 10%. If he continues with this goal, he only needs to lose 1 pound. If Zach burns 400 kcal per session, it will take him approximately 9.98 (so 10 sessions) to reach his ideal body fat percentage. If Zach exercises according to my prescription of participating in aerobic exercise three times per week, it will only take him 3.33 weeks to reach his ideal body fat percentage. However, if we say that Zach’s ideal body fat percentage is 8%, which is still a healthy body fat, he needs to lose 4.86 lbs. to reach his ideal weight of 167.14 lbs. If this is the case, it will take him 42.53 sessions, and approximately 14.18 weeks to reach his goal.

3500 kcal / 400 kcal = **8.75 sessions**

*Goal: 10% body fat*
172 lbs. – 170.68 lbs. = 1.14 lbs.
8.75 sessions * 1.14 lbs. = **9.98 sessions**
9.98 sessions / 3 days per week = **3.33 weeks**

*Goal: 8% body fat*
172 lbs. – 167.14 lbs. = 4.86 lbs.
8.75 sessions * 4.86 lbs. = **42.53 sessions**
42.53 sessions / 3 days per week = **14.18 weeks**
Rate of Progression

According to Zach’s various exercise test results, he is in pretty decent shape. He has an average VO\(_2\)\(_{\text{max}}\) of 46 ml/kg/min. For this reason, Zach’s progression will be fairly rapid in the beginning. After starting off at exercising at a rate of 55-65% VO\(_2\)R and HRR for 30 minutes 3 days per week for 1-2 weeks, his progression will begin. Every other week for the next 6 weeks, Zach will increase his duration by 5 minutes, ultimately ending at 45 minutes of aerobic exercise. His intensity will also increase, but at a much slower pace. After the first 2 weeks, his range will increase from 55-65% VO\(_2\)R to 60-75% VO\(_2\)R. Of course, he will initially begin at the lower end of the range and will slightly increase his intensity every week. Initially, Zach’s progression will be rapid, but will slowly taper off, especially since his goal is to just maintain his cardiorespiratory fitness.

Muscular Strength and Endurance

Recommend a frequency of exercise

For Zach, I recommend he participate in resistance training 4 days per week. His primary goals involve resistance training and increasing strength/definition, including increasing his bench press, so strength training should play a large role in his exercise program. I recommend that Zach participate in resistance training in groups of 2 days, with 1-2 rest days in between depending on the time of week. For example, Zach should strength train on Monday and Tuesday, rest from strength training on Wednesday, then strength train on Thursday and Friday, with two days off over the weekend. ACSM recommends that muscle groups are not worked on consecutive days, and workouts should not take place within 48 hours of each other. For this reason, the first workout of every group will be primarily upper body, and the second workout will be primarily lower body.

Recommend a duration of the exercise

Zach’s resistance training should last approximately 45-60 minutes. While resistance training can be time consuming, if he keeps up his intensity he should be able to complete his workouts in the allotted time. Also, since his goal involves building strength in order to increase his bench press, he will be doing low repetitions with high resistance, meaning his workout will be slightly shorter than an endurance workout.

Recommend a specific intensity for the exercise sessions

Zach has a decent history with weight lifting and strength training, so he can be considered at an intermediate level. For this reason, when he lifts weight based on his 1RM, he will complete 3-4 sets of 4-6 reps at 70-80% 1RM. In order to keep up intensity, there should be approximately 30 seconds-1 minute of rest in between set, with 2-3 minutes of rest in between exercises.

Upper Body

- Barbell bench press (chest, shoulders, triceps) – 3 sets x 6 reps x 75% 1RM (140 lbs.) with 30 s rest
- Bent over row (back) – 3 sets x 6 reps x 90 lbs. (1RM not given) with 30 s rest
- Shoulder press (shoulders, triceps) – 3 sets x 6 reps x 65 lbs. (1RM not given) with 30 s rest
- Barbell biceps curl (biceps) – 3 sets x 8 reps x 55 lbs. (1RM not given) with 30 s rest
- Lying barbell triceps extension (triceps) – 3 sets x 8 reps x 45 lbs. (1RM not given) with 30 s rest
- Dumbbell fly (chest, shoulders) – 3 sets x 6 reps x 40 lbs. (1RM not given) with 30 s rest
- Lat pull (back) – 3 sets x 8 reps x 120 lbs. (1RM not given) with 30 s rest
- Upright row (shoulders, upper back) – 3 sets x 6 reps x 55 lbs. (1RM not given) with 30 s rest
- Pull up with palms facing body (biceps) – 3 sets x 8 reps x body weight with 30 s rest
- Dips (triceps, chest) – 3 sets x 8 reps x body weight with 30 s rest

Lower Body
- Back squat (quadriceps, gluteals) – 4 sets x 6 reps x 250 lbs. (1RM not given) with 30 s rest
- Dead lift (hamstrings, lower back) – 4 sets x 6 reps x 210 lbs. (1RM not given) with 30 s rest
- Leg press (quadriceps, gluteals) – 4 sets x 6 reps x 75% 1RM (495 lbs.) with 30 s rest
- Good morning (hamstrings, lower back) – 4 sets x 8 reps x 55 lbs. (1RM not given) with 30 s rest
- Forward step lunge (gluteals) – 4 sets x 8 reps x 125 lbs. (1RM not given)
- Dumbbell heel raise (calf) – 4 sets x 20 reps x 20 lbs. (dumbbells in each hand) with 30 s rest

Abdominals/Lower back
- Side plank (obliques) – 3 sets x 30 seconds each side x 10 s rest
- Plank (abdominals) – 3 sets x 1 minute x 10 s rest
- Plank + leg crunch (abdominals, obliques) – 3 sets x 30 s x 10 s rest
- Leg raises (abdominals) – 3 sets x 20 reps x 10 s rest
- Crunches (abdominals) – 3 sets x 30 reps x 10 s rest
- Reverse crunches (abdominals) – 3 sets x 20 reps x 10 s rest
- Lower back extension (lower back) – 3 sets x 20 reps x body weight x 10 s rest

Rate of Progression

Zach will be increased at a moderate pace. First, his reps should increase before he is able to increase his weight. Every week, he will increase his reps by 2. Every other week, he will increase the weight used by 5 lbs. It is important that repetitions are increased first, so form can be enforced. Number of sets will not be increased. Once 6-8 weeks has gone by, I will prescribe him a different program in order to avoid plateau.

Exercises + Descriptions

| Barbell Bench Press | Bent Over Row |
For this exercise, back and gluteals should be placed firmly on the bench, and feet planted firmly on the ground. With a firm grip on the bar, slowly raise bar off of rack until arms are almost fully extended above chest and bar is stabilized. Now, slowly lower bar to just about an inch off of the chest, and then slowly raise back to start position. Make sure to inhale on the way down and exhale on the way up (concentric and eccentric contraction phases).

With feet planted approximately shoulder width apart, bend at the hip, forcing butt back and head down, all while keeping the back straight. Make sure to keep bar clutched in front of chest. Once in start position, slowly lower bar until arms are almost fully extended, then return to start position. Once again, exhale on the most forceful part of movement.

<table>
<thead>
<tr>
<th>Shoulder Press</th>
<th>Barbell Biceps Curl</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grasp bar and rest against chest, then push straight up, pushing head forward under bar. Make sure your back is kept straight throughout the whole movement, without arching lower back.</td>
<td>Make sure feet are firmly planted shoulder width apart. With shoulders back and elbows in, slowly bring bar to chest level, focusing mainly on the biceps muscle. Make sure to keep your body almost completely still with no whipping motion as to avoid injury and use of other muscle groups.</td>
</tr>
</tbody>
</table>

| Lying Barbell Triceps Extension | Back Squat |
Start with bar fully extended above your chest, almost in starting bench press position just with arms in a slightly closer grip. Bend only at the elbow and lower forearms and bar down until just above forehead, then return.

Deadlift

With feet slightly more than shoulder with apart, place bar softly on center of upper back. Putting all of the weight on your heels, slowly lower into a squatting position. Return to start.

Leg Press

Once in the leg press machine, place feet on pad a decent width apart. Release the safety and lower weight down to chest – press up slowly, extending at the knees.

Side Plank

With feet planted firmly shoulder width apart, slowly raise the bar off of the ground, focusing on bending at the hip and contracting the hamstrings. Make sure to avoid any quick, excessive movements with the lower back. Keep back straight.

Plank
Make sure your back is completely straight, clenching your core together.

Prop yourself up on one forearm, contracting your core. Make sure to keep your body in a straight line from head to toe, with no odd angles or bends.

**Flexibility and Balance**

**Recommend a frequency of exercise**

Various stretches should be done after every workout. The stretches will vary based on what muscle groups and body parts were worked during that day. ACSM recommends a stretching workout take place 2-3 days per week, so if adequate stretching is achieved after every workout for Zach, then he should be at a healthy level. He already is above average in many of the flexibility assessments done, so not much improvement is needed. He will also partake in yoga on one of the days of his workout routine.

**Recommend a duration of the exercise**

Every day post-exercise, Zach should stretch for 10-15 minutes. On the day he participates in yoga, he should complete yoga for 30-45 minutes.

**Recommend a specific intensity for the exercise sessions**

Each stretch should be done in sets of 2-4 and held/continuously done for 10-30 seconds.

**Upper Body**
- Look right and left (neck) – 2 sets x 15 turns both sides
- Neck flexion and extension (neck) – 2 sets x 15 looks up/down
- Straight arms behind back (shoulders, chest) – 4 sets x 10 s
- Behind-neck stretch (triceps, outer back/axilla) – 3 sets x 20 s
- Cross arm in front of chest (upper back) – 3 sets x 20 s
- Side bend with bent arm (obliques) – 3 sets x 20 s
- Repeat

**Lower Body**
- Spinal Twist (lower back, obliques) – 2 sets x 30 s
- Forward Lunge (quadriceps) – 4 sets x 10 s
- Supine knee flex (hamstrings, gluteals) – 3 sets x 20 s
- Side quadriceps stretch (quadriceps) – 3 sets x 20 s
- Semistraddle (calves, hamstrings, lower back) – 3 sets x 20 s
- Butterfly (hip adductors) – 2 sets x 30 s
- Hip extension – 3 sets x 20 s
- Repeat

**Stretches + Directions**

**Cross arm in front of chest**

As in the name, grab arm and pull across chest. Pull until you feel a stretch in your shoulder/upper back. You should not feel pain.

**Behind-neck**

Grab one elbow with the opposite hand and pull down behind the neck. The elbow of the stretched arm should be pointing towards the sky. A stretch should be felt in the triceps/axilla/outer back.

**Butterfly**

Bend knees at about a 90 degree angle, putting bottoms of feet together in front of body. Lean forward slightly. You should feel a stretch in your groin region.

**Hip extension**

Rest on the ground with one knee touching the ground, the other at a 90 degree angle with corresponding foot planted flat on the ground. Slightly bend forward, creating slightly more than a 90 degree angle in your groin area.

**Outcome Measures**

How will you determine how successful you as well as the client have been in meeting the target goals?

There are a few ways in which the client and I will determine how successful we have been. I will provide Zach with a log sheet that he can keep track of his progress. This log sheet
will include every exercise as well as how much weight they lifted, how long and at what speed they for, among other things. By looking at this log, it should be easy to tell if Zach is making progress towards his goals. Finally, after approximately 8 weeks, Zach will come back into the lab to participate in a modified exercise testing protocol to see how his fitness has changed. Hopefully, he will have made improvements and moved closer to his goals.

Zach specifically set a goal to reach 200 lbs. on his bench press. He also wanted to improve flexibility, increase abdominal definition, and maintain cardiovascular fitness. To go along with these goals, if Zach has reached 200 lbs. on his bench press, if his cardiovascular fitness is at least at the point it is at now, if not higher (such as VO\(_2\), resting HR, etc.), then he has been successful. Also, his flexibility will need to be measured again using many of the same tests used previously in order to assess his flexibility. Finally, if Zach’s body fat % drops below 10%, and the areas of flexibility that he is not already in the above average categorization for increase by one standard deviation, he will have been successful.

**How will your client monitor exercise intensity?**

Zach will invest in a heart rate monitor. If his does this, he will be able to keep track of his heart rate while he exercises. A heart rate monitor will allow him to exercise at the prescribed %HRR. However, a heart rate monitor only helps the client monitor aerobic exercise intensity. In terms of strength training, the amount of weight lifted, how many reps, and how many sets were implemented can be used to track exercise intensity. I will personally go over all of the information with Zach and make sure he is aware of how to track intensity. I will also give him guidelines as to when to increase exercise intensity based on timing of the program as well as personal feeling and belief.

### 1-Week Exercise Prescription

<table>
<thead>
<tr>
<th>WEEK 1</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
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<tbody>
<tr>
<td>Warm-up</td>
<td>Dynamic stretching (5-10 minutes)</td>
<td>Dynamic stretching (5-10 minutes)</td>
<td>Dynamic stretching (10-15 minutes)</td>
<td>Dynamic stretching (5-10 minutes)</td>
<td>Dynamic stretching (5-10 minutes)</td>
<td>Dynamic stretching (10-15 minutes)</td>
<td>REST DAY</td>
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<tr>
<td>Cycling</td>
<td>5 minutes</td>
<td>50 RPM/1.16 kg</td>
<td>Cycling</td>
<td>5 minutes</td>
<td>50 RPM/1.16 kg</td>
<td>Cycling</td>
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<tr>
<td>Cardio</td>
<td>Cycling 30 minutes HR 137-150 (55-65% VO(_2)R) 60 RPM/2.68 kg</td>
<td>Running outside 45 minutes HR 137-150 (55-65% VO(_2)R)</td>
<td>Cycling 30 minutes HR 137-150 (55-65% VO(_2)R) 60 RPM/2.68 kg</td>
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<tr>
<td>Strength/Endurance</td>
<td>Upper Body Barbell bench press (chest, shoulders)</td>
<td>Lower Body Back squat (quadriceps, gluteals) – 4 sets x 6 reps</td>
<td>Upper Body Barbell bench press (chest, shoulders)</td>
<td>Lower Body Back squat (quadriceps, gluteals) – 4 sets x 6 reps</td>
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<tr>
<td>Exercise (Muscles)</td>
<td>Sets</td>
<td>Reps</td>
<td>Weight</td>
<td>Rest</td>
<td>Exercise (Muscles)</td>
<td>Sets</td>
<td>Reps</td>
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<tr>
<td>Triceps</td>
<td>3</td>
<td>6</td>
<td>75% 1RM (140 lbs.)</td>
<td>30 s</td>
<td>Bent over row (back)</td>
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<td>6</td>
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<td></td>
<td>Shoulder press (shoulders, triceps)</td>
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<td>Barbell biceps curl (biceps)</td>
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<td>Lying barbell triceps extension (triceps)</td>
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<td>Dumbbell fly (chest, shoulders)</td>
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<td></td>
<td>Abdominals</td>
<td>Side plank (obliques)</td>
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<td></td>
<td>Leg press (quadriceps, gluteals)</td>
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<td>Good morning (hamstrings, lower back)</td>
<td>4</td>
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<td>Forward step lunge (gluteals)</td>
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<td>Heel raise (calf)</td>
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<td>20</td>
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<td>Dumbbell fly (chest, shoulders)</td>
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<td>Abdominals</td>
<td>Side plank (obliques)</td>
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<td>Leg press (quadriceps, gluteals)</td>
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<td>Good morning (hamstrings, lower back)</td>
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<td>Forward step lunge (gluteals)</td>
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<td>Heel raise (calf)</td>
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<td></td>
<td>Dumbbell fly (chest, shoulders)</td>
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<td>6</td>
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<td></td>
<td>Abdominals</td>
<td>Side plank (obliques)</td>
<td>3</td>
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<tr>
<td>Lat pull (back)</td>
<td>3 sets x 8 reps x 120 lbs. (1RM not given) with 30 s rest</td>
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<tr>
<td>Upright row (shoulders, upper back)</td>
<td>3 sets x 6 reps x 55 lbs. (1RM not given) with 30 s rest</td>
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<tr>
<td>Pull up with palms facing body (biceps)</td>
<td>3 sets x 8 reps x body weight with 30 s rest</td>
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<tr>
<td>Dips (triceps, chest)</td>
<td>3 sets x 8 reps x body weight with 30 s rest</td>
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<td>3 sets x 30 seconds each side x 10 s rest</td>
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<tr>
<td>Plank (abdominals)</td>
<td>3 sets x 1 minute x 10 s rest</td>
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<tr>
<td>Plank + leg crunch (abdominals, obliques)</td>
<td>3 sets x 30 s x 10 s rest</td>
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<tr>
<td>Leg raises (abdominals)</td>
<td>3 sets x 20 reps x 10 s rest</td>
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<tr>
<td>Crunches (abdominals)</td>
<td>3 sets x 30 reps x 10 s rest</td>
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<tr>
<td>Reverse crunches (abdominals)</td>
<td>3 sets x 20 reps x 10 s rest</td>
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<tr>
<td>Lower back extension (lower back)</td>
<td>3 sets x 20 reps x body weight x 10 s rest</td>
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<tr>
<td>Spinal Twist (lower back, obliques)</td>
<td>2 sets x 30 s</td>
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<tr>
<td>Forward Lunge (quadriceps)</td>
<td>4 sets x 10 s</td>
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<tr>
<td>Supine knee</td>
<td>2 sets x 30 s</td>
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<tr>
<td>Spinal Twist (lower back, obliques)</td>
<td>2 sets x 30 s</td>
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<tr>
<td>Forward Lunge (quadriceps)</td>
<td>4 sets x 10 s</td>
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<tr>
<td>Neck flexion and extension (neck)</td>
<td>2</td>
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</tbody>
</table>

**Flexibility**

| Look right and left (neck) | 2 sets x 15 turns both sides |
| Neck flexion and extension (neck) | 2 |
| Spinal Twist (lower back, obliques) | 2 sets x 30 s |
| Forward Lunge (quadriceps) | 4 sets x 10 s |
| Neck flexion and extension (neck) | 2 |
| Spinal Twist (lower back, obliques) | 2 sets x 30 s |
| Forward Lunge (quadriceps) | 4 sets x 10 s |

**Yoga**
<table>
<thead>
<tr>
<th>Exercise</th>
<th>Reps</th>
<th>Description</th>
<th>Reps</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sets x 15 looks up/down</td>
<td></td>
<td>Straight arms behind back (shoulders, chest)</td>
<td>4</td>
<td>Side quadriceps stretch (quadriceps)</td>
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<td></td>
<td></td>
<td>Behind-neck stretch (triceps, outer back/axilla)</td>
<td>3</td>
<td>Semistraddle (calves, hamstrings, lower back)</td>
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<td></td>
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<td>Cross arm in front of chest (upper back)</td>
<td>3</td>
<td>Butterfly (hip adductors)</td>
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<td></td>
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<td>Side bend with bent arm (obliques)</td>
<td>3</td>
<td>Hip extension</td>
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<tr>
<td>Cool-down</td>
<td></td>
<td>Cycling</td>
<td>5</td>
<td>Semistraddle (calves, hamstrings, lower back)</td>
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<td>Running</td>
<td>5</td>
<td>Butterfly (hip adductors)</td>
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<td></td>
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<td>(Outside 98-110 bpm (25-35% VO₂R))</td>
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<td>Repeat</td>
<td>3</td>
<td>Hip extension</td>
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<td></td>
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<td>Repeat</td>
<td>3</td>
<td>Hip extension</td>
</tr>
</tbody>
</table>

**Cool-down**

Cycling 5 minutes 50 RPM/1.16 kg

Running Outside 98-110 bpm (25-35% VO₂R)

Cycling 5 minutes 50 RPM/1.16 kg

Running Outside 98-110 bpm (25-35% VO₂R)