Energy Balance

The science of weight control is rooted in energy balance according to the laws of thermodynamics.[1] Body weight remains stable when there is a state of balance – the energy entering the body equals the energy being expended. Likewise, excess or insufficient energy causes an imbalance and the body restores equilibrium by either gaining or losing weight. Because the law of conservation of energy dictates that energy cannot be created or destroyed, energy entering the human body has essentially two fates – 1) conversion to either mechanical energy to fuel movement or metabolism or 2) conversion to **adipose tissue, lean body mass** or **glycogen** stores. For the purpose of weight control, energy is commonly expressed in **calories** and throughout this text, energy and calories are used interchangeably.
Simply put, **calorie balance** indicates the same calories are being burned as expended; a **calorie surplus** indicates more calories are being consumed than expended, thus resulting in weight gain and a **calorie deficit** indicates more calories are being burned than consumed, resulting in weight loss. As previously discussed, there are several contributing factors to overweight and obesity; however the underlying cause is a chronic energy imbalance - consuming more calories relative to the calories being expended.[2] Therefore, ***successful weight control requires managing calorie intake and expenditure,*** and some experts estimate that weight gain can be prevented in over 90 percent of the population by modifying daily energy balance – either expending an additional 100 calories or reducing intake by 100 calories [3] or doing a combination of the two on a daily basis.

To put this into context, reducing 100 calories can be accomplished by skipping mayonnaise or cheese on a sandwich or replacing a cup of juice or regular soda with water or calorie-free versions. Taking a 20-minute walk would also modify energy balance by 100 calories. Likewise, to avoid the average yearly adult weight gain of one to three pounds that often leads to overweight or obesity, a mere adjustment of 10 to 30 calories per day is all that is required. This equates to taking 200 to 300 additional steps per day, standing for 15 minutes instead of sitting or giving up one bite of dinner. These seemingly insignificant yet simple changes in daily behaviors will not make a difference that day or the next, which is likely the reason they are avoided, but over time they mean the difference between staying slim or becoming an obesity statistic. This concept of self-regulation of behaviors to control body weight is cornerstone to providing viable solutions and will be discussed in further detail in the following section.

Daily Energy Requirements

The number of calories expended daily varies according to age, height, weight, lean body mass, gender and activity level. Humans require a continuous source of energy to fuel their **resting metabolic rate**

(RMR), also referred to as **resting energy expenditure** (REE), physical activity and the **thermic effect of food** (TEF). RMR accounts for the majority (~70 percent) of one's daily energy needs and includes maintenance of normal bodily functions such as breathing, circulation and central nervous system activity. Physical activity is any non-resting movement including exercise and **activities of daily living** (ADL) such as bathing and dressing. In general, physical activity makes up approximately 20 percent of one's energy requirements but varies according to the amount of physical activity performed. The digestion and absorption of food, or TEF, also requires energy and accounts for approximately 10 percent of daily energy expenditure. These three components determine the number of calories required daily for weight to remain stable.

Various methods including direct and indirect calorimetry are used to accurately measure daily calorie requirements. Direct calorimetry measures the heat produced by the body in a closed chamber, while indirect calorimetry uses the amount of oxygen taken in and the carbon dioxide released. These methods are expensive and impractical for most people and instead, several prediction equations, most commonly **Harris Benedict**, are used to estimate RMR. Once this is determined, a **physical activity factor** based on the clients' activity level is used to determine total calorie requirements. Although easy to use, prediction equations are estimations because they do not account for certain individual differences (e.g. body composition) and daily fluctuations in activity level. Wearable body sensors can be used in a free-living environment and measures *daily* calorie burn, which allows day-to-day adjustments to calorie intake based on activity level. All of these methods are used to create a starting point for the user and some to measure progress. Once an estimation of daily requirements is made, calories can be added or subtracted depending on the individual's health and weight control goals.

Weight Loss Guidelines

Recommended weight loss for most people is ½ to two pounds per week, [4,5] however, a faster rate of weight loss may be experienced with increasing degrees of overweight or obesity. Since one pound of weight loss requires approximately 3,500 calories burned, the number of calories required to achieve a desired rate of weight loss can be easily calculated:

Weekly Weight Loss	Daily Calories to Reduce or Burn (Daily Calorie Deficit)
0.5	250
1.0	500
1.5	750
2.0	1000

For example, if one's estimated daily requirements are 2,000 calories and the desired rate of weight loss is one pound per week, the target daily deficit would be 500 calories. The client could choose to burn an additional 500 calories, reduce intake by 500 calories or do a combination of both. A daily intake below 1,000 to 1,200 calories is generally not recommended, as overly restrictive diets often lead to hunger and difficulty adhering to the diet. Very low calorie diets (< 800 calories per day) are typically used only under medical supervision for obese persons who have attempted alternative weight loss methods.
It is imperative to monitor progress regularly by using a scale or circumference measurements at least once a week, but changes in scale weight may not be present from one week to the next due to fluid fluctuations or muscle gain. Therefore, utilize additional methods to assess results such as the loss or gain of inches, a change in clothing size or an improvement in clothing fit. The true trend in body weight or body fat can be captured in any two to three week period during which fluid fluctuations cancel each other. If weight or body fat remains stable over a two to three week period, the client is in a state of energy balance. That is, calorie intake, on average, has been equal to calorie expenditure and the solution is to consume fewer calories, increase movement or both.

Nutrition Strategies for Weight Loss

Diets

Research evaluating the effectiveness of various diets, including conventional high-carbohydrate/low-fat diets and low-carbohydrate/high-protein diets has found no differences in success between diet types after six months or one year.[6] Despite the vast array of weight loss diets, only a small percentage of those who lose at least 10 percent of their initial body weight manage to sustain their results. [7] The remaining majority regain all of the weight lost within three to five years. [8,9]

Since weight loss is a function of energy balance, any diet or eating pattern which restricts calories to below daily requirements will result in weight reduction. However, once this diet stops, weight gain typically follows as normal eating habits resume. This is likely due to the difficulty of changing lifelong habits and restricting food intake to induce weight loss, which can be uncomfortable and is likely counterintuitive for most. Therefore, the chosen weight control plan should be nutritionally sound, suited to individual preference and lifestyle with the primary focus on behaviors that the client is willing to adopt long-term. General diet composition guidelines are listed here and additional nutrition information including menu planning are presented in a separate section.

- Carbohydrates – 45 to 65 percent of total calories
- Protein – 10 to 30 percent of total calories

- Fat – 10 to 35 percent of total calories

In addition, practical and effective nutrition weight control strategies include food logging, portion control, modifying restaurant dining and using meal replacements.

Food Logging

Those who consistently track what they eat lose more weight and are more successful at keeping the weight off. [10,11] The act of writing down the items and quantities that are habitually consumed increases the awareness of one's eating habits, which is important for modifying and self-regulating behaviors that lead to excess calorie intake.

Portion Control

As previously noted, larger portions and serving sizes often lead to higher calorie intakes and greater underestimating which can then contribute to unwanted weight gain. People generally attempt to consume entire meals,[12,13] therefore portion size significantly impacts a person's total calorie intake.[12,14] Overwhelming evidence validates that the smaller the portions, the fewer daily calories consumed.[15] The following strategies can help control portions and reduce over-eating:

- Avoid eating from a package or container. Instead, take out a certain amount and put the container away
- Use smaller plates and bowls
- Avoid all-you-can eat meals and buffets
- Keep tempting items away
- Split a meal with a friend or take half of the entrée home
- Start your meal with a low-calorie dinner salad and/or broth-based soup
- Pay attention to choices at social occasions – the tendency is to eat and drink more

Restaurant Dining

Americans are eating away from home on more frequent basis, yet restaurant meals are often oversized and contain hidden fat and calories. Minimizing excess calories from restaurant meals can be accomplished by using the tips listed here:

- Always ask how the food is prepared. To cut calories, request that items be grilled, baked or broiled.
- Ask for sauces, cheese and salad dressing on the side to help control the amount consumed.

- Replace French fries, onion rings, casserole side dishes and creamy or cheese soups with steamed rice, a small baked potato (with little to no sour cream or butter), a broth-based soup, corn, beans, fresh fruit or a side salad with light dressing.
- Order bread, toast, sandwiches or rolls dry and if needed add condiments (butter, mayonnaise, etc.) to control the quantity.
- Order extra vegetables with your entrée.
- Choose skinless chicken, turkey or fish instead of fatty cuts of beef, hamburgers, pork or lamb.
- Minimize or avoid alcohol. Lower calorie choices include light beer and wine spritzers rather than frozen fruit drinks, liquors and creamy after-dinner drinks.
- Select restaurants that provide nutritional information to help guide decisions. Several restaurants provide nutritional information online.

Meal Replacements

Studies have shown that meal replacements are an extremely effective weight loss aid,[16] and additional research has demonstrated that meal replacements are more effective than conventional dieting. [17,18,19,20] Meal replacements have also been shown to be as effective as dietary restriction combined with drug therapy.[8] Most notably, continuous use of meal replacements may be the most effective means for maintaining weight loss of all treatments [21,22,23,24] (see Figure 1). Meal replacements generally substitute one or two meals a day and allow freedom of choice for the remaining allotted calories. This practice supports weight loss and maintenance by providing portion control and accurate calorie counts and thus reduces under-estimating of daily calorie intake.

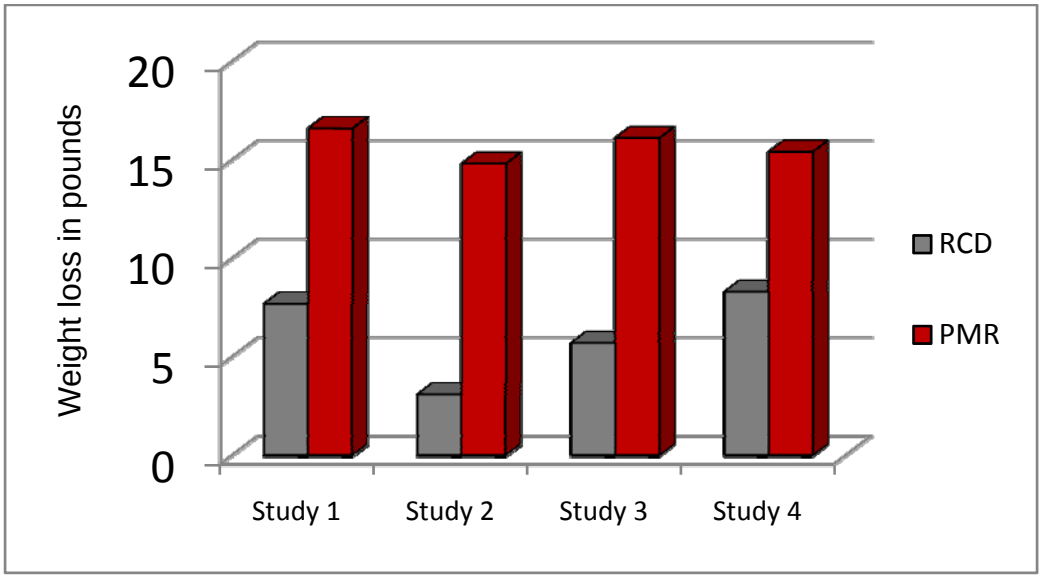

Figure 1: In a one-year follow-up in the groups that were tracked, the subjects still using partial meal replacements (PMR) maintained significantly more weight loss than the reduced calorie diet only (RCD) group. Adapted from Heymsfield SB (2003).

Making Better Choices

Excess calorie intake is often a result of eating foods that are high in calories with very little nutritional value. Therefore, it is prudent to reduce or eliminate these items and to begin making more healthful choices. Typical food choices and their calorie content are listed in the table below. The amount of activity required for a 150 pound male to burn the calories in that typical food choice, a more healthful alternative, and the number of calories ***saved*** by making the better choice are also included.

Typical Food Choices	**Calories**	**Activity Required to Burn Off Food Choice**	**Healthier Alternative**	**Calories *Saved***
16 oz. Café mocha 4 oz. Blueberry scone	708	Running for 1 hr, 14 min at 5 mph	1 cup Special K cereal 10 raspberries 1 banana 6 oz skim milk	404 saved
In-n-Out Double-Double burger French fries 16 oz Soda	1,268	Tennis Singles for 3 hrs, 10 min	Subway 6 inch turkey sandwich Apple Water	933 saved
Jumbo slice of Pepperoni pizza	890	Swimming for 1 hr, 47 min at 50 yd/min	5 oz of grilled chicken 1 cup of brown rice Steamed veggies	390 saved
16 oz. Blended Coffee Bagel with cream cheese and bacon	1070	Stair step machine for 1 hour, 53 minutes	16 oz brewed coffee 2 scrambled eggs ¾ cup oatmeal	799 saved
Chick fil-A Chicken Sandwich Small waffle fries 16 oz soda	887	Ultimate Frisbee for 1 hour, 22 minutes	Chick fil-A Char-grilled chicken sandwich Fruit cup 16 oz unsweetened iced tea	569 saved
Turkey Reuben French fries 1000 island dressing (1.5 oz) 20 oz Soda	1237	Vigorous stationary running 2 hours, 27 min	Greek Gyro sandwich Water or calorie free drink	760 saved

Although all of the aforementioned dietary strategies have proven to be effective, the means used to maintain a healthy body weight will vary according to individual preference and readiness. Lifelong weight control does not require the complete avoidance of any particular food or food group nor does it require severe and prolonged calorie restriction. In terms of weight control, it is vital to recognize that the amount one consumes is more important than the foods chosen as even an optimal diet will result in weight gain if daily needs are exceeded. Clients are often inclined to adopt more healthful eating habits once they experience success during their initial weight loss efforts, which can be achieved by simply

reducing the portions of foods they normally consume. In other words, make subtle changes in a client's life to bring them success while promoting a more healthful diet. Losing weight is healthy by itself.

Habits of Successful Losers

The National Weight Control Registry is the largest ongoing prospective study of individuals who have succeeded at losing a significant amount of weight and maintaining those results.[25] To be included in the study, each person must have lost at least 30 pounds and kept the weight off for at least one year. On average, the 5,000 participants have lost 60 pounds and maintained the weight loss for nearly six years. The range of weight loss is 30 to 300 pounds, and those who may have a genetic predisposition for obesity were included as nearly half of the participants were overweight or obese as children and three-quarters have at least one obese parent. The behaviors of these individuals (listed below) underscore the importance of permanent lifestyle changes to diet and physical activity levels: [26,27]

- Eat breakfast daily
- Exercise approximately 60 minutes a day - the most common form of exercise is walking
- Check weight at least once a week; almost half checked their weight daily
- Watch less than 10 hours of television per week
- Maintain a consistent diet on weekends and weekdays
- Track food intake

Other research has confirmed the findings of the National Weight Control Registry and identified additional behaviors common to sustained weight loss, which include planning meals on most days of the week, tracking fat and calories, measuring food, adding physical activity into daily routines and setting goals.[28,29] Although weight loss can be achieved without adopting these behaviors, it is important to note that they have been shown to be effective. A more simplified approach is to eat less, move more and make adjustments based on whether changes in body weight occur. For most people, it is safe to say that in an era of convenience, automation and a rich supply of energy-dense food, becoming knowledgeable about calories and portions, consciously controlling food choices while deliberately resisting the natural tendency to be sedentary are essential for successful weight control.

Weight Gain Guidelines

Gaining weight, with a primary focus on building muscle, requires a daily calorie surplus in conjunction with progressive resistance training. Resistance training provides the necessary stimulus for additional calories and protein to be utilized for muscle synthesis. Without this stimulus the extra calories are converted to body fat – an undesirable result for most adults. A carefully planned nutrition and dietary

support plan, including correct meal timing, and a properly designed training program can optimize muscle growth potential. In general, adult males can gain approximately half a pound of muscle per week[30] and adult females can gain over a quarter of a pound weekly.[31] However, this will vary based on age, training experience, training load, nutritional status and dietary habits.

At present, there is lack of agreement in the scientific community as to the number of calories required to gain a pound of muscle, particularly since the energy cost of resistance training is highly variable from person to person. The energy content of muscle tissue can be calculated based on the composition of muscle which is approximately 75 percent water, 20 percent protein and the remaining materials a combination of intramuscular triglycerides, glycogen, and minerals.[32] Therefore, protein content in muscle is roughly 364 calories (~4 calories per gram of protein; 454 grams per pound) but the energy expended for resistance training workouts, additional activity and the metabolic activity associated with recovery and synthesizing muscle must also be factored in. Some estimate the total energy in a pound of muscle is small compared to the energy required to stimulate muscle growth through exercise or the cost of doing exercise to maintain added muscle.

Ideally, daily calorie intake should be slightly above needs to allow extra nutrients and calories to be deposited into muscle tissue, allowing one's body fat percentage to naturally "drift down" as muscle weight increases. If simultaneous body fat loss is desired, then the calorie deficit should be no greater than approximately 15 percent of daily calorie requirements (maintenance) or maximum muscle building will be compromised. Otherwise, an additional 200 to 500 calories per day above daily requirements is generally recommended for optimal gains. Measurable changes to skeletal muscle fibers require regular bouts of progressively more challenging exercise for at least six to eight weeks. [33,34,35] However, calories should be increased incrementally – adding approximately 100 to 250 per day depending on body size anytime weekly weigh-ins do not reflect desired gains.

Nutritional Strategies for Weight Gain

Proper diet manipulations can dramatically and positively affect muscle-building hormone production. Accomplishing the proper hormone balance for muscle building, without increasing body fat, is a function of carbohydrates, proteins and fats being supplied in proper ratios, forms and at specific times in relation to training periods while remaining within the calorie allotment necessary for the weight gain goal. Using diet to harness the body's most powerful muscle building hormone, insulin, can reduce muscle catabolism (breakdown) and increase muscle anabolism (buildup), offering the potential to maximize muscle synthesis. In addition to stimulating muscle protein synthesis, insulin also plays a major role in

minimizing the damage caused by exercise. Strength training triggers the release of the catabolic hormones cortisol and epinephrine, which work to breakdown glycogen and muscle protein to supply energy and produce work. However, this process also leads to muscle damage. Although intense training is required to stimulate growth, tissue damage can be minimized during and after exercise, so the body spends more time utilizing incoming nutrients to build new muscle rather than constantly repairing it, thus allowing training plateaus to be avoided.

Pre- and Post-Workout Feedings

There are certain times, primarily immediately post-workout, when muscle building is at its peak. These times are referred to as metabolic windows and may last up to 90 minutes. During the post-workout period, muscle cells become highly receptive to the incoming nutrients responsible for muscle growth. Therefore, if nutrients are low or absent, muscle building is minimal at best. Insulin is the hormone that initiates the cascade of muscle-building events during these short specific periods. By stimulating insulin at specific times with the proper carbohydrate and protein intake before, during and after exercise, cortisol and muscle breakdown can be blunted, while muscle building and energy recovery can be significantly enhanced.[36] Therefore this small "window of opportunity" requires a well-designed fast-acting formula to satisfy the muscle's exercise-induced demands. [37]

Numerous studies have demonstrated that the inclusion of "immediate" pre and post-training, fast-acting carbohydrate/sugar and protein feedings can stimulate muscle protein synthesis (MPS)[38,39] and reduce muscle damage to a far greater extent than normal eating patterns. [40,41] In other words, no matter how well you eat throughout the day, you recover faster and build more muscle and strength by including these quickly absorbed pre- and post-exercise formulas (see Figure 2). [42,43]

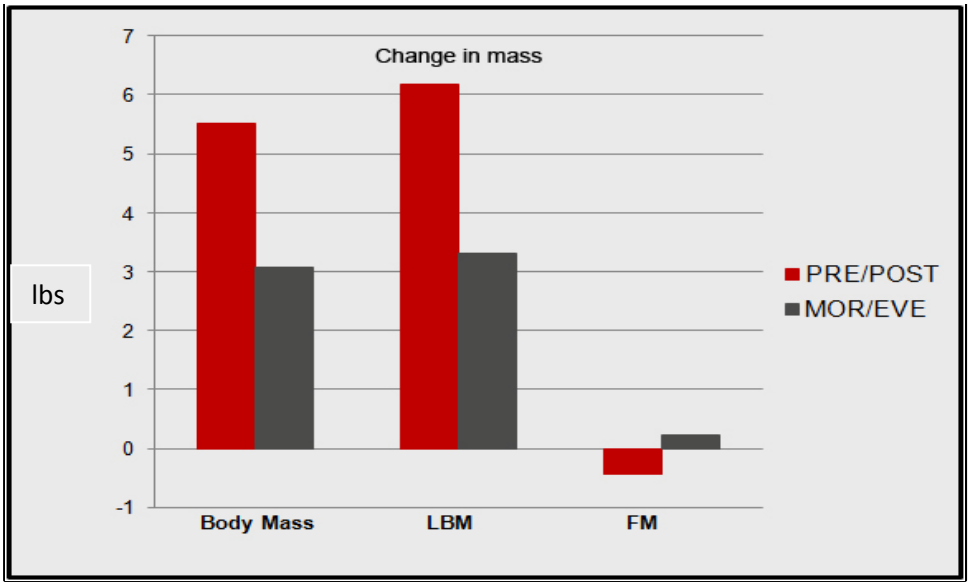

Figure 2: Training results from 23 experienced recreational bodybuilders resistance training for 10 weeks with all things (diet, supplements, training, etc.) equal except the addition of pre/post feedings yielded significantly greater gains in body mass, LBM, strength and reduction in fat mass for the pre/post feeding subjects.[43] Adapted from Rolls et al, 2006.

Diet composition

As stated above, carbohydrates will play an important role in performance, recovery and insulin levels. Carbohydrates should make up 45 to 65 percent of total calorie intake while trying to increase muscle size. Without adequate carbohydrates, ideal insulin activation will not occur, recovery from intense workouts will not be ideal, and muscular stores of energy for the next workout may be suboptimal. None of this contributes to maximum muscular gains. Protein, which mistakenly receives the greatest focus by many exercisers, needs to be high enough to allow for tissue growth. For even the hardest training bodybuilder when calories are not severely restricted, a protein intake of up to 1 gram per pound of bodyweight is more than enough to allow for increased needs due to intense workouts and adding muscle. Higher protein intakes are not necessary and may even impede progress if it takes the place of dietary carbohydrate. The exception to this is during severe calorie restriction during the final weeks of contest preparation of physique athletes. (Nutritional strategies for this population are beyond the scope of this course and are published elsewhere.) Healthy fats will complete the picture, making up the remaining calories and generally supplying 15 to 35 percent of total calorie intake.

Dietary Supplements

The final component to maximizing size and performance gains is the integration of dietary supplements. The primary goal of incorporating dietary supplements into food planning is to supply specific compounds that are used during energy, force production (muscle exertion and subsequent damage) and are needed for recovery and building. This helps keep calories within an appropriate range so unwanted weight gain is avoided. Additionally, these specific compounds must be supplied in greater amounts than are used so that a portion of their intake will be deposited into the damaged or depleted structural tissues. This will lead to the desired increase in muscle size.

By isolating these nutrients and compounds from the food form, they can be ingested without calories in order to control body composition. Dietary supplements that are manufactured in proper forms and dosages allow users to deliver the needed nutrients into the body at the exact times necessary to take full advantage of periods when muscle cells are most nutrient-sensitive. This is established by training, sleep and meal times. Proper dietary supplement use including the science behind individual products is presented in a separate section of this course.

Summary

The science of weight control is rooted in energy balance and the laws of nature. Therefore, managing calories consumed and expended allows for long-term weight management. Critical components in achieving and sustaining weight control goals include becoming aware of influencing factors such as appetite and environmental forces and establishing methods to self-regulate behaviors to properly modify energy balance. Knowing daily calorie requirements, food logging, learning nutritional information, controlling portions and using meal replacements are effective weight control strategies; however, these should be recommended to clients based on lifestyle and readiness.

Optimal muscle gain requires extra calories and nutrients, ideal diet composition, pre- and post-workout feedings, proper dietary supplementation and progressive resistance training. Muscle gain will vary based on individual differences including training experience and frequency. By understanding the science of weight control and applying the information provided in this course, fitness professionals can provide an invaluable service by guiding their clients' daily activity and food choices and helping them achieve a healthy body weight and a higher quality of life.

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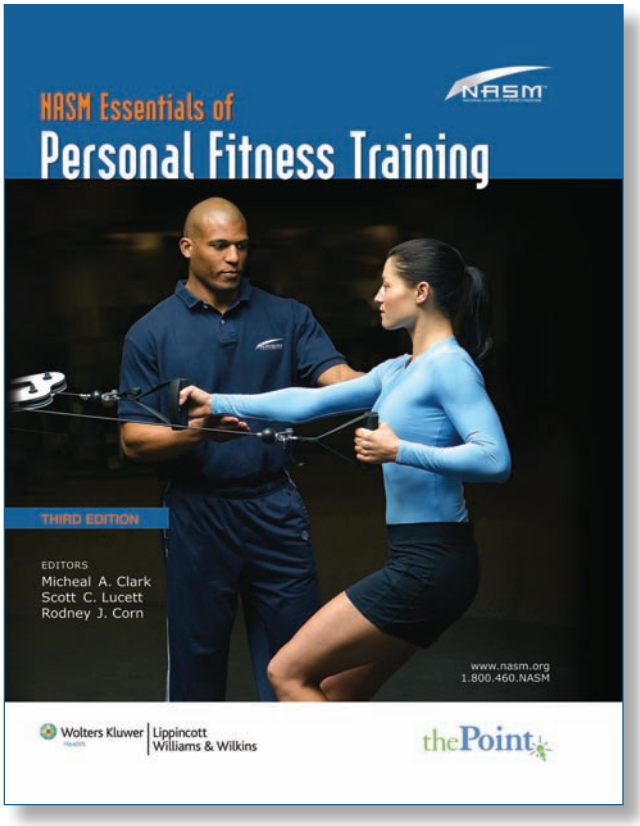
- **Developing and modifying exercises** in a safe and effective manner that is adaptable to any client

The NASM CPT preparation course is designed for entry-level to seasoned fitness professionals looking to advance their careers and discover the power behind Optimum Performance Training™ (OPT).

You will learn the scientific rationale, teaching tools and the practical experience necessary to perform assessments, create individualized programs and progress your clients to their goals. You will also learn human movement, exercise science, nutrition, and behavior modification, as well as how to build clientele and increase revenue.

And because the dotFIT exercise programming tools are based on the NASM's OPT training methodology, earning the CPT will prepare you for success when helping your customers learn how to eat better and move better. Prepare for success, get NASM Certified today!

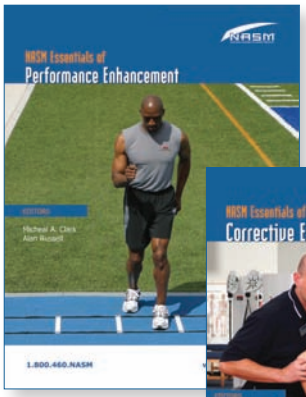


Packages start at $599.00

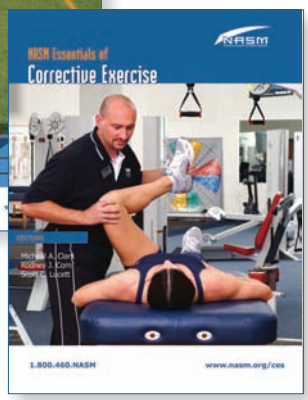
What's included:

- Textbook
- Study Guide
- DVD
- Online Learning
- iPod Video Download
- mp3 Audio Download
- Online Practice Exam
- NASM CPT Certification Exam
- Live Workshops (Optional)

Discounts also apply to the following credentials:



NASM Performance Enhancement Specialist (PES)



NASM Corrective Exercise Specialist (CES)

"As an exercise physiologist and trainer, I have always placed a strong emphasis on the 'science' of exercise. The National Academy of sports Medicine's OPT system has cutting edge training protocols that are backed by sound science and research! That has made all the difference! Go for gold, get NASM certified!"

Roger J. Yasin
NASM PES, CES
The 100 Best Personal Trainers in America,
Top Personal Trainers in Washington, DC

The NASM-CPT certification is proudly accredited by the NCCA.

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