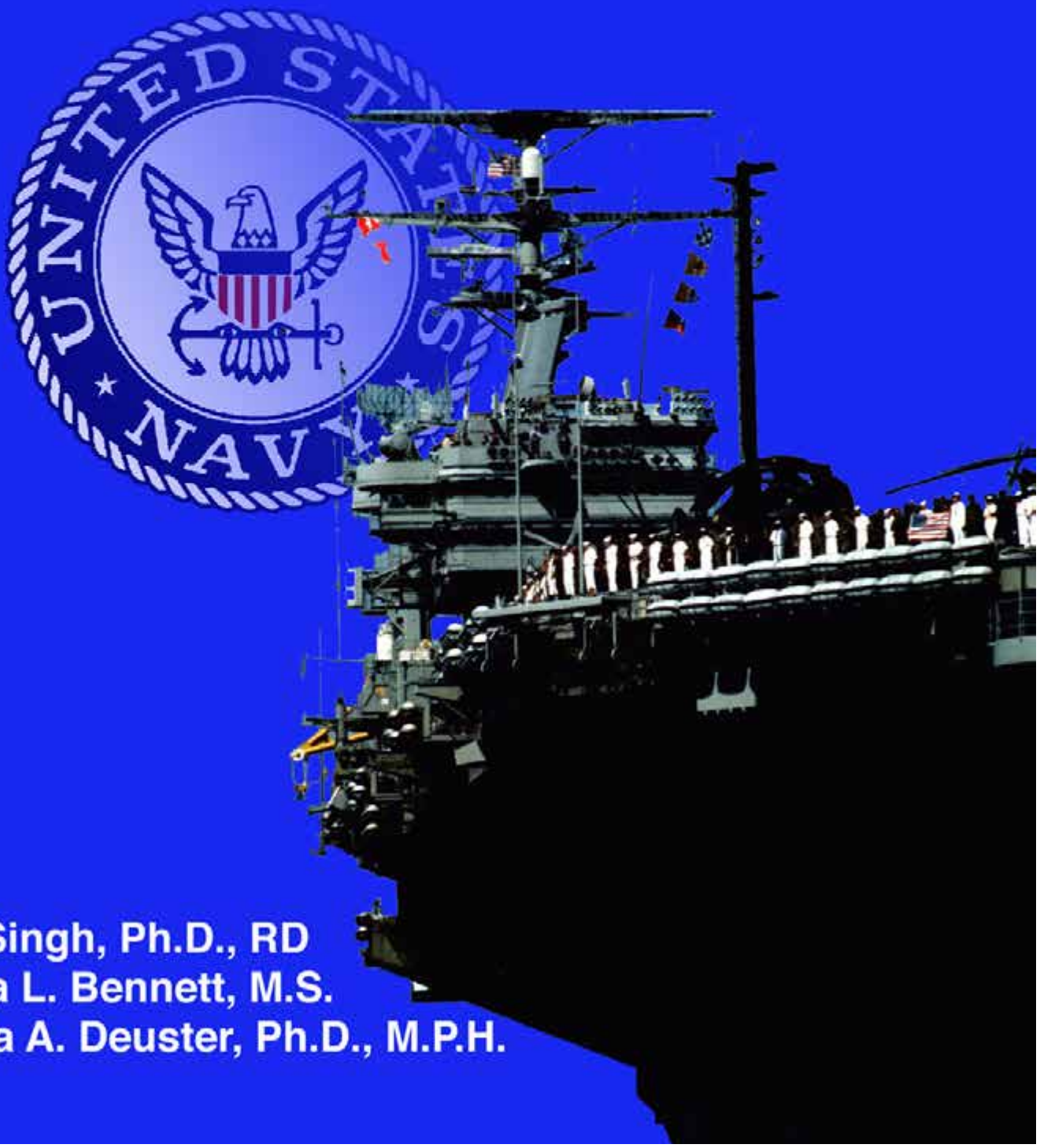
Force Health Protection: Nutrition and Exercise Resource Manual



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Department of Military and Emergency Medicine
Uniformed Services University of the Health Sciences
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September 1999

Foreword

Funding to develop this guide was received from Health Affairs, Department of Defense (DoD). Our project was one of many health promotion and prevention initiatives selected for funding. The selection of this project indicated a need for resources and materials that address the health and fitness needs of military personnel. We recognize that there are a plethora of books, tapes and websites dedicated to physical fitness and performance nutrition for the general public. However, our goal was to develop a comprehensive resource that is specifically tailored to address the unique physical fitness and nutrition requirements of Navy personnel. Our previous publications include "*The Navy SEAL Nutrition Guide*" and "*The Navy SEAL Physical Fitness Guide*". We hope that the nutrition and fitness information in this guide will be a useful resource for all Navy personnel who are striving to excel on the Physical Readiness Test (PRT). In addition, we hope this guide will promote military readiness by improving the performance of personnel on job-related tasks. Clearly the goals of the guide are broad and extend to both personal and professional aspirations, which are important for any health promotion activity.

A companion self-study guide for Navy personnel is entitled "*Peak Performance Through Nutrition and Exercise*."

Foreword from David J. Smith, CAPT, MC, USN, FACOEM
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Adjunct Assistant Professor, Biometrics and Prevention, USUHS
Former Director, Occupational and Community Health, National Naval Medical Center

It is my great pleasure to present the first edition of "***Force Health Protection: Nutrition and Exercise Resource Manual***." Wellness and health promotion are high priority goals for the Navy. Maintaining personal fitness and sensible nutrition habits is essential to this goal. After the Authors' "***The Navy SEAL Nutrition Guide***" and "***The Navy Seal Physical Fitness Guide***" received great acclaim within the Special Warfare community, we felt that a general instructor's guide applicable to all Navy personnel would be very beneficial. The resulting publication provides a common sense approach to achieving improved health for Navy personnel.

Everywhere we look on a daily basis, we are confronted with endless, often conflicting information about nutrition and fitness whether through television, periodicals, Internet, or word of mouth. The quality of this information ranges from sound, scientific based "must-do" information to dangerous mis-information. The authors of this guide have done an excellent job of distilling the vast amount of information available in the professional literature and the lay press, providing an understandable, up-to-date, practical instructor's guide for nutrition and fitness. The goal of this manual is to provide information to help you and your students make informed decisions. Many sections are tailored specifically to meet Navy needs, such as, maintaining physical fitness during deployments, whether in the field or on ships when space is limited, and for altered physical environments, such as, cold, heat and altitude. In addition, it provides sound advice on controversial subjects, such as use of vitamin and protein supplements and performance-enhancing aides. This guide offers scientific based information to serve as a foundation for a fit lifestyle, helping you and others make better, informed decisions concerning diet, exercise, and prevention efforts.

Adopting a healthier lifestyle is an important goal, but like many resolutions, is frequently postponed or not seriously pursued until disease or injury occurs. This manual provides practical, easy to use information for both the beginner to fitness and those who consider themselves informed, but want a scientific basis for their work with others. Please take some time to examine it and see for yourself. Then use the manual's information to help educate your shipmates to make better lifestyle choices and as result enhance their wellness and improve our operational readiness.

Foreword from Jeannette E. South-Paul, COL, MC, USA
Chair, Department of Family Medicine, USUHS

Health promotion and disease prevention are increasingly recognized as the best approaches to achieving and maintaining health in the general population. This is even more true in the military. As a smaller overall military force is receiving more taskings for operations other than war, those who serve our nation and overseas must be in good health and at optimal fitness levels. Service members of all ages seek to establish personal training programs that are focused on individual needs, are an efficient use of time, and which will result in measurable improvements.

This guide is an excellent reference for those who will be organizing unit training or advising individual service members. Readers can calculate fitness parameters for individuals at the beginning of a training program and then monitor these indices throughout the program. Specific guidelines are given for all ages and those with specific needs. The distinctive physiologic differences between men and women are discussed to assist in avoiding injury and maximizing training results. Pregnancy is discussed as a condition requiring an adjusted focus rather than a disease.

From a clinician's perspective, this guide is a welcome addition to the armamentarium of resources that can be recommended to patients who have learned appropriate health and fitness goals, but require more detailed, step-wise instruction. A wealth of information on exercise physiology, biomechanics, nutrition, and health that is usually not found in one document is now available in this unique compendium. It will become a true working document for clinicians, commanders, trainers, and service members for many years to come. Enjoy!

Acknowledgments

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From the Uniformed Services University of the Health Sciences (USUHS):

COL Jeannette E. South-Paul

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Cover photo from Defense Visual Information Center's "U.S. Forces in Haiti" CD ROM, image file number IMG0342.PCD.

Disclaimer: The opinions and assertions expressed herein are those of the authors and should not be construed as reflecting those of the Department of the Navy, the Uniformed Services University of the Health Sciences (USUHS), or the Department of Defense.

Introduction

The mission of the Navy is to maintain, train and equip combat-ready Naval forces capable of winning wars, deterring aggression and maintaining freedom of the seas.

(Source: http://www.navy.mil)

As documented in enclosure (1) of OPNAV6110.1E, it is the responsibility of each service member to:

- Maintain a lifestyle that promotes optimal health and physical readiness.
- Develop a regular, year-round, fitness program of aerobic, flexibility, and muscular strength and endurance exercises using resource information and the assistance of the Command Fitness Coordinator (CFC) and recreational services departments.

This guide has been prepared to assist you, the Navy's Health Promotion Staff, in your efforts to promote the health and physical readiness of all Navy personnel. A comprehensive overview of basic nutrition and physical fitness programs that address aerobic conditioning and strength training are provided. The importance of combining sound nutritional and physical fitness practices for gaining and maintaining physical readiness are emphasized. Navy-specific issues such as maintaining physical fitness during deployments, whether aboard a ship and/or in extreme environmental conditions are discussed. Women's issues, such as nutrition and exercise during pregnancy and lactation, and age-related changes in performance are also addressed. Additionally, resources used to prepare this manual, including websites for various Naval Commands and Civilian organizations involved in health promotion, are provided in Appendix D.

We encourage you to use this manual to educate fellow military personnel about the performance and health-related benefits of good dietary practices and regular exercise. A concise, companion manual entitled "*Peak Performance Through Nutrition and Exercise*" outlines the information provided in this guide and has been prepared for your students. We hope that the ideas presented in Chapter 17 (Adopting Healthy Habits) will be useful and that you are successful in your efforts to promote physical readiness and optimal health in Navy personnel.

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1 | Energy Balance and Body Composition

In this chapter you will learn about:

- Energy balance.
- Estimating energy expenditure.
- Body composition and body fat distribution.

Maintaining a healthy body weight and body fat percentage is one of the best practices to ensure optimal health, fitness, and physical performance. The best way to maintain a healthy body weight and body fat percentage is to follow sound dietary practices and to engage in physical activity. These practices will also promote muscle endurance and strength, improve cardiorespiratory conditioning, and provide a solid foundation for optimal physical performance. In addition, people who maintain a healthy body weight have a lower risk of developing psychological problems related to low self-esteem and low self-image. All of these issues are relevant in maintaining military readiness, force health protection, and in promoting optimal health of military personnel. This chapter introduces you to the basic concepts of energy balance and body composition.

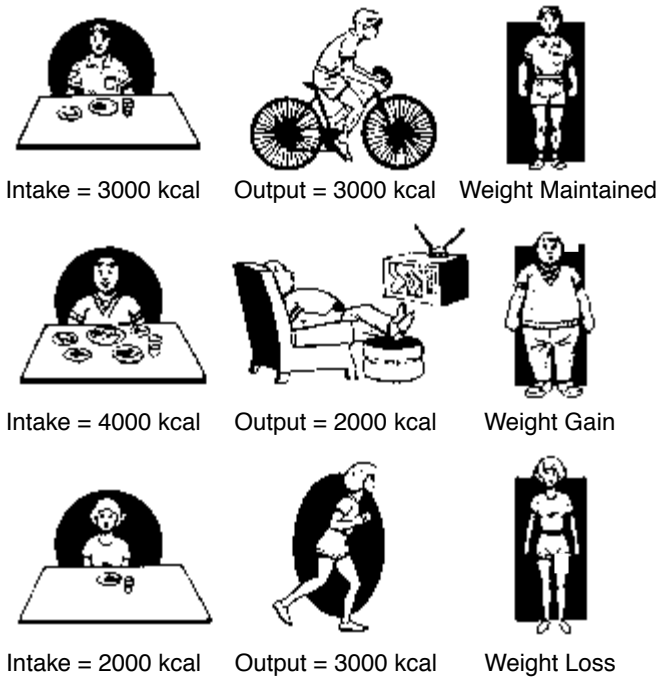
Energy Balance

The difference between energy intake, how many kilocalories (kcal) we eat, and energy expenditure, how many kcal we burn, is termed **energy balance**. Eating the same number of kcal as you burn leads to a net energy balance of zero, and your current weight is maintained. Eating more or less kcal than you burn leads to positive (weight gain) or negative (weight loss) energy balances, respectively. See Figure 1-1.

Kilocalorie vs. Calorie

The correct term to describe food energy is kilocalorie (kcal). However, kcals and Calories (with a capital "C") are used interchangeably.

Figure 1-1. Energy Balance: Intake vs. Output



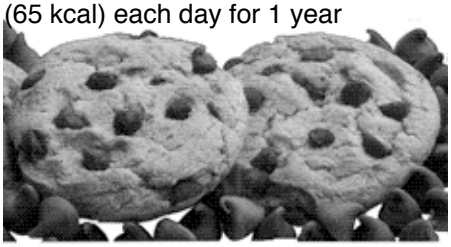
Taken from FI Katch and WD McArdle. *Nutrition, Weight Control, and Exercise, 3rd ed.* Philadelphia; Lea & Febiger, 1988.

Sensitivity of Energy Balance

This energy balance equation can be unbalanced by changing energy intake, energy expenditure, or both, as shown in the following examples. (1 pound (lbs.) of fat equals 3,500 kcal.)

Example 1:

Eating 1 extra chocolate chip cookie (65 kcal) each day for 1 year



would be: 65 kcal x 365=23,725 kcal.

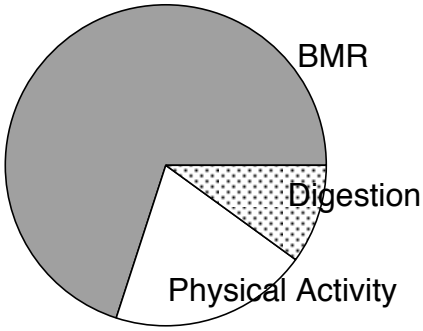
This would add up at the end of the year to a total net weight gain of 6.8 lbs. (23,725 ÷ 3,500).

Example 2:

If you maintain your kcal intake and run an extra mile per day, 5 days per week, you would expend an extra 100 kcal/mile x 5 miles/week x 52 weeks = 26,000 kcals per year. This would result in a net weight loss of 7.4 lbs. per year (26,000 ÷ 3,500).

You see? The energy balance equation is very sensitive!

Components of Energy Expenditure



Energy requirements are based on daily energy expenditures. The three major contributors to energy expenditure are:

- Basal metabolic rate (BMR).
- Energy for digesting foods.
- Physical activity.

Basal Metabolic Rate

Basal metabolic rate (BMR) is the amount of energy required to maintain life such as breathing, beating of the heart, and maintaining body temperature. This accounts for the majority (~70%) of the total daily kcals expended. BMR can be estimated by using the equations in Worksheet 1-1. Find the equation that is appropriate for you and calculate your BMR.

Worksheet 1-1. Calculate Your BMR

Equations to Calculate BMR (kcal/day)

	Age (years):	Equation:
Men:	18-30	6.95 x body weight (lbs.) + 679
	30-60	5.27 x body weight (lbs.) + 879
Women:	18-30	6.68 x body weight (lbs.) + 496
	30-60	3.95 x body weight (lbs.) + 829

Your BMR is _____kcal/day.

Digestion

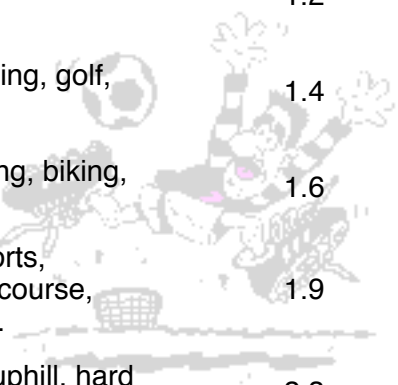
The body must work to digest food. However, the energy needed for digestion is only a small amount and has been accounted for in the BMR equations in Worksheet 1-1.

Physical Activity

In addition to the energy used for BMR and digestion, you must account for the energy expended during your daily activities. Based on your usual daily level of activity, estimate your activity factor from the choices in Table 1-1.

Table 1-1. Estimate Your Activity Factor

	Level of Activity	Activity Factor
Very Light	Seated and standing activities, driving, playing cards, computer work.	1.2
Light	Walking, sailing, bowling, light stretching, golf, woodworking, playing pool.	1.4
Moderate	Jogging, aerobic dance, light swimming, biking, calisthenics, carrying a load.	1.6
Strenuous	Stairmaster, ski machine, racquet sports, running, soccer, basketball, obstacle course, digging, carrying a load uphill, rowing.	1.9
Exceptional	Running or swimming races, cycling uphill, hard rowing, carrying heavy loads.	2.3
Your Activity Factor is _____.		



Total Daily Estimated Energy Requirement

To calculate your total daily estimated energy requirements (EER), you multiply the kcals needed for your BMR and digestion (Worksheet 1-1), by your physical activity factor (Table 1-1).

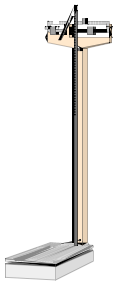
Worksheet 1-2. Calculate Your Estimated Energy Requirement (EER)

Energy Needs = _____ X _____
*BMR *Activity Factor

Your Estimated Energy Requirement (EER) = _____kcal/day.

*Your BMR is calculated in Worksheet 1-1. The Activity Factor is from Table 1-1.

This EER is the amount of kcals you need to eat daily to have an energy balance of "zero" and maintain your current body weight. If you restrict the number of kcals you eat per day, your BMR will decrease because your body will sense that it is being "starved". If your goal is to lose weight, you should lower your caloric intake only slightly and engage in a well rounded exercise program. Your goal should be to lose 1/2 - 1 lbs. per week. If you are losing more weight than this, you are losing water and lean tissue (muscle).



If you want to gain weight, your goal should be to gain 1/2 - 1 lbs. per week. The objective is to gain **lean mass**, not fat. Exercise routinely, including strength training, and increase your caloric intake by using the Food Guide Pyramid guidelines (discussed in Chapter 3). Also, eat healthy snacks between meals.

If you have specific questions about weight management and kcal requirements, consult the **Navy Nutrition and Weight Control Self-Study Guide** (NAVPERS 15602A at http://www-nehc.med.navy.mil and http://www.bupers.navy.mil/services under "Navy Nutrition and Weight Control), or talk to a Registered Dietitian, your Command Fitness Coordinator, or your primary health care provider.

Body Composition

The Body Mass Index (BMI) is commonly calculated for assessing body composition. It is a ratio of body weight in lbs. to body height in inches. Calculate your BMI in Worksheet 1-3 and compare it to the classifications in Table 1-2.

Worksheet 1-3. Calculate Your BMI

Your BMI = _____ x 705 ÷ (_____)^2 =_____.
Body Weight (lbs) Height (inches)

Table 1-2. Classifications for BMI Ratios

Ratio	Classification
< 20	Underweight
20-25	Normal
25-30	Overweight
> 30	Obese

Reference standards have been developed to identify individuals at risk for being either over- or underweight. However, BMI can misclassify some large frame or muscular people as overweight. It is strictly a ratio and does not necessarily reflect percent body fat accurately. If you feel your BMI incorrectly categorizes you, have your percent body fat measured by a trained professional. Body fat can be determined from a variety of techniques including hydrostatic (underwater) weighing, or from skinfolds and circumference (as done in the Navy) measures.

Fat Distribution

In addition to BMI, it is helpful to know your waist-to-hip ratio (WHR). This ratio determines your pattern of fat distribution, i.e., where you store body fat. The formula for calculating waist-to-hip ratio is:

Worksheet 1-4. Calculate Your Waist-to-Hip Ratio

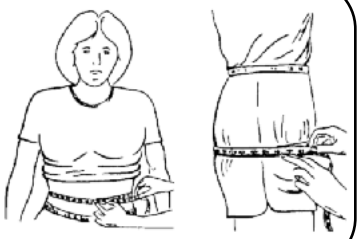
Your WHR = _____ ÷ _____ = _____

waist circumference (inches) hip circumference (inches)

Table 1-3. Standards for Waist-to-Hip Ratios

Men	Women
< 0.95	< 0.80

Measuring waist and hip circumferences using a tape measure.

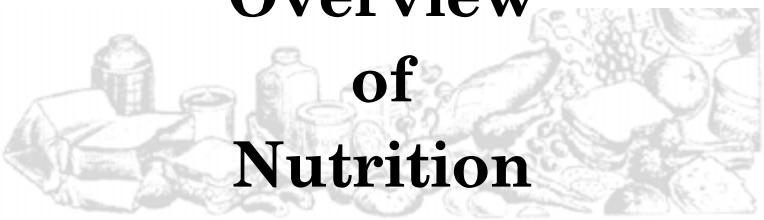


Adapted from OPNAVINST 6110.1E, March 1998 p.7-8.

The appropriate ratios for men and women are listed in Table 1-3. Ratios greater than these indicate a tendency toward central (torso) obesity. People who store excess fat centrally, as opposed to in their extremities, are at increased risk for cardiovascular (heart and blood vessel) diseases and diabetes.

This chapter serves as an anchor around which the remaining chapters have been developed. In the following chapters you will learn sound nutritional practices and ways to enhance your physical performance. Importantly, you will see how good nutrition and a balanced exercise program together influence your physical fitness, military readiness, and ultimately your overall health.

2 | Overview of Nutrition



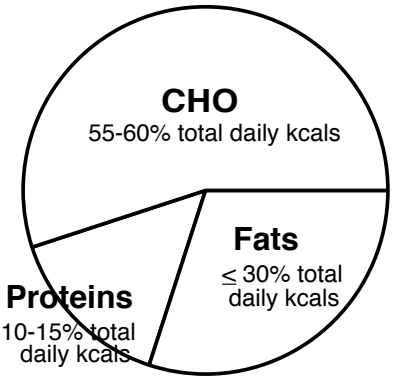
In this chapter you will learn about:

- The different nutrients and their functions in the body.
- The various food sources of all the nutrients.
- Importance and distribution of water in the body.

There are six classes of nutrients: **carbohydrates (CHO), proteins, fats, vitamins, minerals and water.** CHO, proteins, and fat, also called macronutrients, are the energy providing nutrients. Vitamins and minerals, also called micronutrients, are needed in small amounts to help in energy metabolism. Water is the most abundant nutrient in the body and is essential for the normal functioning of all the organs in the body. All six nutrients will be discussed in detail throughout the chapter.

Energy Providing Nutrients

CHO, proteins, and fats provide energy. The ideal percentage of daily kcals from these macronutrients for optimum health and performance are shown in the chart to the right.



Carbohydrates

CHO are found in grains, fruits, and vegetables and are the main source of energy in a healthy diet. Unfortunately, many people think CHO are unhealthy and lead to weight gain. That notion came about because most people add high-fat toppings and sauces to their starchy foods. The two types of CHO are:

- **Simple CHO** - have one (mono-) or two (disaccharides) sugar molecules hooked together. Examples include: glucose, table sugar (sucrose), sugars in fruit (fructose), honey (fructose and glucose), sugar in milk (lactose), maple syrup, and molasses. Some are added in processing. Added sugars provide kcals and no nutrients.

- **Complex CHO** - have three or more simple sugar molecules hooked together and are digested into simple sugars by our bodies. Examples include: whole grains, fruits, vegetables, and legumes (peas, beans). Both **starch** (digestible) and **dietary fiber** (indigestible) are forms of complex CHO. Although, dietary fiber does not provide any kcals, for health reasons it is recommended that adults eat 20-35 grams of fiber a day. This is achieved by eating more fruits, vegetables, and whole grains (see page 22 and Appendix A).

CHO are used in the body to:

- Provide energy in the form of glucose (stored as glycogen).
- Provide fuel for the brain.
- Act as building blocks for chemicals needed by the body.
- Repair tissue damage in the body.

Energy From CHO

1 gram of CHO supplies 4 kcal.

CHO should supply 55-60% of your total daily kcals.

Example1:

One fig newton has 10 grams of CHO and provides a total of 60 kcals. The kcals from CHO and the percent of total kcals from CHO are:

4 kcal X 10 grams = 40 kcal from CHO.

40 ÷ 60 = 0.67 = 67% of energy from CHO.

Example 2:

A woman eats 2,000 kcals per day. How many kcals should be from CHO? How many grams of CHO should she eat per day?

2,000 kcal x 55%=1,100 kcal from CHO.

1,100 kcal ÷ 4 kcal per gram = 275 grams CHO.

Based on your estimated energy requirement (EER) calculated in Chapter 1, how many of your kcals should come from CHO? How many grams of CHO should you eat each day?

Worksheet 2-1. Calculate Your CHO Requirements

_____ x 0.55 = _____ kcal from CHO per day.
Your EER

_____ ÷ 4 kcal per gram =_____ grams CHO per day.
kcal from CHO

Proteins

Proteins are found in meat, fish, poultry and dairy foods. Beans and grains also provide proteins but in smaller amounts than animal foods. All proteins are made of various **amino acids** that are joined together. There are 20 different amino acids. Nine of these are called **essential amino acids** because the body cannot make them, so they must be obtained from the diet.

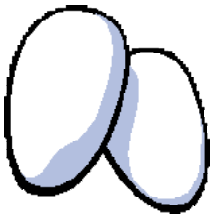
Proteins are used in the body to:

- Form muscle, hair, nails, skin, and other tissues.
- Provide energy.
- Repair injuries.
- Carry fats, vitamins and minerals to different parts of the body.
- Contract muscle.
- Serve a structural role for every part of the body.

Energy from Proteins

1 gram of protein supplies 4 kcal (the same as CHO).

Proteins should supply 10-15% of your total daily kcals.



Example:
One large hard boiled egg provides 78 kcal and contains 6 grams of proteins. Therefore, kcal from proteins are 4 kcal/gram x 6 grams = 24 kcal of energy from proteins.

Your protein needs are determined by your age, body weight, and activity level. Most people eat 100 to 200 g of proteins each day, which is more protein than is actually needed by the body. Many people eat high-protein foods

because they think that proteins make them grow “bigger and stronger”. Actually, these excess kcals from proteins can be converted to fat and stored. Although proteins provide energy, they should not be the main dietary source of energy. High-protein intakes also increase fluid needs and may be dehydrating if fluid needs are not met (see “Water” on page 17 and Chapter 12). In addition, high-protein intakes put the kidneys under great strain in order to get rid of all the breakdown products.

Table 2-1. Determining Your Protein Factor

Grams of Proteins Per Pound of Body Weight

Activity Level	Protein Factor
Low to Moderate	0.5 grams
Endurance Training	0.6 - 0.8 grams
Strength Training	0.6 - 0.8 grams

Your Protein Factor is _____.

Calculate your daily protein requirements in Worksheet 2-2 using your protein factor from Table 2-1.

Worksheet 2-2. Calculate Your Protein Requirements

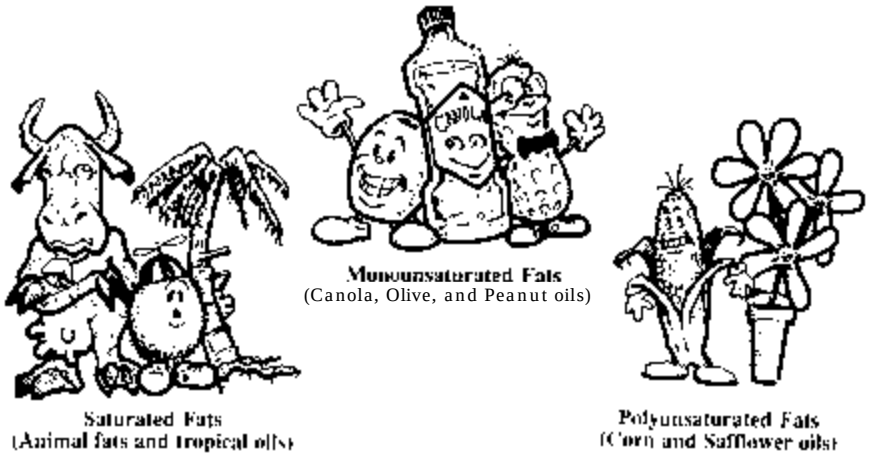
_____x_____=_____ grams of proteins per day.
Body Weight (lbs.) Protein Factor

Fats

Fats are an essential part of your diet, regardless of their bad reputation. However, not all fats are created equal. By knowing about the different types of dietary fats and using the guidelines for daily fat consumption, you can eat the right amount of fat. The three types of fats naturally present in foods are saturated, and mono- and polyunsaturated fats. A fourth type of fat is trans fat and is created during the processing of some foods.

- **Saturated Fats** are solid at room temperature and are found primarily in animal foods (red meats, lard, butter, poultry with skin, and whole milk dairy products); tropical oils such as palm, palm kernel and coconut are also high in saturated fat.
- **Monounsaturated Fats** are liquid at room temperature and are found in olive oil, canola oil and peanuts.
- **Polyunsaturated Fats** are liquid at room temperature and are found in fish, corn, wheat, nuts, seeds, and vegetable oils.

Saturated, monounsaturated, and polyunsaturated fats should each be less than or equal to 10% of your total daily kcals. Therefore, total fat intake should be less than or equal to **30%** of your total daily kcal intake.



- **Trans Fats** are created during manufacturing by a process known as hydrogenation. This process converts unsaturated fats to saturated fats. Manufacturers hydrogenate foods to improve the shelf-life of their products. Currently, food labels do not list the trans fat content of a food but if "hydrogenated oils" are listed under ingredients it indicates the presence of trans fats. The more processed foods you eat the greater your trans fat intake. Trans fats may increase blood cholesterol.

A high-fat diet is associated with many diseases, including heart disease, cancer, obesity, and diabetes. On average, people who eat high-fat diets have more body fat than people who eat high-CHO, low-fat diets. On the other hand, a fat-free diet is also very harmful since fat is an essential nutrient required by the body (see a list of its functions below).

Fats are used in the body to:

- Provide a major form of stored energy.
- Insulate the body and protect the organs.
- Carry other nutrients throughout the body.

- Serve a structural role in cells.
- Satisfy hunger and add taste to foods.

Energy From Fat

1 gram of fat supplies 9 kcal, more than twice the energy supplied by CHO.

Fats should supply no more than 30% of your total daily kcals.

Example:

A 1-ounce bag of potato chips that provides 152 kcals contains 10 grams of fat. The kcals from fat are:

10 grams x 9 kcals = 90 kcals from fats.

Worksheet 2-3. Determine Your Maximum Fat Limit

_____ x 0.30 = _____kcal of fat per day.
Your EER

_____ ÷ 9 kcal per gram =_____grams of fat per day.
kcal of fat

Cholesterol

Cholesterol is a part of body cells, and serves as a building block for some hormones (e.g., testosterone and estrogen), and it is required to digest fats. The body makes cholesterol in the liver. Cholesterol is also consumed in the diet by eating animal products. A diet high in dietary cholesterol and saturated fats is associated with an increased risk for heart disease. The American Heart Association recommends that daily cholesterol intakes do not exceed 300 milligrams. Red meats and egg yolks are cholesterol rich foods that should be consumed in moderation.

Micronutrients

Micronutrients include all vitamins and minerals. Neither provides any kcals but both facilitate metabolism (the chemical breakdown) of the macronutrients. Specific functions of micronutrients are listed in Table 2-2 and Table 2-3.

Vitamins

Vitamins are classified as fat or water soluble.

- **Fat Soluble Vitamins** are absorbed with dietary fat, can be stored in the body, and are not excreted in the urine. These include vitamins A, D, E and K.
- **Water Soluble Vitamins,** including the B vitamins and Vitamin C, are not stored in the body in appreciable amounts and excess amounts are excreted in the urine each day.

Minerals

Minerals are classified according to their concentrations and functions in the body.

- **Minerals** - examples include: calcium and magnesium.
- **Trace Minerals** - are less abundant than minerals; examples include: zinc, copper and iron.
- **Electrolytes** - examples include sodium, potassium and chloride.

Recommended Dietary Allowances

The Recommended Dietary Allowances (RDA) shown in Table 2-2 and Table 2-3 are the amounts of the vitamins and minerals, respectively, that a healthy person should eat to meet daily requirements. The RDAs are designed to meet the daily requirements for most healthy people. The RDAs are undergoing revisions and new standards are gradually becoming available. These new standards are called the Dietary Reference Intakes (DRI). The military has also developed a set of allowances known as the Military DRIs (MDRIs) to be used for designing military rations.

In most cases your micronutrient needs will be met by eating a variety of foods. Taking multivitamin and mineral supplements is another way to meet the RDAs for the micronutrients (see Chapter 14, page 105). However, if you elect to take micronutrient supplements, you are urged to take only the RDA amount for each micronutrient. Taking more than the RDA of a micronutrient could lead to toxicity and create deficiencies of other micronutrients.

Micronutrients in the Diet

No one food can provide all of the micronutrients, so you are encouraged to eat a variety of foods. Also, food preparation can affect the amount of nutrients that remain in the food, especially when cooking vegetables. To

increase the retention of vitamins while preparing a meal:

- Cook food in just enough water to prevent burning, do not soak.
- Cook vegetables only until they are crisp and tender.
- Steam or stir-fry foods to retain the most vitamins.
- Use leftover cooking water for preparing soups and sauces to use the water soluble vitamins that were leached out.
- Cut and cook vegetables shortly before serving or store them in an airtight container.

The amount of minerals that will be absorbed from foods depends upon a number of factors, such as:

- The presence of other dietary constituents, such as dietary fiber and other minerals.
- Medications.
- The body's need for the mineral and the mineral's chemical form.
- The integrity of the intestinal tract.

Many things can affect your body's ability to properly absorb vitamins and minerals. These include caffeine, tobacco, antibiotics, aspirin, alcohol and stress. For example, drinking coffee or tea with meals can decrease iron absorption and taking antibiotics can increase your Vitamin B needs.

The nutrient content of many foods can be found on food labels. For most foods, including fresh produce, processed foods, and fast foods, you can look up specific information on the USDA web site (http://www.nal.usda.gov/fnic) or consult a dietitian or nutritionist.

Table 2-2. Requirements and Functions of Vitamins

Fat Soluble Vitamins	Some Important Functions	Food Sources
Vitamin A: Retinol, Retinoids, Carotene 800-1,000 μg. RE or 5,000 International Units (IU).	Growth and repair of body tissues, immune function, night vision. Carotene is the water soluble form with antioxidant properties.	Oatmeal, green and yellow fruits and vegetables, liver, milk.
Vitamin D: 5-10 μg. or 200 - 400 IU.	Regulates calcium metabolism and bone mineralization.	Fortified milk, egg yolk, salmon, sunlight.
Vitamin E: alpha-Tocopherol, 8-10 mg.	Antioxidant, protects cell membranes, and enhances immune function.	Fortified cereals, nuts, wheat germ, shrimp, green vegetables.
Vitamin K: 60 - 80 μg.	Assists in blood clotting and calcium metabolism.	Green and leafy vegetables.
Water Soluble Vitamins	**Some Important Functions**	**Food Sources**
Vitamin B_1: Thiamin, 1.0 -1.5 mg.	Needed in energy production, CHO metabolism, and growth. Supports muscle, nerve, and cardiovascular function.	Fortified cereals, legumes, pork, nuts, organ meats, molasses, yeast.
Vitamin B_2: Riboflavin, 1.2 -1.7 mg.	Essential for energy metabolism; growth and tissue repair.	Cereals, liver, milk, yogurt, green leafy vegetables, nuts, whole grain.
Vitamin B_3: Niacin, Niacinamide, Nicotinic acid 13 -19 mg.	Essential for energy metabolism, blood circulation, nerve function, and appetite.	Lean meat, seafood, milk, yeast, fortified cereals, whole grain.
Vitamin B_5: Pantothenic acid, 4 - 7 mg.	Essential for energy metabolism and nerve function.	Legumes, meat, fish, poultry, wheat germ, whole grain.
Vitamin B_6: Pyridoxine HCl, 2 mg.	Essential for CHO and protein metabolism, immune function, red blood cell production, nerve function.	Oatmeal and cereals, banana, plantain, poultry, liver.
Folate: Folic acid, Folacin, 400 μg.	Vital for red blood cell synthesis. Essential for the proper division of cells. Maternal folate deficiency may result in an infant with birth defects.	Fortified cereals, green leafy vegetables, liver, lentils, black-eyed peas, orange juice.
Vitamin B_{12}: Cobalamin, 2 μg.	Required for red blood cell production, energy metabolism, and nerve function.	Ground beef, liver, seafood, milk, cheese.
Biotin: 30 - 100 μg.	Participates in energy metabolism, fatty acid formation, and utilization of the B vitamins.	Legumes, whole grain, eggs, organ meats.
Vitamin C: Ascorbic acid, Ascorbate 60 mg.	Antioxidant, role in growth and repair of tissues, increases resistance to infection, and supports optimal immune function.	Cantaloupe, citrus fruit, strawberries, asparagus, cabbage, tomatoes, broccoli.

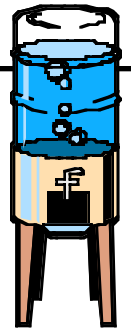
From the 1989 RDA and 1998 DRIs for healthy adults 19 to 50 years. CHO = carbohydrates. mg= milligrams, μg= micrograms.

Table 2-3. Requirements and Functions of Minerals

Mineral	Some Important Functions	Food Sources
Boron Unknown	Important in bone retention.	Fruits, leafy vegetables, nuts, legumes, beans.
Calcium 1,000 - 1,300 mg.	Essential for growth and structural integrity of bones and teeth; nerve conduction; muscle contraction and relaxation.	Yogurt, milk, cheese, tofu, fortified juices, green leafy vegetables.
Chromium[1] 50 - 200 μg.	Participates in CHO and fat metabolism; muscle function; increases effectiveness of insulin.	Whole grains, cheese, yeast.
Copper[1] 1.5 - 3 mg.	Essential for red blood cell production, pigmentation, and bone health.	Nuts, liver, lobster, cereals, legumes, dried fruit.
Iron[2] 10 -15 mg.	Essential for the production of hemoglobin in red blood cells and myoglobin in skeletal muscle, and enzymes that participate in metabolism.	Liver, clams, oatmeal, farina, fortified cereals, soybeans, apricot, green leafy vegetables.
Magnesium 280 - 350 mg.	Essential for nerve impulse conduction; muscle contraction and relaxation; enzyme activation.	Whole grains, artichoke, beans, green leafy vegetables, fish, nuts, fruit.
Manganese[1] 2 - 5 mg.	Essential for formation and integrity of connective tissue and bone, sex hormone production, and cell function.	Nuts, legumes, whole grains.
Phosphorous 800 - 1,200 mg.	Essential for metabolism and bone development. Involved in most biochemical reactions in the body.	Fish, milk, meats, poultry, legumes, nuts.
Potassium[3] 2,000 mg.	Essential for nerve impulse conduction, fluid balance, and for normal heart function.	Squash, potatoes, beans, fresh fruits (bananas, oranges) and vegetables (tomatoes).
Selenium 55 - 70 μg.	Antioxidant, works with vitamin E to reduce oxidation damage to tissues.	Meats, seafood, cereals.
Sodium[4] 500 - 2,400 mg.	Essential for nerve impulse conduction, muscle contraction, fluid balance, and acid-base balance.	Table salt, canned and processed foods.
Zinc 12 - 15 mg.	Involved in metabolism, immune function, wound healing, and taste and smell sensitivity.	Seafood, beef, lamb, liver, eggs, whole grains, legumes, peanuts.

From the 1989 RDA and 1998 DRIs for healthy adults 19 to 50 years. CHO = carbohydrates.
[1]Estimated safe and adequate daily intake range - meets requirements of individuals and avoids the danger of toxicity (Food and Nutrition Board, 1989). [2]Men should consult a physician before taking iron supplements. [3]The minimum daily requirement for potassium is 2,000 mg. [4]The minimum daily requirement for sodium is 500 mg. or 1,250 mg. of salt. Salt is 40% sodium and 60% chloride. One teaspoon of salt (5g sodium chloride) has 2g (2,000 mg) of sodium. mg= milligrams, μg= micrograms.

Water



Approximately 60% of total body weight is water. Thus, adequate amounts of water must be consumed daily to ensure the normal functioning of the body and to replenish lost fluids. Water is found both inside and outside the cells of the body, but most water is inside cells, especially muscle cells. The lowest concentration of water is in bone and fat. Since muscle mass contains more water than fat, the leaner you are, the more body water you have! Water in the body serves many important roles, including:

- Digesting and absorbing nutrients.
- Excreting wastes.
- Maintaining blood circulation throughout the body.
- Maintaining body temperature.

Worksheet 2-4. Calculate Your Daily Water Requirement

Your Body Weight = _____lbs.

0.5 x _____(body weight) ÷ 8 oz. per cup = _____ cups per day.

Note: Exercise, heat, cold, and altitude can increase fluid requirements. See Chapters 11 and 12.

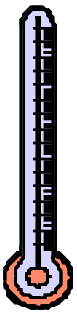
Maintaining Fluid Balance

Fluid balance, like energy balance, is determined by the ratio of fluid losses to fluid intakes. With dehydration, water loss exceeds intake and fluid balance becomes negative. The average person loses 1,000 ml to 2,300 ml (1.0 to 2.4 quarts) of water per day. This water is lost in the urine, in stools, in sweat, and through breathing. When activity levels are low, most fluids are lost through the urine. When activity levels are high or the temperature is high, most of the fluid is lost through sweat. In fact, up to 2,000 ml (2.1 quarts) per hour can be lost through sweating, depending on the temperature. To maintain fluid balance you must consume enough fluids each day from:

- Water in beverages (water, fruit juices, milk, sport drinks).
- Water in food (fruits, vegetables, soups, meats, grains).

Dehydration

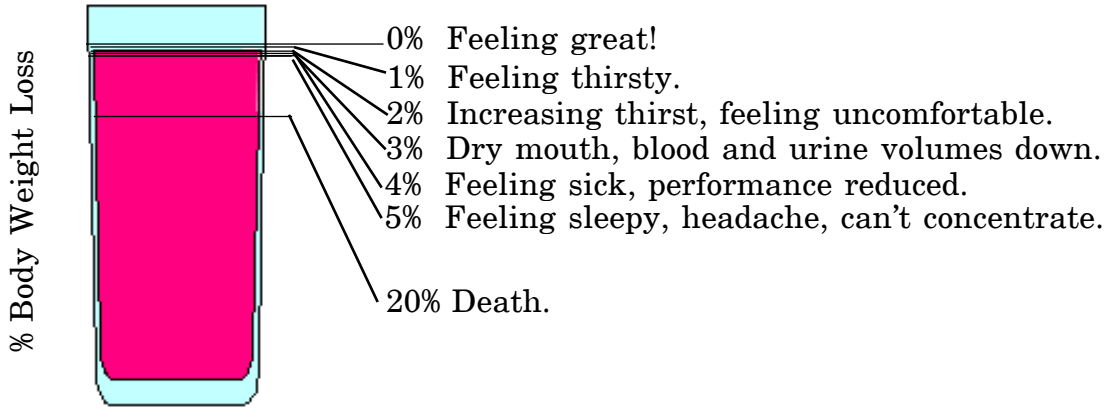
Dehydration results when fluid losses exceed fluid intake. Conditions that can lead to dehydration include:



- Not drinking enough fluids daily.
- Working or exercising in a hot environment - wet or dry.
- Working or exercising in a cold environment - wet or dry.
- Going to high altitudes.
- Drinking too much alcohol or exercising with a hangover.

If 4% of your body weight is lost through fluid losses, decision-making, concentration, and physical work are impaired. A loss of 20% of body water can result in death (see Figure 2-1).

Figure 2-1. Symptoms of Dehydration



Worksheet 2-5. Calculate Your Water Loss Limit

A 2% loss in body weight due to fluid loss equals:

_____ x 0.98 = _____ lbs.
(Your body weight)

Goal: Always stay above this weight!

Chapter 3 outlines the dietary guidelines which apply the information discussed throughout this chapter to every day dietary practices and food choices.

3 | Eating for Optimal Health and Fitness

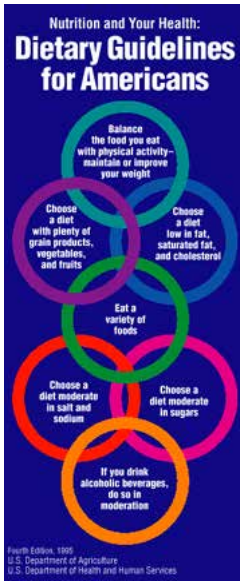
In this chapter you will learn about:

- Guidelines for choosing a healthy diet.
- The Food Guide Pyramid.
- Making wise food choices when eating away from home or between meals.
- Vegetarian diets.

You have heard the saying "You are what you eat". That is because what you eat makes a difference in how you perform, how you feel, and affects your long-term health. This chapter provides information on how to follow healthy dietary practices whether you are eating at home, in a galley, or at a restaurant.

Dietary Guidelines for Americans

The US Department of Agriculture (USDA) and the Department of Health and Human Services (DHHS) prepared Dietary Guidelines for all Americans 2 years of age and older. (http://www.nal.usda.gov/fnic/dga). The seven guidelines are:



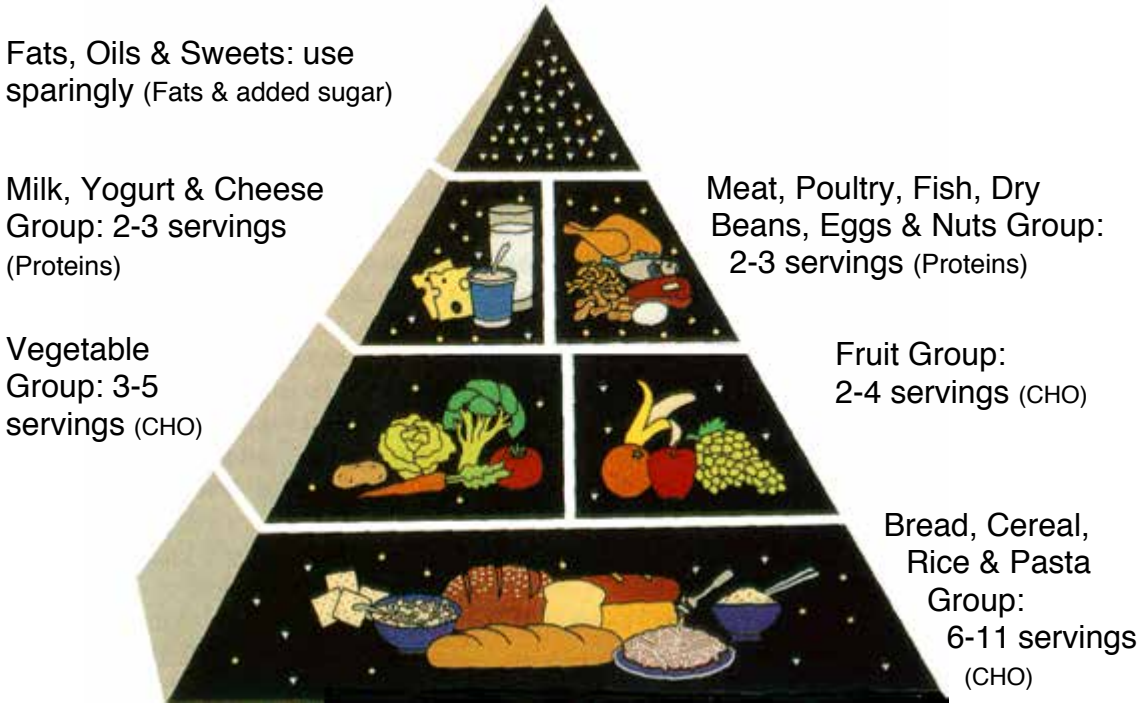
1. Eat a variety of foods.
2. Balance the food you eat with physical activity -- maintain or improve your weight.
3. Choose a diet with plenty of grain products, vegetables, and fruits.
4. Choose a diet low in fat, saturated fat and cholesterol.
5. Choose a diet moderate in sugars.
6. Choose a diet moderate in salt and sodium.
7. If you drink alcoholic beverages, do so in moderation.

For more specific guidance on food selection, the USDA and the DHHS developed the food guide pyramid in Figure 3-1.

The Food Guide Pyramid

You must have noticed the food guide pyramid on food labels. The USDA and the DHHS designed this pyramid to be a flexible dietary guide for Americans. Each compartment contains a different food group and the recommended number of servings that should be consumed daily. The primary macronutrient (see Chapter 2) found in each food group is written in parenthesis. See Figure 3-1.

Figure 3-1. Food Guide Pyramid



Although this Food Guide Pyramid can be found on most food labels, many people are still unsure how to use its information. The most common questions concern both the size of a serving and how many servings should be eaten. Often people overestimate the size of a serving, thereby eating more kcals than they anticipated. Table 3-1 and Table 3-2 help answer questions about serving sizes. Table 3-1 gives an estimate of the amount of food per serving for each food group, and Table 3-2 lists the number of servings required from each food group to meet the total daily kcals shown in the left column. Using your Estimated Energy Requirements (EER) calculated in Chapter 1 as your daily kcals, find the number of servings per food group that best fit your caloric requirement.

Table 3-1. Portion Sizes Equivalent to a Serving

Food Group	Serving Size
Bread, Cereal, Rice, Pasta & Grains	1 slice of bread, 1/2 cup cooked rice or pasta, 1 oz.* breakfast cereal, 1/2 bagel.
Vegetables	1 cup leafy vegetables, 1/2 cup raw or cooked vegetable, 3/4 cup vegetable juice.
Fruits	1 medium size fruit, 1/2 cup canned fruit, 3/4 cup of 100% fruit juice, 1/4 cup dried fruit.
Milk, Yogurt, & Cheese	1 cup milk or yogurt, 2 oz. cheese.
Meat, Poultry, Fish, Dry Beans, Eggs, Nuts	3 oz. lean meat, poultry, fish, 1 egg, 2 Tbsp* peanut butter, 1/2 cup cooked beans.
Fats, Oils, Sweets	1 tsp* oil, 1 pat of butter, 1 Tbsp salad dressing or sour cream (equivalent to 45 kcals).

*oz. = ounces, Tbsp. = tablespoon, tsp = teaspoon.

Table 3-2. Suggested Servings Based on Total Daily Caloric Intake

Total Daily Kcals	NUMBER OF SERVINGS PER FOOD GROUP					
	Bread	Vegetables	Fruits	Meats	Milk	Fat grams
1,400	6	4	3	2	2	<47
1,600	7	5	4	2	2	≤53
1,800	8	5	4	2	3	≤60
2,000	10	5	4	2	3	≤67
2,200	11	5	4	3	3	≤73
2,400	12	6	5	3	3	≤80
3,000	15	6	6	3	3	≤100

Adapted from *Navy Nutrition and Weight Control Self-Study Guide*, NAVPERS 15602A 1996, p. 44.

5-A-Day

You may have heard of the national campaign to increase the amount of fruits and vegetables eaten by all Americans. This campaign, called **"5-a-Day"** has been adopted by all military services. Its purpose is to encourage people to eat at least five servings of fruits and vegetables each day. Following this program can add needed vitamins and minerals to your daily food intake; cut your risk of heart disease, cancer and digestive diseases; help control cholesterol; prevent constipation; and can help manage your body weight and percent body fat. Additionally, many fruits and vegetables contain "antioxidants" (see the Glossary) and other nutrients that are beneficial to your health. Ideas to help you incorporate more fruits and vegetables in your diet can be found in Appendix A.

Food Labels

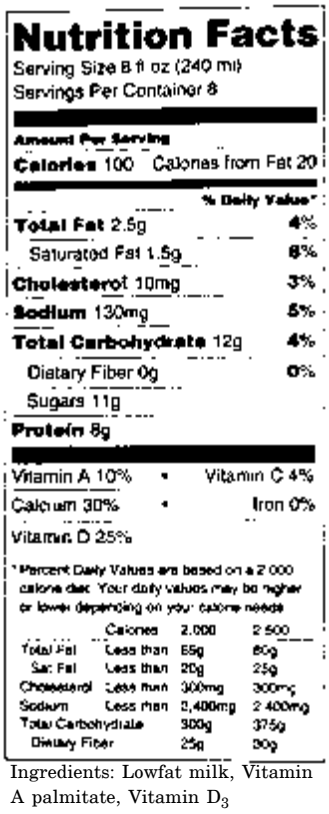
To fully understand and use the information in the Food Guide Pyramid you need to understand how to read the nutrition labels on foods. An example of a food label is shown in Figure 3-2.

Figure 3-2. How to Read a Food Label

Serving size reflects the typical amount of the food that many people eat.

The list of nutrients displays the amount in one serving of the food.

Ingredients are listed from the most to the least abundant items found in the food.



The % Daily Values are based on a 2,000 kcal diet. Use the number to compare the amount of nutrients found in various foods.

Percentage of the daily vitamin and mineral recommendation that is met in one serving of the food.

Selecting Nutrient-Dense Foods

Foods that contain the most nutrients in the fewest kcals are called **nutrient-dense foods**. Now that you know the number of kcals each macronutrient provides and the importance of the micronutrients, can you select foods that provide many nutrients without consuming too many kcals? Let us equate this concept to bargain shopping. If you have $10 and you need to buy several toiletries, you will buy the products that cost the least money yet still meet your needs. The same should be true with respect to the amount of kcals in the foods you eat. For an example look at the nutritional content of skim milk and whole milk.

	Skim Milk	Whole Milk
Total kcal	**85**	**157**
grams CHO	12	11
grams proteins	8	8
grams fat	**0**	**9**
mg Calcium	303	290

Skim milk and whole milk contain the same amounts of proteins, CHO, and calcium; however, skim milk has less total kcals and less fat than the whole milk. Therefore, you can drink two glasses of skim milk for the same amount of kcals as 1 glass of whole milk, yet you will get twice the proteins, CHO, and calcium.

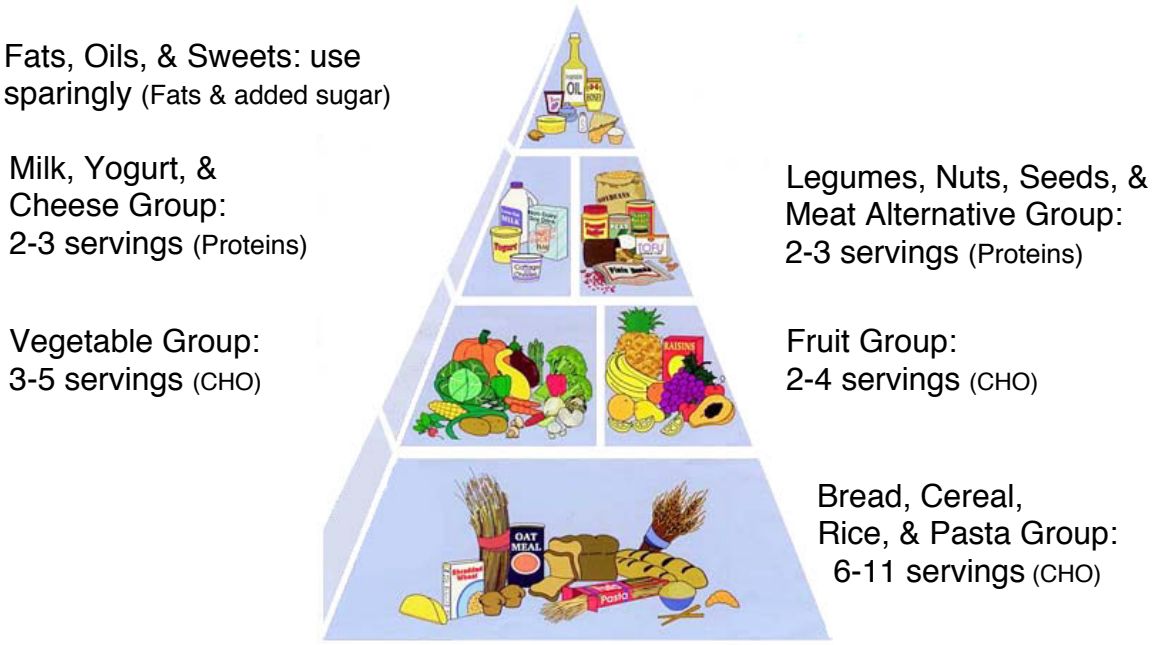
The goal of selecting nutrient-dense foods is not to avoid fat grams, but rather to select foods that contain the essential macro- and micronutrients without eating an overabundance of kcals.

Vegetarian Diets

The popularity of vegetarian diets has increased in recent years. One reason, aside from religious or social beliefs, is that vegetarian diets have been linked to lower risks for several diseases, including heart disease, high blood pressure, and diabetes. There are many different types of vegetarian diets. The similarities among them lie in their emphasis on grains, vegetables, fruits, beans, and nuts to obtain the necessary macronutrients. The vegan diet is the strictest of the vegetarian diets since it contains no animal products. The lacto-ovo-vegetarian diet contains both dairy products and eggs in addition to the above foods. Even within these two types of diets, there is considerable variation based on food choices. The main concern

people have when deciding whether they would like to try a vegetarian diet is whether the diets will meet their vitamins, minerals, and proteins needs. Both protein and micronutrient intake is adequate among vegetarians as long as they eat a variety of foods. Vegetarians who limit or omit animal products from their diets may need to take Vitamin B_{12} and calcium supplements. A well-rounded vegetarian diet follows the US dietary guidelines and can meet the nutritional needs of adults, children, competitive athletes, and pregnant women (see Figure 3-3).

Figure 3-3. Food Guide Pyramid for Vegetarians



Adapted from the Vegsource organization web site at: http://vegsource.com/nutrition/pyramid.jpg

Eating Out

On many occasions you may find yourself eating away from home. If good food choices are made, it is possible to follow the dietary guidelines when dining out. It is likely that many of you eat five or more meals per week away from home. Learning to "eat out" is a very important aspect of optimizing your health, fitness, and performance.

On average, Americans eat 1 of 3 meals away from home each day.

Tips for Healthy Eating in Restaurants

- Order foods high in complex CHO (see Chapter 2, page 8).
- Choose foods described as baked, broiled, steamed, poached, smoked, roasted, grilled, flame-cooked, and marinara.
- Order green salads, plain potatoes and rice. Ask for any condiments, such as salad dressings, gravy, cheese, croutons and sour cream "on the side;" use only a portion of what is served.
- Order dessert after you have eaten your main course only if you are still hungry. Select sorbet, sherbet, frozen yogurt, ice milk, fruit, or angel food cake.
- Trim all visible fat off the meat.
- Limit portions of margarine, butter and sour cream.
- Eat plain rolls, breadsticks or crackers rather than biscuits, chips or nuts as an appetizer. Or ask for your salad to be served as your appetizer.

- Avoid foods described as fried, breaded, battered, flaky, crispy, creamy, au gratin, puffed, loaded, and tempura. Also, avoid hollandaise and bearnaise sauces.
- Limit alcohol consumption.

Fast Food Restaurants

Although you are not encouraged to get your meals from fast food establishments, fast foods are a way of life. If you learn to select the foods with the most nutritional value then fast foods can be OK. Most restaurants have a listing of the nutritional content of their foods and are available on request. More information on the nutritional content of fast foods is available at the USDA's web site at: http:\\www.nal.usda.gov/fnic/cgi-bin/nut_search.pl. Information may also be found on web sites for various fast food restaurants.

Snacking

Many people think snacking is unhealthy and leads to weight gain because many people don't eat healthy snacks! If you enjoy snacking and you want to maintain your body weight and perform well, then selecting healthy snacks is critical. Think through a typical day. How often and where do you usually snack? Are your snacks healthy or loaded with extra kcals? Many people snack on foods when they are bored and often don't realize how much food they have eaten. Snacks should not replace a meal. Avoid these situations by being aware of your behaviors, food selection, and kcal consumption. Follow these tips to help promote healthy snacking!

- Stock foods such as plain popcorn, dried fruits, whole grain crackers, pretzels, unsweetened fruit juices, fresh produce, and low-fat yogurt.
- Snack on fresh fruits or vegetables with low-fat peanut butter or low-fat cheese spreads. (Fruits and vegetables provide dietary fiber.)
- Make a snack mix with wheat, rice, and corn ready-to-eat cereals.

There can be times when you just don't want to be healthy, you just want to satisfy a sweet tooth or craving. When this happens, be selective of the sweets you eat. If you must have a candy bar or other sweets, choose one that is high in CHO and as low in fat as possible. Eating one now and then will certainly not hurt you!

Many people replace high-fat snacks with the low-fat alternatives in an attempt to lower their total fat intake. Be cautious, however, because even low-fat snacks can lead to weight gain and increases in body fat when too many kcals are consumed. Remember: low-fat does not mean low kcals, so do not over eat!

Nutrition Throughout Life

The guidelines put forth in this chapter can be applied to everyone throughout their lifetime. Identify the times in your life when your energy needs are changing and adjust your diet appropriately to maintain your health and fitness. Examples of when energy requirements may be reduced are decreases in physical activity either from a change in job description or

a change in your exercise habits. Examples of when energy requirements may rise are increases in physical activity or during pregnancy and breast feeding. Each individual should eat the appropriate number of servings from each food group based on their EER. Refer to Chapter 1 and Table 3-2 for the recommended daily kcals and the number of servings from each food group to meet various kcal requirements. Seek the help of a Registered Dietitian if you have any concerns about your diet or the diet of a family member. Even if you do not cook your meals or if you eat in the galley, you can make healthy food choices (see Appendix A). When eating in the galley, ask for the **Healthy Navy Options** menu items (available in the larger galleys and ships). Make high-fat foods the exception rather than the rule in your diet.

4 Overview of Physical Fitness

In this chapter you will learn:

- The definition of physical fitness.
- The benefits of being physically fit and its relation to military readiness.
- The FITT Principle.
- The Physical Fitness Pyramid.
- Fuel used during exercise.
- Exercise Sequence.
- Training and Detraining.

In the military, physical fitness is emphasized because of its role in military readiness and force health protection. Many jobs in the Navy require that personnel handle heavy equipment, adapt quickly to harsh environments, and are able to work in limited quarters. Training for these situations ensures that you are physically able to perform these tasks repeatedly, without fail, whenever the need arises. In short, this is the rationale for optimizing your physical fitness levels and the reason you are required to perform PRT tests every six months! (See OPNAV6110.1E at http://www.bupers.navy.mil/services under "New Navy PRT Program" for the PRT standards).

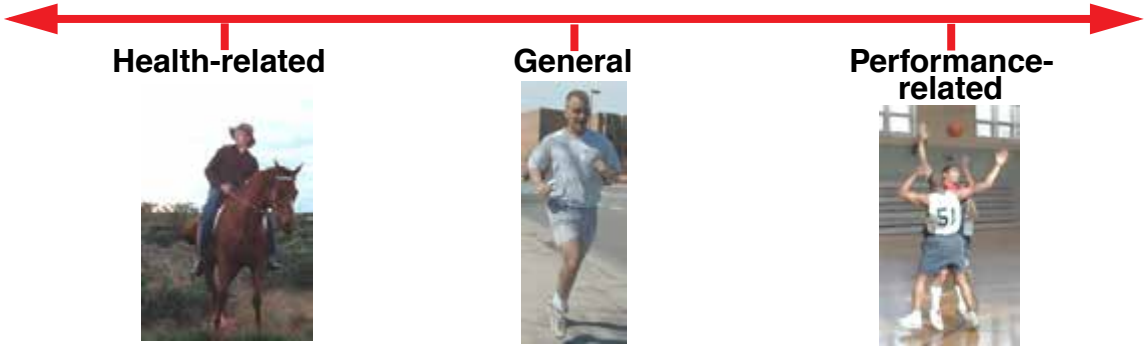
"Fitness, which has been defined as the matching of an individual to his physical and social environment, has two basic goals: health and performance [which lie on a continuum]. Physical fitness requirements in the military consist of a basic level of overall fitness required for health of all individuals and a higher level of fitness that is required for the performance of occupational activities...In addition to this, the military must address the need for ongoing, job-specific performance training."
IOM (1998) Physical Fitness Policies and Programs, in Assessing Readiness in Military Women, p. 64

What is Physical Fitness?

What does it mean to be physically fit? The American College of Sports Medicine (ACSM) has defined physical fitness as a set of characteristics (i.e., the work capacity of your heart and lungs, the strength and endurance of your muscles, and the flexibility of your joints) that relate to your ability to perform physical activities.

Regular physical activity leads to improved physical fitness and many other physiologic, cosmetic, and psychological benefits. Depending on personal goals and job requirements the level of physical fitness to attain can range from basic, health-related to more specific, performance-related fitness (Figure 4-1).

Figure 4-1. The Fitness Continuum



Lowers stress, increases metabolism, promotes health, prevents disease.

Increases muscle and heart and lung fitness, leads to a healthy body composition, improves flexibility. Most Navy personnel are in this category.

Enhances specific physical tasks or skills. For Navy personnel who perform physically demanding tasks. Also, for people competing in organized sports.

FITT Principle

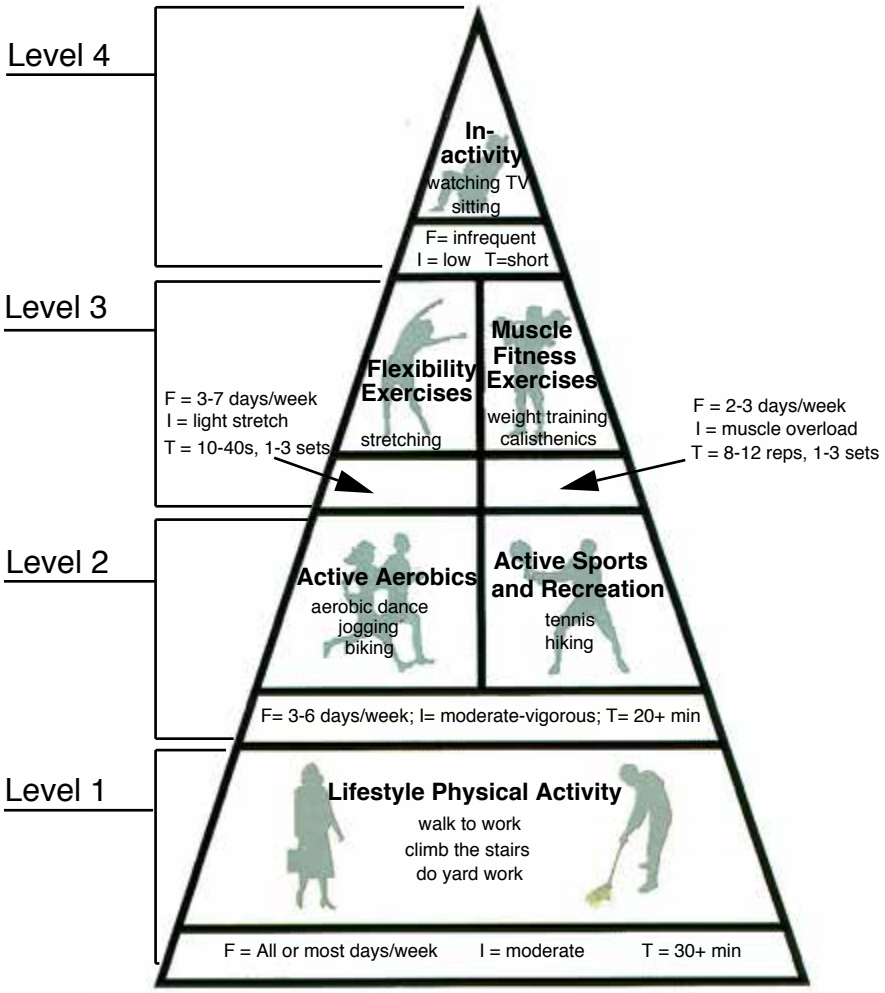
There are four basic components in all physical fitness programs. These are frequency of exercise, intensity of the exercise, time spent exercising, and the type of activity. Each factor is essential in planning your exercise routines and will influence the extent of your training results. Therefore, to optimize training time, recommendations have been set for the different types of training (i.e., cardiorespiratory (heart and lung) and muscle fitness). These are outlined in the Physical Activity Pyramid in Figure 4-2 and are called the **FITT Principle** guidelines.

FITT = Frequency, Intensity, Time & Type

The Physical Activity Pyramid

Just as the nutrition guidelines are outlined in the Food Guide Pyramid (Chapter 3), the guidelines for physical activity are diagrammed in the Physical Activity Pyramid (Figure 4-2). This pyramid was designed to help people live an active lifestyle, reap the fitness and performance benefits of routine exercise, reduce the health risks associated with inactivity, and reduce the injury risks associated with too much activity.

Figure 4-2. The Physical Activity Pyramid



F = frequency; I = intensity; T = time; exercise Type is in bold

Adapted from CB Corbin and RP Pangrazi. Physical Activity Pyramid Rebuffs Peak Experience. *ACSM's Health and Fitness Journal* 1998; 2(1): pages 12-17.

The four levels are arranged in the pyramid according to their FITT principle recommendations. Activities that should be performed most frequently are found at the base of the pyramid, and those that should be

performed less frequently are found at the top of the pyramid. Level 1 activities include household chores, walking to work, and walking up and down stairs. Level 2 activities include aerobic exercises and participation in sports and recreational activities, such as tennis, hiking, and biking. Level 3 consists of strength and flexibility exercises, while Level 4 includes sedentary activities, such as playing computer games and watching TV. It is recommended that you do some Level 1-3 activities each day to get the most health benefits.

Fuel Used During Exercise

Before discussing the various exercise guidelines in the following chapters, here is an overview of the energy systems used during exercise. Your body uses the macronutrients you eat (CHO, fats, and proteins) to make a chemical called **adenosine triphosphate (ATP)**. You need ATP to contract your muscles during exercise. ATP can be made two ways. One way makes ATP without using oxygen and is called the **anaerobic energy system.** The second way requires oxygen to make ATP and is called the **aerobic energy system**. Both of these systems (described below) are required during activity but, depending on the activity, there is a greater reliance on one system over the other.

Anaerobic Energy System

Activities that depend largely on this energy system last less than 5 minutes or have frequent rest periods. Examples include weight lifting, sprinting, and some interval training routines.

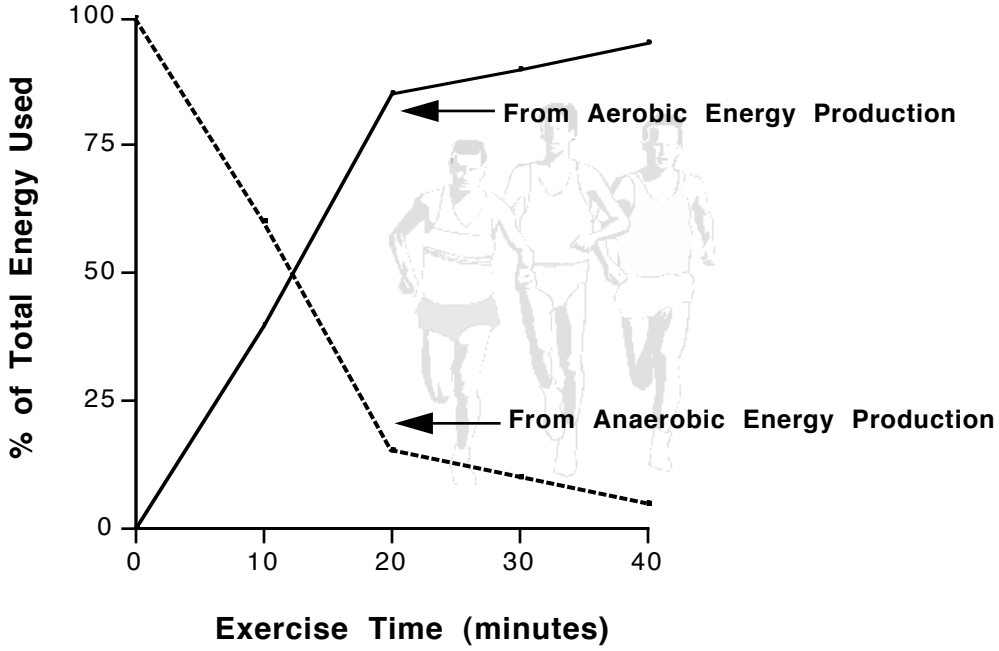
You may have heard about two of the chemicals involved in the production of ATP without oxygen: **creatine phosphate** and **lactic acid**. Creatine phosphate is present in the muscles and is used to make ATP rapidly. Creatine phosphate can make enough ATP to last for 30 seconds worth of exercise. To try and increase the amount of ATP that can be made from creatine phosphate, some people take creatine supplements. However, the research is not conclusive as to the benefits of taking creatine and the long-term risks are not known (see Chapter 14). Furthermore, your body makes creatine and it is obtained in the diet from meats. The second chemical is lactic acid. When maximal or near maximal exercise continues beyond 30 seconds, the muscle must use glucose (a simple CHO) to produce ATP. During this anaerobic energy process, the by-product lactic acid is formed. Small amounts of lactic acid can be converted back into glucose and then broken down again to form more ATP. However, as exercise continues, lactic acid begins to accumulate in the muscles and the blood, and you begin to fatigue. If maximal exercise is sustained, fatigue is inevitable within 3-5 minutes.

Aerobic Energy System

When moderate exercise continues beyond a couple of minutes, the aerobic energy system is activated to make ATP. Glucose and fats are used to make ATP in the presence of oxygen. The aerobic energy system, which produces much more ATP than the anaerobic energy system, is the primary system used during exercise lasting longer than five minutes; such as a 5K run, a 30 minute walk, or a 500 meter swim.

During most types of exercise, both the aerobic and anaerobic energy systems are involved. The amount of energy from each system depends on the duration and intensity of the exercise. Figure 4-3 illustrates the percentage of ATP each energy system contributes during exercise of various durations. As shown, when exercise duration increases there is a shift from greater use of anaerobic energy to aerobic energy.

Figure 4-3. Energy Use During Exercise

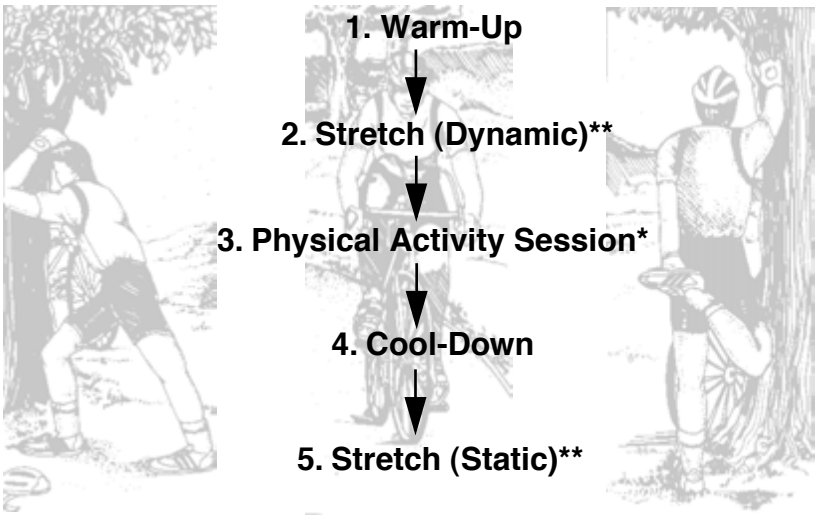


Powers S. (1993) Fundamentals of Exercise Metabolism. In Durstine JL et al (Eds). *ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription, 2nd ed.* (p.61) Baltimore: Lea & Febiger

Exercise Sequence

Regardless of your goals and training routines, there is an exercise sequence that should be followed to improve exercise performance and reduce the risk of injury. This sequence includes warming-up, stretching, and cooling-down, as outlined in Figure 4-4. The rationale for following this sequence is discussed next.

Figure 4-4. Recommended Exercise Sequence



*Refer to the exercises found in Levels 2 and 3 of the Physical Activity Pyramid.
**For more information on stretching see Chapter 9.

Warm-up

A warm-up prepares the body for physical activity by gradually increasing muscle temperature and metabolism, and increasing blood flow and oxygen delivery to the muscles. Warm-ups also protect connective tissue (the tendons that connect muscle to bone) and improve performance by lengthening short, tight (cold) muscles. Many individuals stretch in a misguided attempt to warm-up. However, because cold muscles are tight, there is a chance of injury when stretching without first warming-up. Start your warm-ups slowly (e.g., walk before running) and gradually increase the intensity. Warm-up for at least 5 minutes.

Always warm-up before stretching or exercising.

Cool-down

To avoid pooling of blood in the muscles and to remove metabolic end-products (i.e., lactic acid and carbon dioxide), exercise should end gradually. The cool-down, or recovery period, is very important because it will determine how you feel several hours after your workout. A cool-down should use the same muscles just exercised, and should be done at a light pace for at least 5 minutes after your main workout. This may help prevent muscle cramps, stiffness, and preserve performance during subsequent exercise.

Rest

Though some form of physical activity every day is strongly encouraged, rest is an exceedingly important factor in recovery from strenuous workouts.

Back-to-back high intensity workouts are not encouraged. Hard workout days should be followed by easy workout days or rest. This gives your body time to recover from the workouts. Days when you feel great should be your harder workout days. On days when it is an effort to put on your workout clothes, simply rest or perform a very light workout. The key is to make your workouts fun and challenging, and listen to your body.

Training and Detraining

Training and detraining are responsible for gains and losses, respectively, in fitness levels. Training according to the FITT Principle guidelines will lead to optimal fitness benefits. On the other hand, decreases in fitness due to detraining occur at twice the rate of training gains when physical activity stops completely. Table 4-1 lists some changes in fitness measures due to training and detraining.

Table 4-1. Training vs. Detraining

Training	Fitness Component	Detraining
↑	Heart and lung function	↓
↓	Resting heart rates	↑
↑	Muscle strength and endurance	↓
↑	Resting metabolism	↓
↑	Muscle fuel (glycogen) stores	↓
↑	Ability to sweat and dissipate body heat	↓

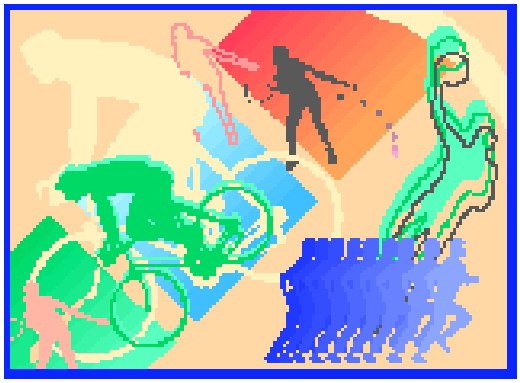
Detraining only takes 1 - 2 weeks! However, this can be minimized by maintaining your usual exercise intensity, even if the frequency and duration of workouts is decreased. This concept is important for Navy sailors to understand, as you may have limited time and fitness equipment available while deployed for extended periods. Ironically, it is in these situations that you depend most on your physical fitness to perform your duties. Therefore, learn the basic training principles and how to work around equipment, space, and time limitations (see Chapter 10).

5 Cardiorespiratory Training

In this chapter you will learn about:

- The physiology of the heart and lungs.
- Benefits of cardio-respiratory training.
- The FITT Principle guidelines for cardio-respiratory training.
- Aerobic training program design and progression.

Cardiorespiratory activities make up the bulk of the physical activities in Levels 1 and 2 of the Physical Activity Pyramid (Chapter 4, Figure 4-2). These activities improve health and fitness by increasing the work capacity of the heart and lungs. Other terms used to describe these activities include cardiovascular, cardiopulmonary, and aerobic exercise.



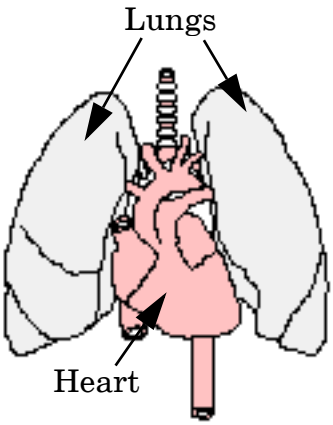
Cardiorespiratory Physiology

The heart is a muscle that is required to contract continuously throughout your life to deliver oxygen to all organs in the body. Your lungs breathe in oxygen and breathe out carbon dioxide. Blood vessels connect the heart and lungs so that carbon dioxide can be removed from the blood and oxygen can be added to the blood. The heart then pumps this blood throughout the body. During exercise your heart must pump more often and more strongly to supply oxygen to your exercising muscles to make energy. In turn, you

breathe in more often and more deeply to increase the amount of oxygen you inhale and carbon dioxide that you exhale.

Therefore, the basis of cardiorespiratory training is to place greater demands on the heart (e.g., make the heart beat more times per minute) than what is required during rest. By regularly overloading the heart in this fashion, it will become stronger. This results in pumping more blood and delivering more oxygen to the body per heart beat, and a lower resting heart rate.

How does lower resting heart rate affect aerobic capacity? Maximum heart rate is determined largely by genetics and age: view it as a fixed number of beats per minute. So, by lowering your resting heart rate, you increase the reserve capacity of your heart, or the number of beats between your resting and maximum heart rates. Therefore, if you decrease your resting heart rate by increasing your physical fitness, you will be able to perform more work above rest.



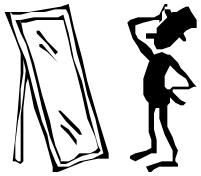
Since most daily activities are aerobic in nature, improving the delivery of oxygen to the muscles will improve your work performance. On the other hand, a sedentary lifestyle decreases the heart's ability to circulate blood and oxygen. So, view your heart as an aerobic muscle that must be conditioned for optimum functional health and fitness throughout your life. Even though some people are born with higher aerobic capacities than others, everyone will benefit from aerobic conditioning.

Benefits of Aerobic Exercise

The benefits of cardiovascular conditioning include:

- A stronger heart and lower resting heart rate.
- Fitness and performance benefits, such as increased aerobic capacity, increased muscle endurance, and a greater ability to perform high-intensity activities.
- Health benefits, such as maintenance of a healthy body weight and body fat percentage, management of stress, and decreases in blood cholesterol and fat (triglycerides) levels.

- Increased performance in physically-demanding jobs such as, load carriage and lift-and-carries.
- Cosmetic changes such as increased muscle tone, better posture and overall appearance.



Aerobic Exercise Guidelines

The FITT Principle guidelines discussed in Chapter 4 and outlined in the Physical Activity Pyramid for cardiorespiratory training are:

- Frequency - 3-5 days per week.
- Intensity - 60% to 90% of maximum heart rate. (Worksheet 5-1.)
- Time - 30-60 minutes within your target heart rate zone.
- Type - continuous, low resistance, high repetition activities.

The guidelines for aerobic exercise "intensity" and "type" can be ambiguous and will be outlined in greater detail in the next two sections.

Intensity of Exercise

The "I" in "FITT" refers to the intensity of the exercise. Intensity is the level of exertion at which an exercise is performed. There are several ways to measure exercise intensity, some of which are discussed below.

Oxygen Consumption

Oxygen Consumption is a measure of exercise intensity that describes how much oxygen is required to perform an activity. Maximal oxygen consumption, or maximal aerobic capacity, varies from person to person and is a measure of the maximum amount of oxygen a person can use to make energy per minute during exercise. The higher your maximum oxygen consumption, the greater your aerobic capacity.

Target Heart Rate Zone

Measuring increases in heart rate is a quick and easy method to gauge the intensity of your workout. It is important to note, however, that the **increase in heart rate is not the training stimulus; it is only indicative of the oxygen consumption required during the exercise**. If an increase in heart rate was all that was needed to increase aerobic capacity, then watching a thrilling movie while sitting on your favorite couch would provide an aerobic training benefit!

To measure your heart rate during exercise, count your pulse at the carotid artery (neck) or the radial artery (wrist) for 10 seconds (Figure 5-1). Multiply this value by six to get your heart rate in beats per minute (bpm).

Figure 5-1. Measuring Heart Rate at the Wrist

- Use your fingertips, not your thumb, to find your pulse at the radial artery (at your wrist, below your thumb).
- Count the beats for 10 seconds.
- Multiply this number by 6 to get your heart rate in beats per minute (bpm).

Once you measure your exercising heart rate how do you know whether you are exercising at the appropriate intensity?

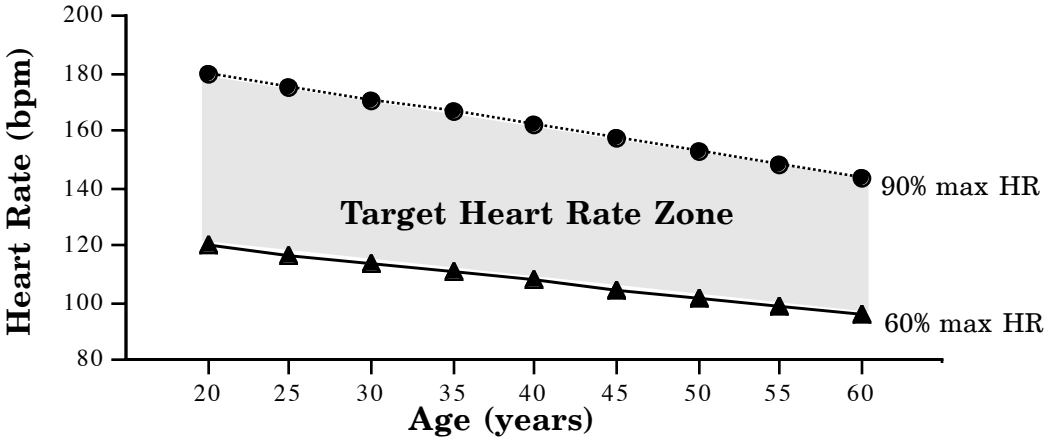
- First calculate your age-predicted maximum heart rate (max HR):

  Max HR (bpm) = 220 - your age (in years)

- Second, multiply your max HR by 0.60 and 0.90 to determine 60% and 90% of your max HR, respectively. This range is your target heart rate zone.
- Your exercising heart rate should be in this zone. If it is not, increase or decrease your exercise intensity accordingly.

You may have seen the following figure displayed in gyms and fitness centers. Use this figure or Worksheet 5-1 to find your target heart rate zone.

Figure 5-2. Target Heart Rate Zones



Note: Max HR is lower during swimming and arm exercises. For these activities, subtract 13 from Max HR before calculating your target training zone.

Worksheet 5-1. Determine Your Target Heart Rate

Age-Predicted Max HR = 220 - _____ your age = _____bpm.

60% max HR = _____max HR x 0.60 = _____bpm.

90% max HR = _____max HR x 0.90 = _____bpm.

Target HR Zone = _____ to _____ bpm.

See "Training Design and Progression" on page 43 to determine what heart rates, within this range, you should aim for during exercise based on your level of physical fitness and your fitness goals.

Calories

The term "Calorie" is very familiar to most people and is often used to gauge exercise intensity. Calories per hour is the amount of energy an exerciser expends when maintaining the same exercise intensity for an hour. This value is calculated by most exercise machines.

Perceived Exertion

Ratings of Perceived Exertion, or RPE, are the subjective measures of exercise intensity perceived by the exerciser. Measurements are based on a twenty-point scale, "6" is no exertion and "20" is maximal exertion. These numbers were chosen because when multiplied by "10," they are roughly equal to the resting and max HR values of 60 and 200 beats/min., respectively. Once accustomed to a particular exercise, you will be able to estimate your exercising heart rate based on your RPE. Most people should workout at a perceived exertion between 12 and 15 (moderate to hard). See Table 5-1.

Relationship Between Measures of Exercise Intensity

Table 5-1 presents the relationship between %max HR, maximal aerobic capacity, and RPE. Performance of exercises classified as "moderate" (level 1 in the Physical Activity Pyramid) is recommended on a daily basis. If your goal is to maintain or improve general fitness (see Figure 4-1 on page 29), exercise at an intensity of "moderate" to "hard." At this intensity you should be able to talk when exercising and take deep, comfortable breaths. If your goal is to maintain or increase performance-related fitness, occasionally exercise at an intensity of "hard" to "very hard." Exercise intensities of "very,

very hard" to "maximal" should only be performed by individuals in extremely good aerobic condition who have been cleared by a physician to perform near maximal exercise. Exercise in this range cannot be sustained for long periods of time and is primarily performed to develop the anaerobic energy system and improve performance in activities such as sprints.

Table 5-1. Relationship Between Measures of Intensity

% Max HR	% Max Aerobic Capacity	RPE		
55	40	9	very light	
65	50	12	moderate	Typical Training zone
70	55	13	somewhat hard	
80	70	15	hard	
90	85	17	very hard	
95	90	19	very, very hard	
100	100	20	maximal	

Chart adapted from the American College of Sports Medicine 1998 Position Stand: The Recommended Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory and Muscular Fitness, and Flexibility in Healthy Adults, and from ET Howley and BD Franks (1992) *Health and Fitness Instructor's Handbook*.

Other Measures of Exercise Intensity

Two other measures of exercise intensity that are used are **METs** and **Watts**. A MET, or metabolic equivalent, is a measure of the amount of energy needed to perform an activity and is expressed as a multiple of the energy required at rest (rest = 1 MET). For example, if you exercise at 5 METs you are using 5 times the energy you do at rest. A Watt is the amount of work (kcal) performed in a given period of time. Therefore, the greater the watts (kcal/min), the higher the intensity of the exercise.

Type of Exercise

The last "T" in "FITT" refers to the type of exercise performed. To increase aerobic fitness, exercise should be a low-resistance, high-repetition activity (e.g., biking) that trains the heart and the muscles to use oxygen more efficiently. To choose the best exercises for you, consider the following:

- Training is exercise specific; what you practice, you perfect. Therefore, to improve your run time, you must run.

- As a general rule, exercises that involve several muscle groups and are weight bearing will require the greatest amount of Calories and oxygen to perform.
- Exercises that you enjoy the most are the best exercises for you.
- Alleviate boredom and decrease your risk for injuries by alternating the types of exercise you perform, i.e., **cross-train**.

Table 5-2. Examples of Aerobic Exercise

Activity	Advantages	Comments
Aerobic Classes	Group setting, variety of levels	Work at your own pace, ask instructor prior to class for any tips.
Bicycling	Low impact, good for cross-training	Bike at 70 rpms, with a slight bend in knee to best work the quadriceps muscles.
Climbing (Stairclimbing)	Weight bearing	Uses major muscles of lower body; weight-bearing (by not leaning arms on machine); Rock climbing strengthens upper body, too.
Cross-country Skiing	Low impact, good for cross-training	Uses most major muscle groups.
Jumping Rope	Can be performed in small quarters	Variety of styles, fast pace mimics running, wear good shoes and avoid cement surface.
Martial Arts	Group setting	Popular; many focus on flexibility, strength, and relaxation.
Rowing	Low impact	Works most major muscle groups.
Running	Minimal gear required	High impact, alternate with other exercises.
Swimming, water aerobics	No impact, can be a group setting	Uses most major muscle groups; great as primary, cross-training, or rehab. exercise.
Walking	Low impact, minimal gear	Uses most major lower body muscle groups; weight-bearing.

Variations of these basic types of exercise include kickboxing, treading, and spinning. Now that you are familiar with the different exercise choices, look over Table 5-3 for descriptions of routines that you can use in your workout. If you are exercising for health and general fitness benefits rather than specific performance-related fitness, alternate the exercises and routines that you perform. For example, try biking for 10 minutes, stairclimbing for 10 minutes, and jogging for 10 minutes. As long as you keep your intensity within your target heart rate zone, add as much variety as you wish. This may help alleviate boredom too!

The benefits of performing routines listed in Table 5-3 that increase your anaerobic capacity include enhanced performance in fast, short duration activities (like sprinting). These types of workouts increase the muscles'

ability to store and generate more energy via the anaerobic energy system. This is beneficial in sports such as basketball, baseball, tennis, and soccer that require several short bursts of speed throughout an entire game.

Table 5-3. Various Training Strategies

Workout	Description
Long and Slow	20 to 60 minutes at an easy pace. Use to improve and maintain health benefits and general fitness (see Figure 4-1).
Steady State	20 to 40 minutes at a pace which barely allows you to talk to someone; uses anaerobic and aerobic systems. Use to increase general fitness.
Intervals	Ratios of recovery to work; i.e., 3 minutes normal (recovery) pace, 1 minute sprint (work) pace (3:1); 30 second recovery to 15 second work (2:1), etc.; increases anaerobic and aerobic systems depending on ratios. Use to increase general fitness and performance fitness.
Fartleks (Speed Play)	Mix normal exercise pace with hard exercise pace in an unstructured pattern; increases anaerobic and aerobic systems. Use to increase general fitness and performance fitness.
Time Trial	Exercise for predetermined distance at a race pace. Use to establish baseline of performance fitness.
Pyramids	Exercise is divided in stages as follows:1 minute (min) hard: 1 min rest, 3 min hard: 2 min rest, 5 min hard: 3 min rest, 7 min hard: 5 min rest, then work back down (5:3, 3:2, 1:1); increases anaerobic and aerobic systems. Use to improve general fitness and performance fitness.
Sprint	Maximum exercise effort lasting 5-10 seconds, followed by complete recovery; increases anaerobic system. Use to improve performance fitness.
Acceleration Sprint	Jog 100 yards (yds.), then sprint 100 yds., then walk 100 yds.; repeat this pattern for a given distance or time; increases anaerobic system. Use to improve performance fitness.

Cross-Training

It is good idea to vary your workout routines to avoid overuse injuries which can be caused by the repetitive motions of your favorite exercise. The major benefit of **cross-training**, or altering the types of exercise you perform, lies in the prevention of injuries while maintaining cardiorespiratory fitness. Engaging in a variety of activities will provide a good aerobic base while using alternate muscle groups.

Training Design and Progression

Now you are ready to design your aerobic workout! When designing a cardiovascular routine there are a few questions you must answer. These are:

Questions	1. What are your goals?	Are you interested in health, general fitness, or performance benefits? Get more specific as you become more involved with your workout.
	2. What do you enjoy?	Do you prefer team or solitary activities? List at least three activities that you enjoy doing.
	3. What are your time limits?	Be realistic about the time you can devote to these activities.
	4. What gear do you need?	Plan to get the gear you need to participate in these activities.

You want to tailor your program to realistically meet your goals and time demands, so answer the questions honestly. (See Chapter 17 for more information on setting goals.) If you have been sedentary, begin by increasing your physical activity by performing more daily activities, found in Level 1 of the Physical Activity Pyramid (Figure 4-2). Once you can easily perform these activities, add 5-10 minutes of Level 2 activities two to four days per week. Gradually increase the duration of the Level 2 activities by 10% per week until you can perform 20 to 60 minutes continuously. Your training intensity during these exercise sessions should be between 65% and 70% of your max HR (see Worksheet 5-1).

If you can already perform 30+ minutes of Level 2 activities and wish to maintain or increase your aerobic capacity, exercise between 65% and 80% max HR for 30 to 60 minutes three to four days per week. If you are interested in performance fitness benefits and are in excellent aerobic condition, consider adding 15-30 minutes of high-intensity (80% to 90% max HR) activities per week in addition to your aerobic training. This will increase your anaerobic energy system and increase your ability to sprint and recover more rapidly during sports such as basketball and soccer. For sport specific performance, some of your training sessions should mimic movements you perform during the sport.

The golden rules of training progression are:

- Increase only one FITT component, i.e., frequency, intensity, time, or type, at a time.
- Increase your training by no more than 10% per week. Allow yourself time to adjust to this new routine before you increase your workout again. Increasing too fast will lead to injury and overtraining (see Chapter 13).

- Signs of overexertion include pain in your chest, breathlessness or gasping for breath, nausea, and dizziness. If you have any of these symptoms, stop exercising immediately!

Based on your answers to the questions above and your current fitness level, set up a weekly routine with moderate to hard workout days and rest days. You will add a strength training workout to this schedule in Chapter 7.

6 | Walk, Run, Swim!

In this chapter you will learn to:

- Design a walking program.
- Design a running program.
- Design a swimming program.

Walking, running, and swimming all provide excellent aerobic workouts. These three types of exercise will be discussed in this chapter for two reasons: 1) walking and running are the most common types of exercise that people engage in, and 2) all three modes of exercise can be used to test your level of physical fitness on the Navy PRT tests.

Walking and Running Gear

To maintain or improve your fitness and avoid injuries while walking and running you need to use the right exercise gear. Below are some tips and information to help you purchase training gear.

Shoes

A good pair of shoes will provide shock absorption, cushioning, motion control and durability. The proper shoes will help correct biomechanical problems, such as foot **pronation** (inward roll of your ankle) and arch height, which can lead to pain or injury of the lower leg and knees. Specialty stores, magazines, and web sites have a lot of information about the latest footwear and what footwear is best for you based on your foot type.

Tips for Buying Shoes

- Know your foot type; i.e., pronation and arch (normal or high arch, or flat-footed).

- You should have a thumb's width between your longest toe and the end of the shoe.
- Replace shoes every 300 to 500 miles. Wearing worn-out shoes can eventually lead to injuries.
- Try on shoes towards the end of the day while wearing athletic socks and any inserts you use while exercising. Feet are smallest first thing in the morning and swell slightly as the day progresses. The shoe should hold your heel firmly in place.
- Do not buy shoes based on their brand name. Try on several different shoes to determine which one might be best for you, for the type of exercise you perform. Consider going to a specialty shoe store where a knowledgeable salesperson can evaluate your gait and foot type and recommend a shoe.

Other Gear

- **Orthotics** are shoe inserts that provide additional foot support and control for people with biomechanical conditions that may cause pain while running. They can be purchased as over-the-counter inserts or custom-made. Commercial orthotics are sold according to shoe size and can work as well as custom inserts. If the pain continues or returns when you increase your mileage, see a sports medicine specialist or podiatrist.
- **Clothes** - In hot weather, wear light-weight, light-colored clothes. In cold weather, dress in layers. Experience will teach you what to wear. When weather conditions are extreme, substitute outdoor training with indoor activities.
- **Heart Rate Monitors** gauge exercise intensity by continuously monitoring heart rate. These consist of a wrist watch and a chest strap: the chest strap detects your heart beat and transmits it to the watch which displays heart rate in beats per minute. This allows you to check and maintain your heart rate within your target training zone (see Chapter 5) while you exercise.
- **Reflectors** and portable **beverage containers** are great for your safety and health when exercising outdoors. Other gear, such as walkmans, can provide entertainment, however, consider your training environment to determine whether they will hinder your safety by decreasing your awareness of your surroundings.

Walking

Walking is the easiest, most common, low impact exercise that people engage in. However, there are many misconceptions about the usefulness of walking for weight loss and cardiorespiratory conditioning. These health benefits can be realized by walking, as long as the intensity is high enough to increase your heart rate to 60-75% of your max HR (Worksheet 5-1).

When you walk, keep your back straight and your stride comfortable. **Do not use ankle or hand weights** because they increase the stresses placed on your joints, especially as you quicken your pace. If you have been sedentary and would like to begin a walking program, start by walking on a flat surface. Walk for 15 minutes at a pace that allows you to talk somewhat easily. Walk every other day. Each week increase the time you walk by 10% until you can walk for 20 minutes continuously. Once you can comfortably walk for 20 minutes, increase your pace by no more than 10% each week until you can walk 1 mile in 20 minutes (3 m.p.h. pace). Once you reach this point, hold your pace and gradually increase your distance (by no more than 10% each week) until you can walk 2 miles. Once you have reached this point, try the walking program outlined in Table 6-1.

Table 6-1. Outline of a Walking Program

Weeks	Frequency times/week	Miles	Goal Time (min)/ pace	Comments
1-2	3	2.0	40 min / 3.0 m.p.h*	Quicken your pace by 1 min each week
3-4	4	2.0	38 min / 3.2 m.p.h.	
5-6	5	2.0	36 min / 3.3 m.p.h.	
7	5	2.0	34 min/ 3.5 m.p.h.	Increase your distance by 1/2 mile each week
8	5	2.5	43 min/ 3.5 m.p.h.	
9	5	3.0	51 min/ 3.5 m.p.h.	
10-15	5	3.0	45 min/ 4.0 m.p.h.	
16-17	4	3.5	53 min/ 4.0 m.p.h.	
18-19	4-5	4.0	60 min/ 4.0 m.p.h.	

Adapted from OPNAVINST 6110.1D Jan. 1990. *m.p.h. = miles per hour.

You can maintain a walking program indefinitely and reap the health and fitness benefits. Once you can walk 60 minutes at a 4 m.p.h. pace, add hills or inclines to vary your exercise intensity, add variety to your routine, and to combat boredom. The key to maintaining your aerobic fitness level is to maintain your walking intensity between 60% and 75% of your max HR.

Running

A running program should only be started if you are able to walk 4 miles at a 4.0 m.p.h. pace. There are several reasons to begin a running program, such as managing your body weight, increasing your cardiovasclar fitness, and building your self-esteem.

Running Form

Once you have identified your goal, begin your program by paying particular attention to your running form. This will ensure your running style is biomechanically efficient and safe for your joints. The key is to run naturally and remain relaxed. Running is a function of footstrike, forward stride, body angle, and arm drive.

Figure 6-1. Three Traits of a Good Running Form

- **Footstrike** - For distance runners the heel-ball footstrike method works well: (1) the outside of the heel strikes the surface; (2) the foot rolls inwards to the ball of the foot while the knee is slightly bent; and (3) the foot lifts off from propulsion provided by the big toe. This method provides good shock absorption.
- **Forward Stride** - Your foot should contact the ground in line with your knee, which should be slightly bent. As you run faster the length and frequency of your strides will increase and you will begin lifting your knees higher. Do not overstride such that your foot hits the ground ahead of your knee (i.e. your leg should not be straight at point of impact). Overstriding is hard on the knees, back and the hips and can cause injuries. Alternatively, short choppy strides, which usually result from tight or inflexible muscles, require more energy and are inefficient.
- **Body Angle** - Keep your back straight, your head up and look forward as much as possible. Lean forward only when going uphill or sprinting as this puts stress on leg muscles and may cause back pain and shin splints. Leaning back puts tremendous

pressure on the back and legs and has a “braking effect”. The key is to run “tall” and remain relaxed: allow your shoulders to hang in a relaxed manner and let your arms drop from time to time.

- **Arm Drive** - Relax your shoulders, elbows, wrists and fists. Occasionally let your arms hang by your sides and loosely shake them out. Vigorous pumping of your arms is unnecessary during distance running.

Training Surfaces

The best running surfaces are unbanked, smooth cinder tracks or artificially surfaced tracks. Grassy trails can hide uneven terrain that may aggravate biomechanical problems or cause injury. Concrete and asphalt sidewalks and roads are often banked and provide no shock absorption, so you need shoes with good shock absorption. Beaches also tend to be slanted, whether the sand is firmly packed or loose. Avoid running barefoot on this surface, no matter how good the sand feels between your toes! Lastly, always change the direction you run on a track or path from one session to the next to reduce any biomechanical problems that may result from the track conditions and repetition.

Other running surfaces include treadmills and water. Most treadmills are state of the art in terms of cushioning and you can control the speed and intensity of your workout. Deep water or aqua running is mainly used for rehabilitation as it takes the pressure off muscles and joints while providing cardiovascular benefits. This type of exercise is becoming popular at various swim centers.

Beginning a Running Program

When transitioning from a walking to a running program, combine walking and jogging, gradually increasing the time spent jogging while decreasing the time spent walking. Remember that your exercise intensity should be between 60%-75% of your max HR, so adjust your pace accordingly. Table 6-2 outlines a beginning jogging program to help make your transition easier. Advance to the next phase once you can consistently perform the walk-jog cycles outlined within your target heart rate zone.

If you are interested in running for fitness, a good goal is 6 to 8 miles per week, spread over 3 running days of 2 to 3 miles each. Maintaining this weekly mileage is sufficient for improving or maintaining your aerobic fitness. The duration of your runs will depend solely on your pace. Distance is the goal, so take walking breaks as necessary until you have reached your target mileage. Start a running log to track your workouts (Worksheet B-1). Note mileage, time, heart rate, and perceived exertion (see Chapter 5).

Table 6-2. Beginning a Jogging Program

Phases	Walk	Jog	Total Time or Distance	Comments
Phase 1:	1 to 2 min.	Work up to jogging 2 min. continuously.	20-30 min	Check heart rate after every jog interval, heart rate should be 60-75% max HR.
Phase 2:	1 to 2 min.	Quarter mile (1 lap on a 440 meter track).	Jog six, quarter mile laps.	Check heart rate after every quarter mile jog; heart rate should be 60-75% max HR.
Phase 3:	1 min.	Half mile (2 laps on a 440 meter track).	Jog three, half mile laps.	Check heart rate after every half mile jog; heart rate should be 60-75% max HR.
Phase 4:	during warm-up and cool-down	1 mile continuously.	1-mile jog, 1-mile walk.	Periodically check heart rate during jog, adjust pace to keep heart rate in training zone.
Phase 5:	during warm-up and cool-down.	Increase jog by quarter-mile increments until running 2 to 3 miles continuously.	2 to 3 miles.	Periodically check heart rate during jog, adjust pace to keep heart rate in training zone.

Increasing Your Running Workout

If you can comfortably run 6-8 miles per week and you desire to progress further in a running program, start by increasing either your mileage or pace. This is beneficial if you are interested in running 5K or 10K races, if you want to build a solid running base for longer distance races, or if you enjoy progressively working toward new goals. Increasing either your distance or pace too quickly can cause training injuries, so gradually increase one at a time by no more than 10% per week. For example, if you can comfortably run five miles, increase your distance by a half mile and keep your pace constant. Maintain this new distance for at least one week, or until it is consistently easy for you. Consistency is more important than speed.

Increase your mileage or pace by only 10% per week.

Do not increase your mileage and pace simultaneously.

Frequency and Speed

Run three to four times per week with one or two rest days. When running for exercise and not competition, your pace should be even and allow you to talk comfortably. If you run too fast and get breathless, you may not be able to go the distance. Check your heart rate to see that it is within your target training zone (see Chapter 5). Tips to increase your running speed include:

- Increase the length of your stride without overstriding.
- Increase the frequency of your stride.
- Increase both the length and the frequency of your stride.

Distance

Increase your mileage only when you can consistently run your current distance. Twenty to 30 miles per week is a good training distance for an intermediate runner (Table 6-3). As a rule, your risk of injury sharply increases as your running mileage increases. So, if running for exercise rather than competition, keep your weekly mileage below 30 miles. Beyond this, your injury risks far outweigh any additional aerobic fitness benefits. To work on aerobic fitness without running more than 30 miles a week, try cross-training by swimming or biking.

Table 6-3. An Intermediate Running Program

Week	Mon	Tues	Wed	Thur	Fri	Sat	Sun	Total
One	2	-	2	-	2	2	-	8
Three	2	-	3	-	3	2	-	10
Five	3	-	3	-	3	3	-	12
Seven	3	-	4	-	4	3	-	14
Nine	3	-	4	3	-	3	4	17
Eleven	4	-	5	3	-	5	3	20
Thirteen	4	-	5	5	-	4	5	23
Fifteen	5	-	5	5	-	6	5	26
Seventeen	5	-	6	6	-	6	7	30

Cross train or rest on non-run days.

With an endurance base of 30 miles per week you can easily compete in 10Ks, the Army 10 Miler, and other similar events.

Training for Long Distance Runs

If you are interested in building an endurance base for running long distance races, such as a half marathon, the Marine Corps marathon,

the Air Force Marathon, or similar events, contact a local running group, a national running program, or a trainer with experience in coaching distance runners. Training for these distance races can be very challenging, both physically and mentally. For more information on running distance races, contact the American Running and Fitness Association at http://americanrunning.org.

Swimming

Swimming is an excellent exercise for overall fitness. Because the water supports your body weight, swimming is a great cross-training exercise for running and other gravity-intense activities. Swimming is also an alternative for people with orthopedic problems or those who are in rehabilitation.

Beginning a Swim Program

For swimming to be the primary mode of exercise, a swimmer must be skilled. Unskilled swimmers are very inefficient. To emphasize the energy expenditure during a swim, swimming 1/4 mile, or 440 meters, is equivalent to jogging 1 mile. Therefore, it is very likely that an inexperienced swimmer will not be able to swim continuously for 20 to 30 minutes. Knowing this, if you are unfamiliar with the basic swimming strokes, focus on your technique by taking lessons.

If you have never swum, start by walking or jogging the width of the pool in chest deep water using any flotation device you want. Once you can complete two to four, 5-10 minute exercise bouts within your target HR zone, progress to swimming exercises. Try walking or jogging the width of the pool and swimming back, again using a flotation device. Gradually decrease the distance you walk or jog and increase the distance you swim until you can swim four widths without stopping.

Once you have reached this point, begin swimming the lengths of the pool (1 length = 25 meters; roughly 25 yards). Start by alternating a 25 meter swim with a 30 second rest. Gradually increase the number of lengths you swim without a rest, until you can swim continuously for 20-30 minutes. Then you will have a good base for increasing your distance or pace. Table 6-4 outlines a 10-week swim program for intermediate swimmers.

Table 6-4. Swim Program to Build Your Distance

Week	Distance (meters)	Number of Lengths	Frequency (Days/Week)	Goal Time (minutes)
1	300	12	4	12
2	300	12	4	10
3	400	16	4	13
4	400	16	4	12
5	500	20	4	14
6	500	20	4	13
7	600	24	4	16
8	700	28	4	19
9	800	32	4	22
10	900	36	4	22.5

Table taken from *OPNAVINST 6110.1D*, Jan 1990, p 17.

Interval Training

Pool sessions with a pace clock allow you to design workouts that vary in intensity and emphasis, as well as provide good feedback. While runners often go for long steady runs, a swimmer training this way becomes slow and inefficient. This is due to the inability to increase your respiratory rate during most swim strokes. Since performance can be hindered by limited oxygen or excessive amounts of carbon dioxide, interval training is ideal for swimming. As mentioned in Chapter 5, intervals can train both the anaerobic and aerobic energy systems depending on the time ratio between recovery and work intervals. For swim intervals, swim at a set intensity during the work interval (usually 50-100 yards) then rest during the recovery interval. The basics of interval training include:

- To stimulate aerobic adaptations, recovery intervals should be less than 15 seconds. Short rest intervals keep the aerobic system functioning, particularly during the initial recovery.
- To stimulate anaerobic adaptations, recovery intervals should be longer than one minute, up to twice the duration of the work interval. These effects occur independent of distance or pace. The longer the recovery interval between work intervals the greater the reliance on the anaerobic system.

Open-Water Swimming

Open-water swimming can be a very challenging and rewarding workout. But before heading out to sea, you should be able to swim at least one mile continuously, and consistently, in a lap pool. When swimming in open water you are faced with many safety issues not addressed in pool training, so follow these safety rules:

- Ask lifeguards or locals about the safety of the area. (Are there any strong currents or riptides? What marine life is in the area? Avoid areas where sharks have been spotted.)
- Walk the beach along the course you will be swimming. Look at buoys, surfers, and other swimmers to gauge the direction and strength of the current. Pick landmarks (houses or lifeguard stations) to use as markers while you are swimming.
- Wear proper gear for open-water swimming, including: a comfortable, unrestricted suit (a wet suit in cold water); a swim cap; goggles with UVA/UVB protection; water gloves and fins. Use a waterproof sunscreen all over your body.
- Never swim alone, especially in unfamiliar waters. Ask someone familiar with the waters to accompany you. On your first outing, swim just past the breaking waves. As you feel more comfortable, gradually move further out.
- Follow the shoreline as your primary guide, staying 100 to 150 yards outside the breaking waves. Check your distance from the shoreline as you turn your head to breathe. Swim toward an unmoving target in the distance so you do not get off course. Check your position with this target every 50 to 100 yards and adjust your course appropriately.
- A good starting distance for open-water swimming is a half mile. Use your landmarks to judge your distance. Swim against the current for the first quarter mile, then turn around and swim with the current for the last quarter mile. As you become comfortable swimming in open-water, gradually build up your distance by quarter mile increments.
- Avoid boats and jet skis by wearing a brightly colored suit and cap. If a boat is moving toward you, swim away from it and kick hard, making large splashes that announce your presence.

Section adapted from L. Cox. Seaworthy. *Women's Sports and Fitness* July-August 1995;17(5):73-75.

7 Strength Training

In this chapter you will learn about:

- Muscle strength.
- Muscle endurance.
- Strength training guidelines.
- Designing a strength training program.
- Proper training techniques.

Muscle strength and endurance training are essential components of overall fitness. Your ability to perform daily tasks and strenuous physical tasks can be enhanced by strength training. As you read through this chapter think about the physical tasks you perform routinely in your job or at home, the strength needed to perform those tasks, and which exercises mimic those tasks. The focus of your strength training routine should be functional or applied strength for job-specific activities, military readiness, and injury prevention. This chapter outlines the principles of muscle strength and muscle endurance training and the proper use of exercise equipment to help you achieve your goals.

Strength versus Endurance

- Muscle strength is the force your muscle or group of muscles can exert against resistance. As you lift and lower a weight your muscle must generate enough force to move that weight.
- Muscle endurance is the ability of your muscles to repeatedly apply force to lift and lower a weight. Muscle endurance describes how long or how many times (number of repetitions) you can lift and lower a given weight.

Benefits of Strength Training

Strength training should complement aerobic training workouts because each type of training results in different benefits. General benefits of strength training include:

- Increased muscle strength and muscle endurance, greater lean body mass, less body fat, and higher energy metabolism.
- Increased connective tissue (ligaments that hold bones to bones; and tendons that hold muscles to bones) strength.
- Increased coordination and greater protection against injury.
- Increased self-esteem and less perceived stress.
- With respect to military readiness, greater muscle strength and endurance translates into better performance of physically-demanding, job-related tasks. Table 7-1 lists the strength requirements needed to perform some physical tasks in the Navy.

Table 7-1. Strength Requirements in Navy Jobs

Strength Classification (Percent of Navy Jobs)	Strength and Endurance Requirements	Examples of Some Occupational Codes
High/High (23.9)%	Occasionally lift over 100 lbs (45 kg); Typically lift over 50 lbs (23 kg)	Artillery and Gunnery (GM); Aircraft Engines (AE) & Accessories (ABE); Construction (CM); Electricians (CE).
High/Moderate (20.9%)	Occasionally lift 100 lbs (45 kg); Typically lift 50 lbs (23 kg)	Machinists (MR); Food Service (MS); Supply Administration(SK); Teletype and Cryptographic Equipment (WT).
Moderate/Moderate (9.0%)	Occasionally lift 80 lbs (36 kg); Typically lift 40 lbs (18 kg)	Air Crew (PR); Missile Guidance and Control (FC); Medical Care and Treatment (HM); Interior Communications (IC).
Moderate/Low (4.5%)	Occasionally lift 50 lbs (23 kg); Typically lift 25 lbs (11 kg)	Musicians (MU); Supply Administration (AK).
Low/Low (41.7%)	Occasionally lift 20 lbs (9 kg); Typically lift 10 lbs (5 kg)	Radio/Radar (ET); Sonar (OTA); Air Traffic Control (AC); Analysts (CTI); Information/Education (JO); Administration(YN).

Adapted from Institute of Medicine. (1996) *Assessing Readiness in Military Women: The Relationship of Body Composition, Nutrition, and Health.* Washington, D.C.; National Academy Press.

Which classification in Table 7-1 best matches the requirements of your job? Which classification best describes your leisure activities?

Muscle Fiber Types

Before discussing strength training exercises and guidelines, here is a quick review of muscle physiology. To generate force, muscles contract. This action requires ATP (see Chapter 4, page 31). Muscle fibers are classified according to which energy system they use to make ATP. The three types of skeletal muscle fibers are:

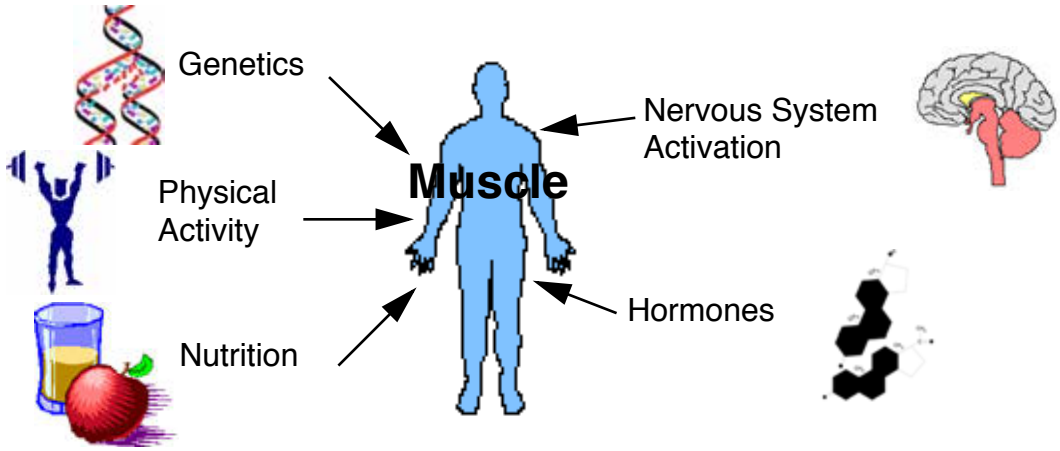
- **Slow Twitch Oxidative (Type I) fibers** are mostly involved in endurance activities. They rely on ATP from aerobic energy metabolism (see page 31) and are generally resistant to fatigue.
- **Fast Twitch Glycolytic (Type IIb) fibers** are involved in quick, strong muscle contractions and rely on the anaerobic energy systems to produce ATP. These fibers are susceptible to fatigue.
- **Fast Twitch Oxidative-Glycolytic (Type IIa) fibers** are a cross between the slow and fast twitch fibers since they rely on both aerobic and anaerobic systems (see page 31) for energy.

Everyone has all three muscle fiber types; however, genetics determine which fiber type is more abundant in each person. Physical training can lead to changes in the characteristics of the muscle fibers. For example, endurance training makes the Type IIa fiber act more like the slow-twitch, Type I fiber.

Determinants of Muscle Size

Apart from muscle fiber type, various factors influence muscle size (see Figure 7-1). Although some factors cannot be controlled, two factors that we can control are exercise and nutrition habits (Chapters 3, 4, and 11).

Figure 7-1. Factors that Affect Muscle Size



Adapted from WD McArdle, FI Katch, and VL Katch. *Exercise Physiology, 4th ed.* Baltimore; Williams & Wilkins, 1996.

Men generally have more muscle mass than women, mainly because men produce more testosterone than women. Strength training may increase muscle mass slightly in women; however, a common **misconception** is that strength training will cause women to "bulk up." Importantly, strength training will greatly increase muscle strength and endurance and reduce the risks for injury. Moreover, women tend to have poor upper body strength and many military tasks require upper body strength.

Strength Training Guidelines

Training Form

Correct lifting techniques are critical for achieving maximum benefits and preventing injury (see Appendix C). If your form is incorrect, strength training can lead to injury, not strength gains.

- When learning a new exercise, start with minimal weight.
- Use a closed grip (fingers and thumbs wrap around the bar or handle and touch each other), and place hands equidistant from the ends of the bar. Load the weights evenly across the bar.
- For free weights, feet should be hip to shoulder width apart, knees slightly bent, and your back should keep its natural curve. Keep your head level and eyes focused straight ahead. If maintaining this posture is difficult than the weight is too heavy.

- If using resistance machines, adjust the pads to fit your body size. This is very important since the pads support you during the lift. Keep your head level and eyes focused straight ahead.
- **Lifts should be slow, smooth, and controlled.** Lift the weight for at least 2 seconds and lower the weight for at least 4 seconds to ensure that your muscle, not momentum, moves the weight.
- **Exhale** during the exertion (moving the weight against gravity), and **inhale** when returning to the start position. Holding your breath (Valsalva maneuver) causes extremely high increases in blood pressure and can damage the cardiovascular system. **Never hold your breath while exercising!**
- Always use a spotter when lifting free weights.

The most common training errors occur when people focus on lifting the weight rather than focusing on stabilizing themselves and controlling the weight. The best way to avoid training mistakes is to ask a staff member at the gym to teach you new exercises and to suggest the best exercises for you based on your fitness level and goals. See Appendix C for examples of common errors in training techniques.

FITT Principle Guidelines

Once you are comfortable with the basic training techniques for performing strength exercises, follow the FITT Principle, illustrated in the Physical Activity Pyramid (Chapter 4, Figure 4-2), to set up your routine. The FITT guidelines for strength training are:

- Frequency - 2 to 3 times per week for each major muscle group on non-consecutive days.
- Intensity - the total weight lifted or the resistance.
- Time - the duration of the exercise.
- Type - equipment used and the exercises performed.

Two terms you need to know are **repetition (rep)** and **set**. A repetition is a single lifting and lowering of the weight. For example, one rep of a leg curl is equivalent to lifting your ankle toward your buttocks, pausing one second, then returning your ankle to the start position. A set is the number of reps performed without stopping to rest. For example, if you perform 10 leg curls, rest for 60 seconds, followed by another 10 leg curls, you would have performed 2 sets, each of 10 leg curls. When recording the number of sets and reps performed, write **"sets x reps"** (e.g., 2x10 for the leg curl example above).

Intensity of Exercise

Focus on the intensity of your training only **after** you have perfected your lifting form. The basis of strength training is to gradually increase the amount of weight that you lift during training to ultimately increase the amount of force your muscles are capable of generating. This is called progressively overloading the muscle to achieve gains in strength without causing injury. The following intensity guidelines for general strength gains are for beginners, for people who are restarting their routines after a break, or for people learning new exercises.

- Once your form is perfected (page 58), gradually increase the weight you are lifting until you reach a weight that you can lift only 12 times with good form. If you can perform 13 or more reps with relative ease, increase the weight. Conversely, if you cannot perform 12 reps while maintaining proper form, decrease the weight. Finding this 12-rep weight will be trial and error at first. Be patient and gradually increase the weight to avoid straining or injuring yourself.
- Your 12-rep weight will increase as you gain strength, so increase the weight you are lifting appropriately (by no more than 10% per week).
- Start a training routine consisting of one to two sets of 12 reps for each major muscle group (defined in "Type of Exercise" on page 61). Perform this routine for at least eight weeks.

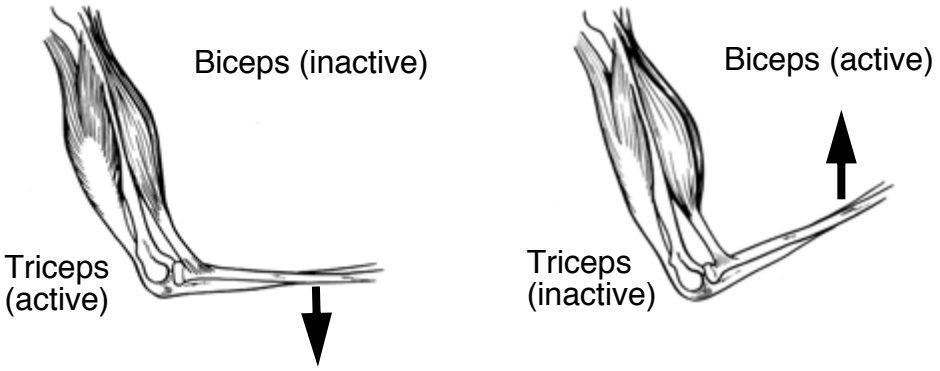
A long-term strength routine of one to two sets of 12 reps is excellent for maintaining and increasing general strength, even beyond the first eight weeks of training. In addition, this type of routine only takes roughly 30 minutes to perform. Once you have developed a solid strength and endurance base you may be interested in pursuing more specific training goals. In general, the following guidelines apply to the various types of strength training goals:

- Muscle endurance - two to three sets, 12-15 reps (with a weight that cannot be lifted more than 15 times); 30-60 seconds rest between sets.
- Muscle hypertrophy (increase in muscle mass) - three to six sets, eight to 12 reps (with a weight that cannot be lifted more than 12 times); 30-90 seconds rest between sets.
- Muscle strength - three to five sets, two to eight reps (with a weight that cannot be lifted more than eight times); at least 120 seconds rest between sets.

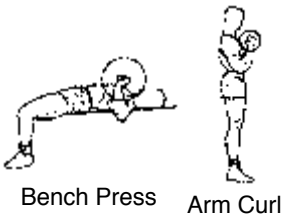
Note: Do not perform maximal lifts when strength training.

Type of Exercise

Muscle balance refers to the strength ratio of opposing muscle groups across a common joint; i.e., the biceps and triceps muscles in the upper arm. By performing exercises that target the opposing muscle groups across the joints, you improve the function of the joints and reduce your risks for injury. With this in mind, select at least one exercise for each of the major muscle groups. The **major muscle groups** are the chest, back, shoulders, arms, legs, lower back, and abdominals. (See Worksheet B-2.)

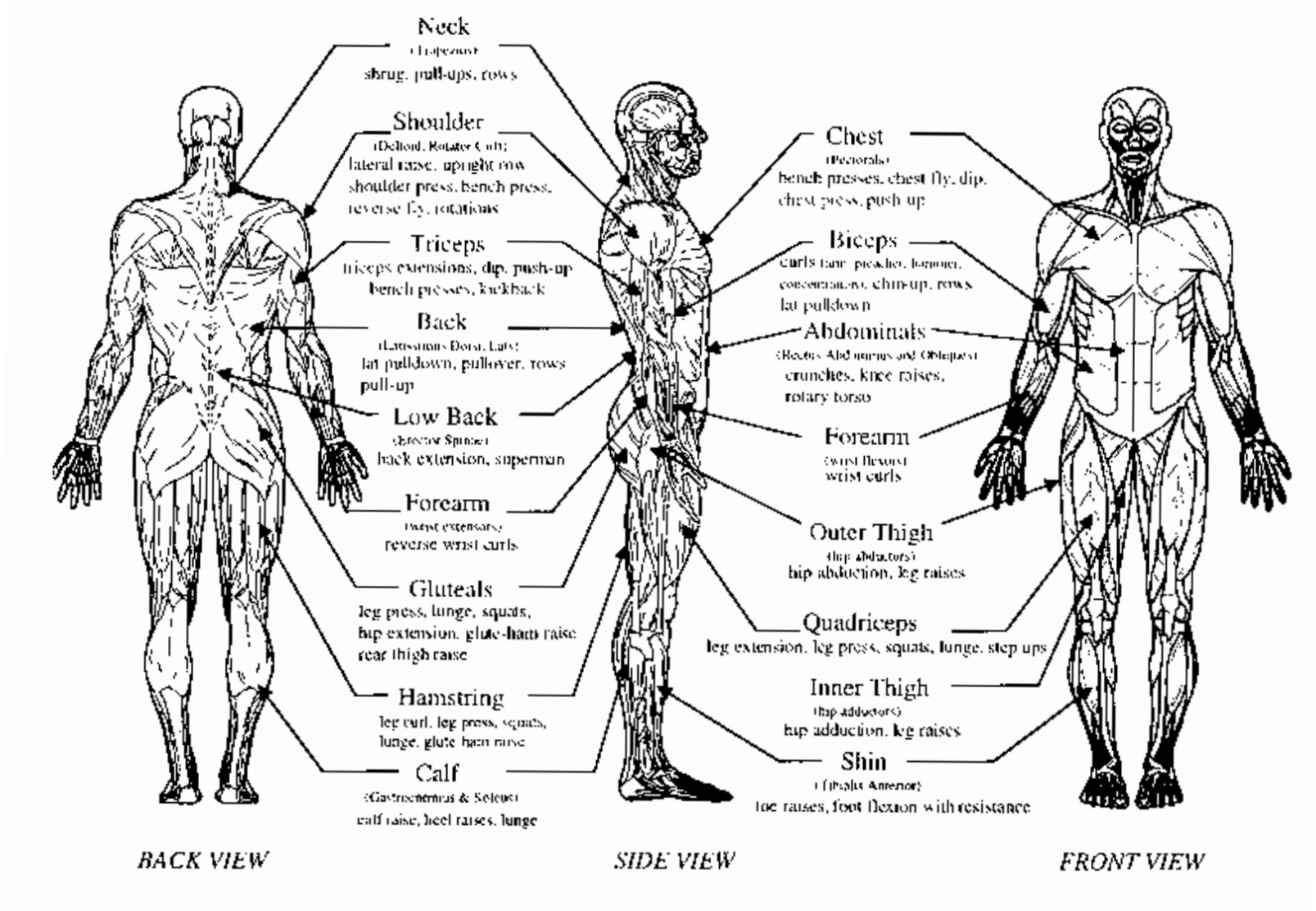


From Harmon, E. The biomechanics of resistance exercise. In *Essentials of Strength Training and Conditioning*. Baechle, TR. (Ed.). Human Kinetics. Champaign, Il. 1994. p.20.



With respect to **exercise order**, perform multi-joint exercises (e.g., squats) before single-joint exercises (e.g., leg curl). To determine which exercises are multi- versus single joint exercises, watch and feel how many joints move while you perform the exercise. An example of a multi-joint exercise is the bench press because your upper and lower arms move at the shoulder and elbow joints, respectively. An example of a single-joint exercise is a biceps curl because only your lower arm moves at the elbow. Single-joint exercises target and fatigue the smaller muscle groups that are needed to perform multi-joint exercises. Therefore, fatiguing the smaller muscle groups by first performing single-joint exercises will alter your lifting form and decrease the amount of weight you can lift in the multi-joint exercises. Lastly, lower back and abdominal exercises should be performed at the end of your workout because these muscles are used during other exercises for balance and posture. Figure 7-2 is a diagram of the muscle groups and the exercises that target them. Pick at least one exercise per major muscle group.

Figure 7-2. Exercises for Various Muscle Groups



Use Worksheet B-2 as a template to design your workout and to record your training progress. Change the exercises you perform for each muscle group every four to eight weeks, even if you keep the same set and rep routine. Changing exercises will overload the muscles differently, increase your strength gains, and alleviate boredom. To increase their upper body strength, women should perform exercises that target the back, neck, chest, shoulders and arms (Figure 7-2).

Equipment

Strength training requires minimal personal gear: weights, a pair of supportive shoes, fitted lifting gloves, and standard PT attire. A weight lifting belt is only recommended during maximal or near maximal lifts, and is not recommended at all for exercises that do not stress the back. This is because the belt takes over the role of the abdominal muscles in stabilizing the torso, preventing the strengthening of the abdominal muscles which can increase the risk for injury when lifting a heavy object without the belt.

The most common barbells found in gyms are Olympic style barbells. These barbells have a narrow center bar for gripping and wider ends for loading weights. They are 5 to 7 ft. long and weigh 30 to 45 pounds (lbs) or 13 to 20 kilograms (kg). The plates used to load the bars are available in both lbs and kg, and range between 2.5 to 45 lbs or 1.25 to 20 kg. Make sure you pay attention to the weight measurements in your gym; there is a big difference between 10 lbs and 10 kg! Lastly, you are encouraged to use adjustable collars to keep the plates on the bar. Depending on the style of collar, the pair can add 1 to 5 lbs to your bar. There are several other styles of barbells which range in size and weight. Ask a staff member at your gym to help you determine which barbell would best suit your needs.

Choosing free weights, machines, or a combination of both depends largely on your goals and training experience. Table 7-2 lists a comparison of free weights and machines to help you with your choice. If you are new to a fitness center or if you are unsure how to work a piece of equipment, ask a fitness center staffer for an orientation. This orientation will help you design a workout routine based on the equipment selection at your fitness center.

Table 7-2. Free Weights vs. Resistance Machines

Free Weights	Resistance Machines
Low cost and versatile.	Expensive, less versatile, need access to equipment.
Form is crucial; spotter is needed.	Supports the body during the exercise; easy to adjust.
Trains balance and posture; mimics daily activities.	Isolates muscle groups more easily than free weights.
Can perform multi-joint and single-joint exercises.	Machines made for multi-joint and single-joint exercises.
Muscles trained through joint's full range of motion.	Muscle training occurs in a limited range of motion.

Though this chapter focuses on resistance machines and free weights, resistance for strength training can come from a variety of sources, including your own body weight. To learn about other exercise techniques and equipment available for strength training see Chapters 8 and 10. These other options may be most beneficial when space and equipment are limited.

Types of Workouts

Following is a description of several strength training routines. Choose the routine that is best for you based on the time available, your goals, your training experience, and your fitness level.

- **Full body workouts -** All the major muscle groups (as listed in Worksheet B-2) are exercised during a single session. Perform one to two sets of an exercise for each muscle group and rest between sets. This should take 20-45 minutes. For general strength training purposes; should be done at least twice a week.
- **Circuit Training -** Combines aerobic and strength exercise stations. Each exercise station takes 30-45 seconds to perform and stations alternate between upper and lower body exercises. The circuit is repeated two or more times per session. It improves aerobic conditioning and moderately increases strength when performed three times per week. This routine is good for people who have less than 45 minutes to do both aerobic and strength exercises. (See Table 10-2 for an example.)

The following routines are more advanced workouts. They should only be performed once you have developed a solid strength base using one of the above formats, and you have exercised regularly for at least eight weeks, and are comfortable with the correct lifting techniques.

- **Split-routine workouts** - Different muscle groups are targeted on alternate training days. Examples include: upper versus lower body, or push (e.g., chest press, leg extension) versus pull (e.g., seated row, leg curl) exercises. Allows for more intense training for each muscle group per training session; is time consuming.
- **Pyramid sets -** Successive sets of the same exercise are performed with progressively greater resistance while decreasing the number of reps. For example: perform 10 reps with a 10-rep weight in set 1; perform eight reps with an eight-rep weight in set 2; perform six reps with a six-rep weight in set 3. Rest between sets. You can mix up the number of sets and reps per set that are performed. Allows for a varied training intensity, but is more time consuming than performing one set per exercise per muscle group.
- **Super sets** - Performing two exercises for opposing muscle groups without a rest period between sets. Example: a set of a chest exercise immediately followed by a set of a back exercise, followed by a rest. This combination can be repeated one to two more times. Limit this type of workout to once a week; on the remaining workout days, rest between each set. May be useful for muscle hypertrophy.
- **Compound sets** - Performing two exercises for the same muscle group without a rest period between sets. Example: a set of one chest exercise immediately followed by a set of a different chest exercise, followed by a rest. Repeat this combination one to two more times. Limit this type of workout to once a week; on the remaining workout days, rest between each set. May be useful for muscle hypertrophy.

Use the guidelines provided to develop sound strength training programs and alternate exercises with in each muscle group every four to eight weeks to maximize strength gains, enhance job-related fitness, and have fun!

8 Calisthenics

In this chapter you will learn about:

- Proper form and guidelines for performing calisthenics.
- Designing a calisthenic exercise program.
- Abdominal exercise techniques.

Calisthenics require minimal equipment and can be performed in almost any location. These exercises can be used to develop and maintain muscle strength and muscle endurance, and can be particularly useful when strength training equipment is not available.

Muscle Balance

As discussed in Chapter 7, muscle balance is an important consideration when designing any strength workouts. Exercises should be selected according to which muscle groups they target (Table 7-2). Table 8-1 lists several calisthenic exercises and the muscle groups they target. Use this table to design your calisthenic routine. Also, you can add any of these exercises to your gym-based strength and endurance routines to create variety and alleviate boredom.

Calisthenic Guidelines

When performing calisthenics to develop muscle strength or endurance, you should follow the same recommendations outlined in Chapter 7. Intensity is largely based on the number of sets and reps, and the length of rest periods. Resistance is provided by body weight rather than an external resistance. Proper form for calisthenic exercises follows many of the general exercise guidelines outlined in Chapter 7. Detailed instructions are found in Table 8-1. (Table 8-1 was adapted from *The Navy SEAL Physical Fitness Guide*.)

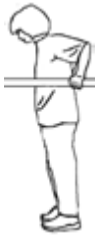
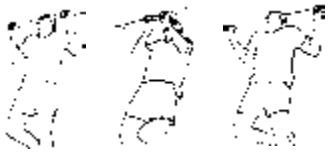
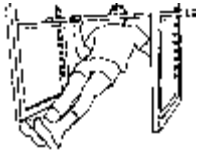
To begin a calisthenics program select one exercise per muscle group from Table 8-1. Perform this routine two to three times per week.

- For each exercise, start with one set of eight reps. Each set should take about one minute. Rest for 60 seconds after each set.
- Gradually increase your workout by adding one or two reps per week until you can perform twelve reps with good form.
- Once you have reached this point, do two sets of eight reps of each exercise. Again, increase your workout by one or two reps per set each week until you can perform two sets of twelve reps.
- Once you have reached this point, do three sets of eight reps; again, gradually increase your workout by one or two reps per set each week until you can do three sets of twelve reps.
- At this point you can increase the difficulty of your workout by: 1) changing the exercises you perform; 2) increasing the number of reps per set; 3) modifying the difficulty of the exercise; 4) decreasing your rest period; or 5) for each muscle group, do a different exercise during each one of your sets (for example, do one set of one-legged squats and one set of hand-to-knee squats as your two sets of leg exercises).

Once you can perform three sets of 12 reps, try some of the modifications listed below or in Table 8-1 to increase the difficulty of the exercises. These modifications can be useful for developing and maintaining muscle strength when training equipment is not available.

- Gradually add weight (e.g., do pull-ups or push-ups with a weighted pack).
- Use a partner for resistance (e.g., have a partner push against your lower leg during leg extensions).
- Exercise one side of the body first (i.e., one-legged squats), then repeat the exercises for the other side.
- Modify the exercise (e.g., elevate legs during crunches).
- Perform super sets or pyramids (see Chapter 7).

Table 8-1. Calisthenic Exercises Arranged by Muscle Group

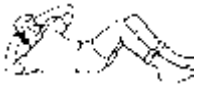
CHEST, SHOULDERS, ARMS	**Push-Ups** Lie on stomach, feet and hands shoulder width apart on deck, head facing forward, body straight. Extend arms. Count 1: Bend elbows 90°, lowering chest toward deck. Count 2: Return to start position. Works triceps, chest, shoulder, and abdominals. **Variations:** Fingertip Push-ups - Begin as above, except use fingertips to support weight. Works forearms and improves grip strength. Triceps Push-ups - Begin as above, except place your hands close together beneath your chest and spread fingers apart. Your thumbs and index fingers of both hands should almost touch. **Dips** Rest hands on parallel bars. Extend arms; legs are not to support your weight unless needed for assistance. Count 1: Bend the elbows until shoulders are level with the elbows. Count 2: Extend arms to return to start position. Works triceps, chest and shoulders. 	BACK, ARMS	**Pull-Ups** Begin from a dead hang on a horizontal bar, arms shoulder-width apart, palms facing out. Count 1: Pull body up until chin touches bar. Do not kick. Count 2: Return to start position. Works the back and forearms. Grip variations: Narrow, Wide.  **Incline Pull-Ups** Using a low bar, lie or sit on the deck with chest under bar, place hands shoulder-width apart on bar, palms out. Count 1: Pull upper body toward bar at a 45° angle. Squeeze shoulder blades together during movement. Count 2: Extend arms. Works back, shoulders, and arms.  **Chin-Ups** Begin from a dead hang (i.e., full extension) on a horizontal bar, arms shoulder-width apart, palms facing in. Count 1: Pull body upward until chin touches top of bar. Do not kick. Count 2: Return to start position. Works the back, biceps.
NECK	**Neck Rotations** Lie on back. Count 1: Lift head up and over to side. Count 2: Bring head to center; Count 3: Bring head to other side. Count 4: Return head to start position. Works neck flexors. 	HIP FLEXORS	**Straight Leg Raise** Sit on the edge of a bench, keeping back straight. Place hands behind you for support. Bend left knee 90°. Straighten right leg in front of you with your right heel resting on the deck. Count 1: Slowly raise your right leg, lifting it no higher than your hips, keeping your back straight. Count 2: Lower heel to 1 inch above the deck. Works hip flexors. Variation to increase difficulty: use an ankle weight.

ABDOMINALS (See "Abdominal Exercises" on page 70.)

Crunches

Lie on back, knees bent 90°, feet on deck, hands behind head, elbows back. Count 1: Lift upper torso until shoulder blades are off the deck, tilt pelvis so lower back is pressed to the deck. Lead with the chest, not the head. Count 2: Return to start position. Works abdominals and obliques. Variations to increase difficulty: bend legs and bring knees toward chest; extend legs vertically, straight in the air; or place a rolled towel under lower back. Arms may be placed (easy to most difficult) alongside body, across chest, hands behind head, or hands clasped above head.

Crossovers



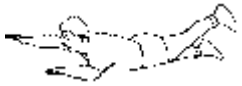
Lie on back, hands behind head, knees bent 90°, and feet on deck. Count 1: Turn slightly and lift torso, bringing left rib cage toward belly button. Count 2: Return to start position. Repeat on other side. Works abdominals and obliques.

Hip Rollers

Lie on back, legs bent and elevated off deck. Count 1: Slowly bring both knees down together to the right until lower back begins to rise off deck. Count 2: Return to start position. Works abdominals and obliques.

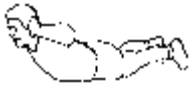
LOWER BACK

Superman



Lie on stomach. Count 1: Lift opposite arm and leg (i.e., right arm, left leg) 6 inches off deck. Hold for 3-5 seconds. Avoid hyperextension of the back. Count 2: Slowly lower arm and leg to deck. Repeat using opposite arm and leg. Variation to increase difficulty: Add weights to arms and legs. Works lower back and gluteals.

Prone Back Extension



Lie face down, hands clasped behind back. Count 1: Lift upper torso until shoulders and upper chest are off Deck. Hold 3-5 seconds. Avoid hyperextension of back. Count 2: Return to start position. Variations to increase difficulty: Place hands behind back (easiest), behind head, straight over head (most difficult). Works lower back.

GLUTEALS

Rear Thigh Raises

Start on and knees and forearms. Lift left leg, keeping it bent 90°, so that left knee is no higher than hips. Keep back flat. Count 1: Lower left leg 6 inches. Count 2: Lift leg to start position. Switch legs and repeat. Works gluteals. Variation to increase difficulty: Straighten leg to be lifted.

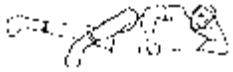
LEGS

Hand to Knee Squat

Place feet shoulder-width apart, arms at sides. Count 1: Bend at hip and knees, keep back straight and feet flat, until your fingertips pass knees. Knees should not go beyond toes. Count 2: Push through the heels to return to start position. Works quadriceps, hamstrings, and gluteals.

LEGS

Burt Reynolds
Lie on left side with head supported by hand, bend right leg and place it in front of left knee. Count 1: Lift left leg approximately 8 inches off deck. Count 2: Lower left leg to 1 inch above the deck. Repeat for the right leg. Works inner thigh (hip adductors).



Leg Lifts
Lie on left side, bend both knees at a 90° angle from torso. Count 1: Lift right leg 6-8 inches, keeping knee and ankle level. Count 2: Lower right leg to 1 inch above left leg. Repeat for the left leg. Works outer thigh (hip abductors).

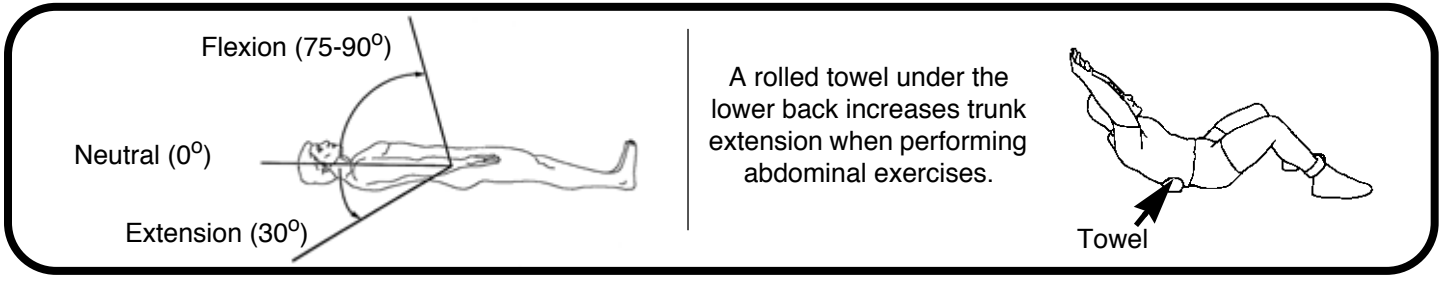
One-Legged Squat
Shift weight to right leg, lifting the left leg straight out in front of you. Count 1: Bend right knee until it is over your toes. Count 2: Push up through right heel to return to start position. Repeat using other leg. Works quadriceps, hamstring, and gluteal muscles.

Calf Raises
Stand on step with heels hanging off edge. Count 1: Lift heels 3 inches. Count 2: Lower heels 3 inches. Works calf muscles. Variations: Perform exercise with toes pointed inward, straight forward, and turned outward.

Abdominal Exercises

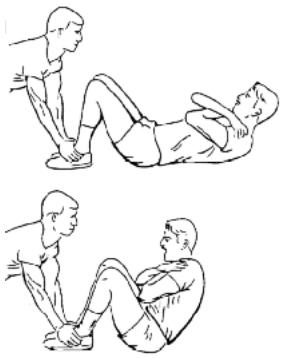
Abdominal muscles help support the lower back. Therefore, strong abdominal muscles can decrease the risk of developing lower back pain. When doing abdominal exercises on the deck, only a portion of the abdominal's range of motion is being strengthened because your lower back is flattened. However, by placing a rolled towel under your lower back you can extend the range of motion for abdominal exercises (see Figure 8-1).

Figure 8-1. Range of Motion of the Abdominals



In this section two common abdominal exercises, the curl-up and the crunch, will be described. The curl-up, used on the PRT as a measure of muscle endurance, targets both the abdominal and hip flexor muscles. The form for the curl-up is:

- Lie on back with knees bent, feet flat on deck, heels 10 inches from buttocks and held down by a partner. Cross arms and hands on chest or shoulders.
- Curl torso up, touching elbows to upper thighs while hands remain on the chest or shoulders. Exhale as you lift.
- Lie back until the lower edge of your shoulder blades touches the deck. Inhale as you lower.



From OPNAVIST 6110.1E

The crunch is similar to the curl-up but is performed within a smaller range of motion. The torso is lifted by abdominal muscles during a crunch. The form for the crunch is:

- Lie on back with knees bent 90°, feet flat on deck, shoulder width apart. Do not anchor your feet. (Anchoring your feet or placing your legs out straight on the deck will target your hip flexors, not your abdominals.)
- Place fingertips lightly on the back of the head, elbows out to sides and in line with ears. (Variations to this include arms at sides, arms across chest, and arms above head.)
- Lift torso until the shoulder blades come off the deck by moving rib cage toward hips. Exhale as you lift. Look up at the ceiling to prevent neck strain.
- Return to the starting position. Inhale as you lower.

Some people may develop lower back pain if they perform curl-ups routinely. For them, the crunch is recommended as an alternate exercise. Regardless of which exercise you choose when training, focus on the quality, not the quantity, of repetitions. If you perform either exercise rapidly, you are using momentum and not building abdominal strength!

9 Flexibility

In this chapter you will learn about:

- The benefits of flexibility training.
- Physiology of stretching.
- Proper stretching techniques.

Most trainers, exercise physiologists, and health care professionals agree that flexibility training, although often overlooked, is an important component of a physical fitness program. Stretching becomes even more important as you achieve advanced levels of muscle strength and endurance. If optimum functional fitness and military readiness are the goals, then well-balanced flexibility training is a must.

Benefits of Stretching

What is flexibility? When someone says they are flexible, what do you think of? Maybe you picture someone who can touch their toes. Flexibility is the ability to move your joints freely through a full range of motion. The range of motion at each joint is different and depends largely upon the structure of the joint and the condition of the muscles, tendons, and ligaments around the joint. Proper stretching increases flexibility and leads to:

- Reduced muscle soreness after exercise.
- Lower risk for injury.
- Mental and physical preparation for exercise or competition.
- Enhanced muscle performance through a larger, functional range of motion.
- Mental relaxation.

The goal of flexibility training should be to enhance joint movement while maintaining joint stability. Therefore, stretching exercises complement both strength and aerobic activities. An intense workout can cause small tears in muscles. Also, during exercise recovery, muscles and connective tissues (ligaments and tendons; defined in the Glossary) can shorten. Stretching prevents this muscle shortening and decreases the muscle soreness associated with intense workouts.

Physiology of Stretching

To understand the proper techniques for stretching it is helpful to know how the muscle and connective tissue respond to being stretched. There are areas within both your muscles and tendons that can sense both how quickly and how far your muscles and tendons are being stretched. These areas protect your muscles and tendons from becoming overstretched or torn during a quick stretch by causing a reflex muscle contraction. This muscle reaction is called the stretch reflex. A classic example of this is when someone taps your leg just below the kneecap. This action quickly stretches the quadriceps muscle (see Figure 7-2) and causes your thigh to contract and kick out your lower leg. The quicker the stretch, the stronger the reflex contraction. Therefore, by stretching slowly you avoid contracting the muscle you are trying to stretch!

Tendons respond to stretching as well. They cause the stretched muscle attached to the tendon to relax and signal its opposing muscle to contract. This protects the stretched muscle and tendon from tearing. As a stretch is held your muscles and tendons adapt to the new length.

The most effective stretches are performed slowly and are held for 10 - 30 seconds.

Flexibility Exercises

One of the most safest and most beneficial types of flexibility exercises is static stretching. **Static Stretches** are slow, controlled movements through a full range of motion. The term "static" means the stretch is held at the end of the joint's range of motion. These static exercises are considered safe and effective because they stretch the muscles and connective tissue without using fast movements that will be resisted by the muscles. These exercises can be done actively (e.g., you contract the opposing muscle group to stretch the target muscle group) or passively (e.g., you use a towel to stretch the muscle). Incorporate the static stretches in Table 9-1 in your exercise program. These exercises target the muscle groups shown in Chapter 7, Figure 7-2. Select at least one stretch for each muscle group. Hold each stretch for 10-30 seconds then rest 10 seconds. Repeat each stretch 2-5 times. Muscle balance also applies to stretching, so stretch opposing muscle groups (e.g., stretch hamstrings and quadriceps).

A second type of flexibility exercises is dynamic stretching (Table 9-2). **Dynamic Stretches** are controlled muscle contractions through a joint's range of motion. These stretches should be used to enhance the performance of an activity that immediately follows the stretch; i.e., swinging your racket prior to a tennis match. This type of stretching warms the muscles. Dynamic exercises are safe as long as you do not use momentum to force a joint through a greater range of motion than it is capable. Also, avoid bouncing movements. (See page 73.)

Table 9-1. Static Stretches

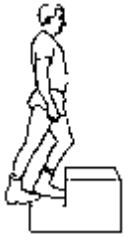
Calf Stretch	Quadriceps Stretch	Hamstring Stretch	Modified Hurdler's Stretch
 Standing on a step, place the ball of the right foot on the edge of the step. Bend left knee and gently drop right heel. Stretches the right gastrocnemius. Variation: To stretch the ankle, slightly bend the right knee after dropping your right heel. Switch legs and repeat.	Lie on stomach with both legs extended. Slowly bend left knee. Gently grasp left ankle with right hand and pull toward body. Keep back straight. Stretches the quadriceps. Switch legs and repeat. Variation: Perform stretch when standing, holding on to a stationary object to keep your balance.	Lie on back with both legs extended. Bring left leg to chest and grasp left thigh with both hands. Gently pull left leg toward chest. Stretches left hamstring and right hip flexor. Switch legs and repeat.	Sit down, extend right leg and place left foot against inner right thigh. Gently bend forward from the hips, toward toes. Stretches the hamstring. Switch legs and repeat.

Table 9-1. Static Stretches

Hip Stretch

Lie on back with knees bent, feet flat on the deck. Place right ankle on left knee. Grasp left thigh with both hands and gently pull it toward chest. Switch legs and repeat. Stretches hip extensors.

Pretzel Stretch

Sit with both legs straight. Bend the left knee and cross left foot over the right shin. Turn torso left and place right elbow just below the left knee. Turn as far left as possible. Stretches hip abductors, lower back, and iliotibial band. Switch legs and repeat.

Butterflies

Sit with legs bent and bottoms of feet together. Wrap hands around ankles and gently lean your torso forward, keeping your back flat. Do not pull on ankles or press knees down with elbows. Stretches hip adductors.

Lunge

With feet side by side, take a large step forward with left foot. Bend your left knee until it is directly over left ankle. Gently press your hips forward and down, keeping your back straight. Stretches hip flexors. Switch legs and repeat.

Lizard

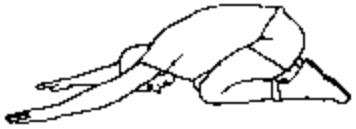
Lie face down, palms on the deck under your shoulders. Gently lift torso with arms and lower back muscles. Lift only until your pelvis is off the deck. Stretches the abdominals.

Lower Back Stretch

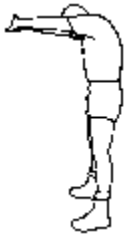
Lie on back, bring knees to chest and grasp knees with hands (arms may either be below or above lower legs). Gently pull both knees toward chest. Lift chin toward chest. Stretches the lower back.

Kneeling Back Stretch

Kneel down with knees shoulder width apart. Sit back on your heels. Lean forward so your chest rests on your thighs. Extend arms over head. Stretch arms and chest as far forward as possible. Stretches lower back.

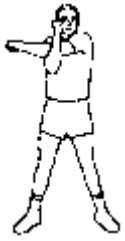


Upper Back Stretch



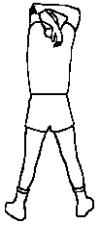
Clasp hands together in front of chest, palms facing out, arms extended. Press through palms until back and shoulders are rounded. Stretches back and shoulders. Can do seated or standing.

Posterior Shoulder Stretch



Bring left arm across chest. Use right hand to gently push upper left arm toward chest. Stretches shoulders. Switch arms and repeat.

Triceps Stretch



Bring left arm up and back until left palm is between shoulder blades and left elbow is above left ear. Gently grasp upper left arm with right hand and push left arm behind head. Stretches the triceps. Switch arms and repeat.

Chest Stretch

Clasp hands behind lower back, thumbs pointed down. Gently pull arms up toward ceiling. Stretches chest and shoulders. Can do seated or standing.

Neck Stretch

Clasp hands behind back. Bend neck so right ear moves to right shoulder. Gently pull left arm. Stretches neck. Switch arms to stretch the right side of the neck.

Table 9-2. Dynamic Stretches

Neck Stretch Begin from a standing position. Count 1: slowly roll the head to one side, Count 2: slowly roll the head to the front, Count 3: slowly roll the head to the other side, Count 4: slowly roll the head to the front again. Repeat. Do not roll the head back. Stretches the neck muscles. Variation: Turn your head to look over your right shoulder then slowly turn your head to look over your left shoulder. Repeat.	**Up Back and Over** Begin from standing position with arms at sides. Count 1: slowly bring both arms forward and upward. Count 2: slowly bring both arms down and back. Count 3: slowly move both arms forward, up, back, and around to complete a full circle. Stretches the shoulders, chest, and back.	**Press-Press-Fling** Begin from a standing position with arms bent, fists at chest level, and elbows out to the side. Count 1: gently pull elbows back and release. Count 2: repeat count 1. Count 3: slowly extend arms and pull them back. Stretches the chest and shoulders.
Trunk Twisters Begin in a seated position with legs crossed and hands placed behind your head. Count 1: slowly turn your torso, at the waist, to the right and pause. Count 2: slowly turn your torso to the left and pause. Repeat. Stretches abdominals and obliques.	**Standing Toe Pointers** Start from a standing position with body weight over the heels. Flex and extend the feet and toes. Stretches both the calf muscles and the muscles in front of the shins. Variation: walk on the heels with toes pointed upward.	**Four-Way Lunges** Begin from a standing position. Count 1: lunge forward with right leg, distributing body weight across both legs. When lunging forward, the knee should not extend beyond the toe of that leg. Count 2: using the right leg, push off and return to start position. Repeat this movement using the same leg but lunge to the side. Perform exercise with the left leg. Stretches the leg muscles.

Table 9-1 and Table 9-2 were adapted from *The Navy SEAL Physical Fitness Guide.*

10 | Training in Confined Spaces

In this chapter you will learn about:

- Exercises to perform when space and equipment are limited.
- Designing a circuit training workout.
- Maintaining morale during deployment.

During deployment or extended training exercises you may encounter conditions that limit your physical training routines and options. Submarines and small assault craft probably create the greatest challenge; but a well balanced training program can be maintained even with limited space and equipment. So, take this opportunity to design new routines with alternative exercises and have fun. The concepts for designing training routines in confined spaces is the same as any gym-based routine, you just have to be more creative. Follow the FITT Principle guidelines outlined in Chapters 4, 5, and 7 and try some of the exercise in this chapter when designing your workouts.

Aerobic Conditioning

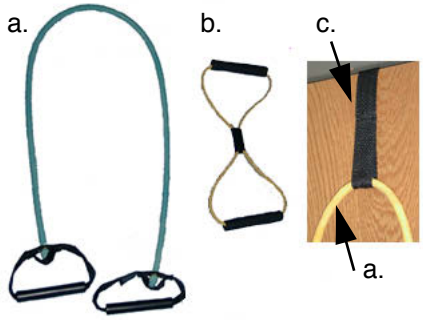
Performing your aerobic training routines may seem impossible if you don't have access to cardiovascular training equipment or large areas to train. However, with a little creativity you can design a training routine to maintain your fitness level. Some exercises you can perform in confined quarters with minimal equipment include:

- Jogging or marching in place.
- Jumping rope or jumping jacks.
- Stair stepping, if you have access to stairs or if you have space for an aerobic step bench (plastic step with risers).

Strength Training

In addition to calisthenics, strength exercises using light-weight, portable equipment, such as elastic tubing, dumbbells or a ball, can be performed in small spaces. Examples of these exercises are shown in Table 10-1. Regardless of the equipment used, the general principles and techniques outlined in Chapter 7 for muscle strength and endurance training apply. Follow the set and rep recommendations outlined in Chapter 8 for calisthenic exercises, starting with one set of eight reps. Include exercises for each of the major muscle groups mentioned in Chapter 7, Figure 7-2.

Elastic Tubing and Bands



a. 4 ft. elastic band.

b. 1 ft. elastic loop with foam handles.

c. Nylon anchor piece to place in door jams.

These come in different widths and resistances, each designated by a different color. (As a rule, the smaller the tube's width, the less resistance it provides.) The basis of elastic tubing exercises is that as you stretch the tubing during your exercise, it provides a continuously increasing resistance. Resistance can be adjusted by: 1) altering the placement of the tubing (addressed in Table 10-1), 2) using two tubes, 3) using a thicker tube, or a combination of all these. Note that using two thin tubes may provide less resistance than using one thick tube. Typically, tubes and bands are sold in

4 ft. lengths and cost $5 to $10. When purchasing tubing, buy one with handles large enough to slip over your forearms. Buy several tubes of varying widths since you will need different resistances for different exercises. Also, check the tubes periodically for wear and tear.

Inflatable Resistance Balls

These light-weight balls are becoming very popular in fitness centers and are excellent for abdominal, lower back, stability, and stretching exercises. The goal in resistance ball training is to keep your balance and stability while performing exercises on the ball, which acts as an unstable base. Resistance balls are typically 18 to 30 inches in diameter and cost about $30. Purchase a resistance ball that when you sit on it after it is fully inflated, your thighs are parallel to the deck. In addition, when you purchase these balls, you get a video of various exercises and routines. One drawback is that you need access to an air pump because, if the ball is kept inflated, it can take up a lot of storage space.

Strength Exercises

Table 10-1 shows exercises that can be performed using resistance tubing (bands) and balls. When performing elastic tubing exercises, you can use a partner, instead of an anchor, to secure the tubing during your exercise. Just be sure your partner holds the tubing at the appropriate height and distance from you (and doesn't let go!). When using the resistance bands, it is important to anchor them properly. Some examples are shown in Figure 10-1.

Figure 10-1. Anchoring Elastic Tubing

1.

1. Wrap the band around the top and sides of both feet, then pull the handles up through the middle of your feet. This type of wrap is useful for anchoring the band during rowing exercises.

2.

2. a. Using the 1 ft. elastic loop, sit down and place your right foot on the middle of the loop.
   b. Wrap the right end of the tubing over your foot.
   c. Pull the left end of the tubing up through the right end of the tubing loop.
   d. Take the left end of the tubing loop and wrap it around your left foot.
   This type of anchor is useful for leg lifts and leg curls.

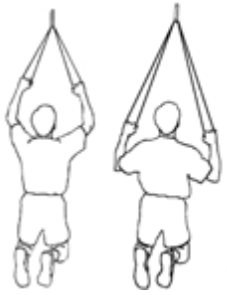
Table 10-1. Exercises to Perform in Confined Spaces

Back

Bent-Over Row with Band

Grab one end of the band in each hand. Step on the middle of the band with your left foot, step back 2 ft. with your right foot. Bend forward slightly at the waist, keep your shoulders and hips facing forward. Count 1: Lift both hands from your thighs to your waist. This should take 2 seconds. Pause for 1 second. Count 2: Return hands to thigh level in 4 seconds. Keep your elbows close to your body throughout the exercise. Works the back and biceps muscles.

Lat Pulldown with Band



Secure the middle of the band to a fixed object above your head. Grasp one handle in each hand. Facing the anchor, step back 1 foot and kneel. Arms should be extended above head. Count 1: Pull hands down to shoulder height in front of your head, keeping chest and head up. Back should remain straight. Press your shoulder blades together in the middle of your back as you pull your arms down. This should take 2 seconds. Pause 1 second. Count 2: Return to start position in 4 seconds. Variation: may need to use the tubing loop instead of a band for adequate resistance.

Seated Row with Band

Sit on deck with legs extended, knees slightly bent. Place the center of the band under your feet. Count 1: With arms extended at chest level and hands over knees, bend your elbows and pull your hands back to each side of your chest. This should take 2 seconds. Pause 1 second. Count 2; Return to start position in 4 seconds. Works back and biceps.

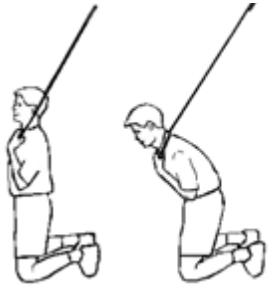
Lower Back

Lower Back on Ball

Kneel beside resistance ball, lay your chest on top of the ball, place your hands in front of the ball. Extend your legs so only your feet are on the deck and walk forward, rolling the ball back closer to your hips. Place your hands behind your back. Count 1: Keep your back straight and raise your torso up off the ball until your back is extended. Count 2: Return to the start position. Try to keep ball steady during exercise. Works the lower back. Similar to prone back extension performed on the deck. Variations: Can do all the same extension exercises as on the deck.

Abdominals

Abdominal Crunch with Band



Anchor the middle of the band above your head. Kneel 1 ft. in front of the anchor, and grasp both ends of the band in your hands. Place your hands palms down on your shoulders. Count 1: Pull your rib cage down closer to your hips. This should take 2 seconds. Pause 1 second. Keep your hips and legs still. Count 2: Return to the start position in 4 seconds.

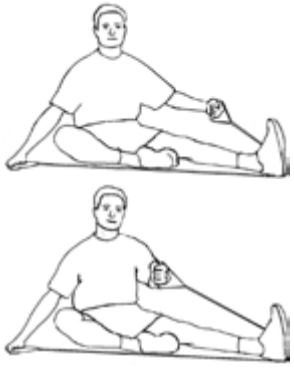
Abdominal Crunch on Ball

Sit on ball, slowly walk feet away from ball as you lie back on to the ball. Ball should be underneath your midback. Place your hands behind your head. Count 1: Pull your rib cage closer to your hips. Count 2: Return to the start position. Try to keep ball steady during exercise. Works the abdominals. Variations: Use a towel under your lower back instead of the ball; perform side crunches on the ball to target the obliques.

Table 10-1. Exercises to Perform in Confined Spaces

Chest

Chest Fly with Band



Sit on the deck with your left leg straight and your right leg bent, with your right foot touching your left thigh. Hold one handle of the band in each hand. Wrap the band under your left heel, about 1/3 the length of the band down from your left hand. Keep your back straight, head up, and shoulders back. Place your right hand on the deck by your right knee. Straighten your left arm so that your elbow is only slightly bent and raise your arm in front of you to chest level. Count 1: Slowly pull your upper left arm across your chest without bending your elbow; this should take 2 seconds. Pause for 1 second. Count 2: Return to the start position in 4 seconds. Your torso and hips should not move during this exercise. Works your chest muscles.Variations: a) perform this standing or kneeling by anchoring the band to a stationary object at chest height; b) lie on your back on a bench and use dumbbells; c) have a partner push (manual resistance) against your upper arms as you do the exercise.

Incline Press with Band

Grab one end of the band in each hand. Step on the band with your right foot, step your left foot through the band and forward 2 ft. Bring your hands to your shoulders with your palms facing forward. Count 1: Extend your arms up and forward in front; your hands should be in front of and a little higher than your forehead. This should take 2 seconds. Pause for 1 second. Count 2: Return to start position. Works the chest and shoulders. Variations: a) for more resistance, use a second tube and place it under your front foot; b) for less resistance, anchor the tube to a stationary object at waist height, step forward 2 ft. and perform the exercise.

Chest Press with Band

Wrap the band at shoulder height around a bench that is wider than shoulder-width (or secure with two anchors). Keep your back straight, shoulders down and head up. Grip one end of the band in each hand, and place your hands on each side of your chest. Count 1: Extend arms straight in front of you at chest height, do not lock your elbows; this should take 2 seconds. Pause for 1 second. Count 2: Return to the start position in 4 seconds. Works your chest, shoulders, and triceps.Variations: a) have a partner hold the band in both hands, keeping his hands at your shoulder height and wider than your shoulder-width; b) lie on back on a bench and use dumbbells; c) have a partner provide manual resistance against your hands as you perform a press.

Biceps

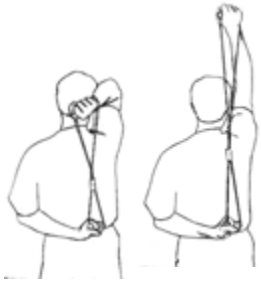
Biceps Curl with Band

Grab one end of the band in each hand. Step on the band with your left foot, step your right foot through the band and forward 2 ft. Count 1: With hands at sides and palms up, bring your palms to your shoulders. This should take 2 seconds. Pause for 1 second. Count 2: Return to start position. Works the biceps. Variations: a) for more resistance, use a second tube (as shown) and place it under your front foot); b) use dumbbells; c) have a partner pull against your lower arm during the curl.

Table 10-1. Exercises to Perform in Confined Spaces

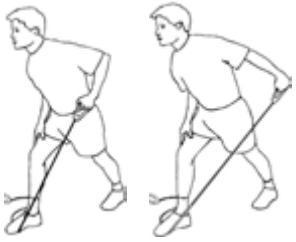
Triceps

Triceps Extension with Band



Stand with feet hip distance apart, knees slightly bent. Grab one end of the band in your right hand and place it over your right shoulder. Your right elbow should be beside your head and the band should be dangling down your back. Reach around your back with your left hand and grab the other end of the band with your left hand. Place your left hand on your low back. Count 1: Extend your right arm straight above your head, keeping your left hand still and your right elbow close to your head. Do not lock your right elbow. This should take 2 seconds. Pause 1 second. Count 2: Return to the start position in 4 seconds. Works the right triceps. Switch arms to work the left triceps.Variations: a) if you have a long piece of tubing, grab the middle of the tubing (instead of the end) with your left hand; b) use dumbbells.

Triceps Kickback with Band



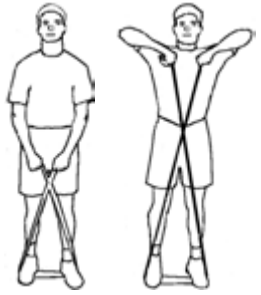
Grab one end of the band in each hand. Step on the middle of the band with your left foot, step back 2 ft. with your right foot. Bend forward slightly at the waist, keep your shoulders and hips facing forward. Place your left hand on your left thigh for support. Pull your right hand up to your right hip, keeping your right elbow close to your body. Count 1: Straighten your lower right arm behind your back without lifting your elbow. This should take 2 seconds. Pause 1 second. Count 2: Return to the start position in 4 seconds. Works the right triceps. Switch to work the left triceps. Variations: a) use dumbbells; b) have a partner push against your lower arm during the lift.

Shoulders

Lateral Raise with Band

Grab one end of the band in each hand. Stand on middle of the band, feet shoulder-width apart, knees slightly bent. With arms at sides, bend elbows 90°. Count 1: raise your upper arms to each side until your elbow (still bent 90°) is level with your shoulder. This should take 2 seconds. Pause 1 second. Count 2: Return to start position in 4 seconds. Keep your elbow bent during the lift. Works the shoulders. Variations: a) for more resistance, use 2 bands, stand on only one band with each foot, hold one end of each band in each hand; b) use dumbbells; c) have a partner push down against your upper arms as you lift; d) increase the difficulty of the exercise by straightening your elbow.

Upright Rows with Band



Stand on the middle of the band, feet shoulder-width apart, knees slightly bent. Cross ends of band in front of you and grasp one end of the band in each hand, palms facing back. Count 1: With arms extended and hands together at the center of your body, pull elbows up and back to the level of your shoulders. Your arms should form a “V”. This should take 2 seconds. Pause 1 second. Count 2: Return to start position in 4 seconds. Do not arch your back during the lift. Works the front of the shoulders. Variations: a) for more resistance, use 2 bands, stand on only one band with each foot, hold one end of each band in each hand; b) use dumbbells.

Table 10-1. Exercises to Perform in Confined Spaces

Shoulders

Reverse Fly with Band

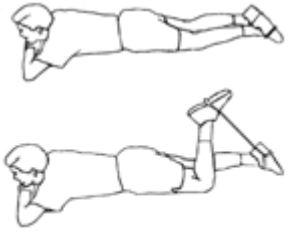
Anchor the middle of the band at chest height. Facing the anchor, step back 4-5 ft. Grab one end of the band in each hand. Extend your arms straight in front of you at chest level, elbows slightly bent. Count 1: Pull your upper arms out to each side without bending your elbows any more. This should take 2 seconds. Pause 1 second. Count 2: Return to the start position in 4 seconds. Works the back of the shoulders. Variations: a) kneel on one knee, bend at the waist, rest chest on opposite thigh, and use dumbbells or have a partner push against your upper arms.

Legs

Lunge with Band

Grab one end of the band in each hand. Step on the middle of the band with your left foot, step your right foot through the band and beside your left foot. Bring hands up to shoulders, palms facing forward. Band should be behind your arms. Count 1: Take a large step forward with your right foot, keep your back straight and head up. Count 2: Squat straight down, dropping your left knee, until your right knee is over your right ankle. Count 3: Lift up. Count 4: Push off your right foot to return to the start position. Works the leg muscles. Switch sides. Variation: a) for more resistance, use a second tube and place it under your front foot; b) on Count 1, step to the left or right instead of straight ahead; c) use dumbbells.

Leg Curl with Band



Wrap one end of the tubing loop around your right foot. Hook the other end on your left foot. Lie on your stomach with both legs extended. Count 1: Lift your left heel up toward your buttocks, keeping your right knee and hips flat on the deck. This should take 2 seconds. Pause 1 second. Count 2: Lower your leg to the start position in 4 seconds. Works the hamstrings.

Leg Lifts with Band

Anchor the band at shin height. Wrap the band around your left ankle and, facing the anchor, step back 3 ft. Place feet side by side and point your left foot up. Place your hand on the wall for support and slightly bend your right knee. Count 1: Keeping your left leg extended, pull your left ankle back 1-2 ft. This should take 2 seconds. Pause for 1 second. Count 2: Return to start position in 4 seconds. Switch legs. Works hamstring and gluteal muscles. Variations: a) to work inner and outer thighs and hip flexors, change the position of your body so you pull against the band in all four directions (front, back, and two sides); b) lie down and use ankle weights.

Squat with Band

Grasp one handle in each hand, step on the band with feet hip-width apart, knees slightly bent. Bring hands up to shoulders, palms facing forward. Band should be behind your arms. Count 1: Slowly squat down; look forward, keeping your shoulders back, chest and head up. Squat until your knees are above your toes. This should take 2 seconds. Pause 1 second. Count 2: Return to the start position in 4 seconds. Works the quadriceps and gluteals.

Wall Squat with Ball

Stand against a flat wall, place both feet 2 ft. from the wall hip distance apart. Place a small ball between your knees. Count 1: Slide down the wall until your knees are over your feet and squeeze the ball between your knees. Hold this position for 10 seconds. Count 2: Return to the start position. Works the thigh muscles.Variations: a) hold dumbbells in your hands.

Workout Design

The FITT principle guidelines described in Chapters 4, 5, 7, and 9 should be followed for each type of fitness training. Since space, equipment, and time are limiting factors during deployment, one of the most effective workouts for you to perform is circuit training (described in Chapter 7). The basics of this type of workout are:

- Total session is 30-60 minutes, divided into 30-60 second stations.
- Each station is a new exercise; alternate aerobic and strength stations, and upper and lower body exercises.
- Perform aerobic exercises in your target heart rate zone.
- Perform strength exercises with proper form and use a resistance that you can lift 10-12 times.
- Stretch after your workout. (See Chapter 9.)

Table 10-2. Circuit Training Workout

Station	Exercise	Time
	Warm-up	5 minutes
1	Wall Squat with Ball	60 sec
2	Push ups	60 sec
3	Jog in place	60 sec
4	Stair step/Jog	60 sec
5	Jumping Jacks	60 sec
	Check heart rate	10 sec
6	Lat Pulldown with Band	60 sec
7	Abdominal Crunches and Lower Back Extensions	60 sec (30 sec each)
8	Biceps curl and Triceps Extension with band	60 sec (30 sec each)
9	Jumping Jacks	60 sec
10	Stair Step/Jog	60 sec
11	Jog in place	60 sec
12	Jumping Jacks	60 sec
	Check heart rate	10 sec
	Repeat Stations 1-12, 2-4 times	
	Cool Down	5 minutes
	Stretch	5-10 minutes

Note: One cycle of this circuit training workout has 7 minutes of aerobic exercises and one set of strength exercises for each of the major muscle groups.

Morale During Deployment

Although confined spaces can limit your training options and make you feel less than enthusiastic to train, you need to remain physically active. Stopping all physical training results in a rapid decline in muscle strength and endurance, flexibility, and aerobic conditioning (see Chapter 4). One option to boost morale and increase participation in physical training during deployment is to create training competitions. Some ideas include:

- Mini-triathlons - Perform any three aerobic exercises back-to-back for the best time. Honor the winner by engraving his/her name on a plaque or give him/her a token that is symbolic of the competition.
- Organize team competitions that coincide with major sporting tournaments, such as the NFL playoffs or the NCAA Final Four tournament. Assign each crew member to a team and organize the teams into tournament-style playoffs. Record the time each team member exercises. The team with the most total exercise time wins the tournament.

Anyone can organize these types of competitions. Such events make exercising a social and morale boosting activity for all sailors during deployment.

Finally, you may feel that the biggest barrier to working out when deployed is time limitations. In actuality, it requires less time to maintain fitness levels than to increase fitness levels. Though not ideal, you can maintain your fitness level by working at your usual intensity fewer times per week and for shorter durations than what is required to improve your fitness level. A minimum of one strength session, which includes exercises for all the major muscle groups (1 set of 8-12 repetitions), and two 20-minute aerobic sessions, within your target heart rate zone, per week will allow you to maintain your current fitness level. Though this limited amount of training is not ideal for your overall fitness, it is much better than not performing any exercise at all. Remember, detraining occurs rapidly when all training is stopped (see Chapter 4).

11

Nutrition for Exercise

In this chapter you will learn about:

- Dietary practices for enhancing endurance and strength performance.
- Dietary measures for exercise recovery.

Your physical performance is greatly influenced by regular conditioning and by following sound dietary practices. Both prolonged aerobic exercise and multiple bouts of high intensity exercise impose significant demands on energy and fluid balance. Failure to replace energy and fluids used during exercise can significantly impair performance in later activities.

The following recommendations are for an individual who regularly participates in at least 90 minutes of aerobic exercise each day or in multiple, strenuous bouts of exercise several times a week. This information does not apply if you exercise less than one hour per day.

Carbohydrate Needs

During heavy training you must increase your kcal intake, especially from carbohydrates (CHO), to meet your energy demands. Failure to do so may result in:

- Chronic muscular fatigue.
- A feeling of staleness.
- Weight and muscle mass loss.
- Poor sleep patterns.

Liver and muscle glycogen are the primary sources of glucose for energy during prolonged and intense physical activities. Once your glycogen stores are used, your performance decreases sharply. So, the key to optimal performance is to maintain glycogen stores by eating a high-CHO diet.

CHO for Endurance Training

The endurance capacity of an individual on a high-CHO diet is approximately **3 times greater** than on a high-fat diet. When CHO intake is low, several days of rigorous training will result in a gradual depletion of muscle glycogen stores and eventually impair performance. The guidelines for CHO intake while training are:

60 - 65% of your total daily kcal intake.

Worksheet 11-1. Calculate Your Daily CHO Needs

_____ x 0.60 = _____ kcal from CHO per day.
Your EER*

_____ x 0.65 = _____ kcal from CHO per day.
Your EER*

You should eat _____ to _____ kcals from CHO daily.

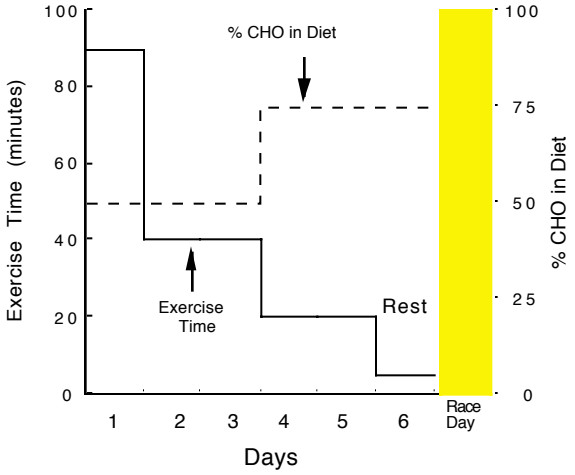
* Your estimated energy requirement (EER) was calculated in Chapter 1, Worksheet 1-2. To calculate grams of CHO see Worksheet 2-1.

Keep a dietary log for a few days to see if your CHO intake is adequate.

CHO Loading/Glycogen Supercompensation

CHO Loading is a regimen that combines diet and exercise to "pack" more glycogen into muscle and liver (Figure 11-1). It is used by endurance athletes to optimize physical performance during prolonged endurance events. CHO loading causes temporary weight gain (2.7 grams of water are stored with every gram of glycogen). The extra weight may impair performance. CHO loading is unnecessary for individuals who eat according to the dietary guidelines outlined in Chapter 3 and whose CHO intakes are within the range calculated in Worksheet 11-1.

Figure 11-1. CHO Loading for Endurance Events



CHO loading requires that you reduce your training sessions and increase your CHO intake the week prior to an event. As shown to the left, five to six days before the event train no more than 40 minutes (solid line). CHO intake (dotted line) should be approximately 50% of your total energy intake. Two to three days before the event train no more than 20 minutes a day and increase CHO intake to 70% of your total energy intake. Rest the day before the event and keep CHO intake at 70%.

CHO for Strength Training

CHO are required for strength training because the exercises rely on muscle glycogen stores for energy. The recommended CHO intake is:

55-60% of your total daily caloric intake.

This is slightly lower than the requirements for endurance activities (see Worksheet 11-1) because the total amount of energy expended is less. CHO loading is not recommended for strength training because it causes extra water to be stored in the muscle.

Protein Needs

Protein needs of strength athletes and endurance athletes are quite similar at:

0.6 - 0.8 grams of proteins per pound of body weight.

This corresponds roughly to 10-15% of your total daily kcals. It is highly likely that your diet provides adequate proteins since most Americans consume proteins in excess of their needs. Use Worksheet 11-2 or Worksheet 2-2 (Chapter 2) to determine your protein needs.

Worksheet 11-2. Calculate Your Protein Needs

Body Weight = _____ lbs.

0.6 grams/lb x _____ lbs. = _____grams proteins.
(Body weight)

0.8 grams/lb x _____ lbs. = _____grams proteins.
(Body weight)

Your daily protein grams = _____ to _____.

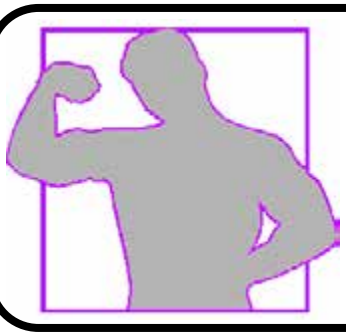
The High-Protein Myth

One of the most common myths is that eating high-protein diets and protein supplements leads to bigger muscles. Clearly, this is not the case! Muscle is only 20% proteins; the rest is water, minerals, lactic acid, and urea. (See Figure 11-2.) Moreover, excessive protein intakes, mostly from protein supplements, can cause:

- More waste production.
- Increased water needs.
- Greater demands on the liver and the kidneys.
- Imbalances in the essential amino acids.
- Diarrhea or abdominal cramps.

For these very reasons, avoid protein powder drinks that provide excessive amounts of proteins or selected amino acids. Although heavily advertised and endorsed by celebrities, you do not need protein supplements to build muscle. Supplements can be very expensive, dangerous to your health, and they are quite unnecessary. Spend your money on a variety of foods for a balanced diet that will sufficiently meet your protein needs. Exercise to gain muscle!

Figure 11-2. Components of Muscle



Muscle is:
20% proteins,
75% water, and
5% inorganic salts, urea, and lactate.

Vitamin and Mineral Needs

Any increased vitamin and mineral needs can be met by eating according to the Food Guide Pyramid (Chapter 3, Figure 3-1). Particularly, increase the number of fruits and vegetables you eat as these foods are good sources of many vitamins and minerals, as well as antioxidants. (See Chapter 3 page 22, Table 2-2, Table 2-3, and Appendix A.) These antioxidants may protect you from environmental stressors and may accelerate your recovery from exhaustive exercise. Fresh fruits and vegetables also provide potassium, which is lost during prolonged strenuous exercise (see Table 2-3).

Fluid Needs

Drinking fluids at regular intervals and eating foods with a high water content (i.e., fresh fruits) are important for maintaining hydration and fluid status during training. See Chapter 2 for more information on fluid balance.

Getting Enough Fluids

- Drink 16 oz. (2 cups) of fluid two hours before starting exercise.
- Drink 3 to 4 oz. (1/2 cup) of fluid every 15-20 minutes during exercise.
- Weigh yourself before and after exercise to determine how much fluid you lost. Drink 16 oz. of fluid for every pound of weight lost.
- Do not rely on thirst as an indicator of fluid needs because it is not adequate. Once you feel thirsty you are already dehydrated.
- Drink water when exercising less than 60 minutes. Drink a sports drink (5% to 8% CHO with electrolytes) when exercising longer than 60 minutes.
- Monitor your urine: urine should be a pale yellow (unless you take vitamin B supplements) and you should be urinating frequently.

What to Drink

Many beverages can replenish lost fluids, so select a beverage that:

- Tastes good.

- Does not cause gastrointestinal or stomach discomfort.
- Is rapidly absorbed from your gut, especially when exercising.
- Contains electrolytes (see Glossary) and CHO (5% to 8%) when performing prolonged or strenuous exercise.
- Rehydrate with a non-caffeinated, non-carbonated, non-alcoholic beverage.

Overhydration

Although less common than dehydration, untreated overhydration can be life threatening. It is seen when plain water is used to replace fluid losses during prolonged (greater than 3 hours) strenuous exercise. Remember, water and electrolytes are lost during sweating, so both need to be replaced in this situation. Overhydration decreases the concentration of electrolytes in the body, upsets metabolism and other bodily functions, and is just as harmful as dehydration. Prevent overhydration by drinking a beverage that contains electrolytes (such as a sport drink) or by eating a light snack (e.g., oranges) with your water. Between exercise sessions, electrolytes lost through sweating can be easily replenished by eating well-balanced meals and snacks (Chapter 3).

Nutrition for Exercise Recovery

Within 30 minutes of completing an extended or intense exercise session, consume at least **50 grams of CHO** (roughly 200 kcals). Also, continue to snack on high-CHO foods for up to six hours. This will help restore your muscle glycogen for the next exercise session. Some foods and servings sizes that contain roughly 50 grams of CHO are:

- Bagel with jam
- Baked potato with skin
- Cooked sweet corn, 1.5 cups
- Cornflakes, 2.5 cups
- Watermelon, 4.5 cups
- Raisins, 0.4 cup
- Shredded wheat cereal, 1.4 cups
- Baked Beans, 1 cup
- Bananas (2)
- Cooked oatmeal, 2 cups
- Cooked Rice, 1 cup
- Orange juice, 2 cups

For more information on the CHO content of foods, check food labels (Figure 3-2), check the USDA website at http://www.usda.gov, or ask a dietitian.

12 Deployment and Altered Climates

In this chapter you will learn about:

- Acclimation.
- General guidelines for altered environments.
- Maintaining performance in the heat, cold, and at altitude.

Adapting to a new environment, such as extreme changes in climate or altitude, imposes considerable demands on the body. This adaptation, or **acclimation**, occurs gradually, allowing the individual to better tolerate and perform in that new environment. Thus, acclimation is the gradual change the body undergoes in order to function more efficiently in a new environment.

Acclimating to New Environments

Adapting to a new environment can take one to three weeks. During this time, endurance activities become more difficult and onset of fatigue occurs sooner. If environmental conditions permit, gradually increase the intensity of exercise until you reach your desired training intensity. Having a good aerobic fitness base will accelerate your acclimation to new environments. Factors that negatively affect acclimation include:

- Dehydration.
- Drinking alcohol.
- Cessation of physical activity.
- Electrolyte depletion.
- Inadequate energy intake.
- Illness.
- Infection.
- Injury.
- Loss of sleep.

General Nutrition Issues

Maintaining or improving health and fitness is more challenging in adverse conditions such as extreme heat, cold, or altitudes. Even highly, physically fit individuals can be quickly overcome by "environmental exposure" if proper preparation is overlooked or if symptoms of impending illness are ignored. The adaptation of the body to adverse environments increases energy expenditure and water losses. Furthermore, dehydration results in a loss of appetite. If energy and fluid needs are not met, then performance will be impaired. General suggestions for meeting increased energy and fluid requirements are provided below. Issues relevant to a particular environment are provided later.

Maintaining Energy Balance

- Eat a high-CHO diet to meet increased kcal needs, as CHO are more readily absorbed and better tolerated than fats or proteins.
- Avoid fatty foods which may not be well tolerated.
- Avoid high-protein intakes which will increase water loss and can lead to dehydration. (See Chapter 2 page 9.)
- Eat small frequent meals.
- When eating field rations, eat the entrees as well as the other food and beverage items provided in the pack.
- Drink a high-CHO beverage to increase your kcal intake if you are having difficulty eating enough solid foods to meet your energy needs.

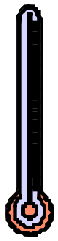
Maintaining Fluid Balance

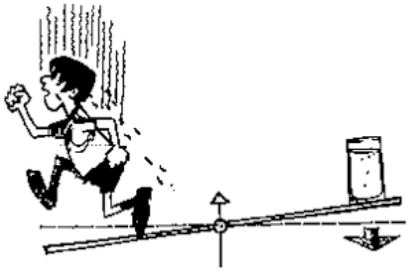
Maintaining fluid balance is crucial to avoid dehydration, as stated in Chapter 2 on page 17. Dehydration can limit performance and severe dehydration can be life-threatening. Tips for maintaining fluid balance include:

- Monitor hydration status by the frequency and color of your urine. Infrequent and dark yellow urine suggests dehydration.
- When possible, monitor fluid status by weighing yourself prior to and after prolonged physical activities. For every pound of weight lost due to water losses, drink 2 cups (0.45 L or 16 oz.) of water.

- Thirst is not a good indicator of fluid status. Drink fluids regularly throughout the day. When working in the heat, do not drink more than 6 cups of fluid an hour.
- Avoid alcoholic beverages as alcohol increases fluid losses.
- Reduce caffeine consumption as caffeine increases fluid losses.
- Avoid salty foods as salt increases fluid needs.
- Drink CHO/electrolytes beverages during prolonged physical activity or on extended missions (Chapter 11, page 90).

Hot Environments





How hot is too hot? Heat advisories are announced when a wet bulb-globe temperature (WB-GT) is over 87° F (30.5° C) or when temperature and humidity are over 85° F and 60%, respectively. Under these conditions exercise should be performed indoors or undertaken with caution. Any time you perform physical activities in the heat, you will lose a lot of water and electrolytes through sweat. Only the sweat that evaporates effectively cools the body; sweat that "drips" provides little cooling effect. As you adapt to the heat, you will start producing more dilute sweat (less salty) to conserve electrolytes. Factors that can limit "effective cooling" include high humidity, impermeable clothing, and skin conditions, such as sunburns or rashes.

Energy Needs

Although appetites may be suppressed in the hot weather, especially during the first few days after arriving, adequate caloric intake is very important. Inadequate food intake will lead to weight loss which can impair both physical and mental performance. When you do the same task in a hot environment, energy requirements are increased due to the increased work of maintaining a normal body temperature. When living and working in temperatures ranging from 86° to 104°F (30° to 40°C), kcal intakes should be increased by 10%, unless your activity level decreases accordingly.

If your activity level decreases,
you do not need extra kcals!

Worksheet 12-1. Calculate Your Energy Requirements for a Hot Environment

Your Estimated Energy Requirement (EER) = _____kcal/day.
(from Worksheet 1-2)

A 10% increase in energy requirements equals:

_____ EER x 0.10 = _____ kcal/day.

Your total energy requirement equals:

_____ EER + _____ 10% increase= _____ kcal/day.

Tips for Maintaining Performance in a Hot Environment

- Prepare by maximizing aerobic fitness before your exposure.
- Plan your workouts to avoid the heat of the day.
- Plan for decreased physical performance the first two weeks.
- Drink plenty of fluids and eat enough kcals.
- Be aware of any symptoms that may predispose you to dehydration (diarrhea, vomiting, fever).
- Be aware of the warning signs of heat illness. Stop if signs or symptoms of heat injury become apparent (See Chapter 13).
- Avoid substances that can lead to dehydration or heat injuries.

Table 12-1. Substances that Can Cause Dehydration

Caffeine	Alcohol	Decongestants
Antihistamines	Atropine and other anticholenergics	

Check with the medical department for other substances that may affect fluid balance.

Cold Environments

What is a cold environment? It is considered cold if the air temperature is below 15° F and the wind speed is greater than 25 m.p.h, or the water temperature is below 64°F. Cold wind and cold water accelerate heat loss by replacing the warm layer of air or water surrounding the body with colder air or water.

The body responds to cold by constricting (tightening) blood vessels to conserve heat and by shivering to generate heat and guard against hypothermia. There is increased urination and increased energy metabolism in cold environments, both on land and in water.

Energy Needs

Many studies have shown that soldiers tend to progressively lose weight when conducting field exercises in the cold for two to three weeks. Because significant weight loss can result in fatigue and performance decrements, energy intake must increase to meet the increased energy demands. Energy requirements can increase by 25 to 50% because of the increased work associated with performing physical tasks in the cold and the kcal expenditure due to shivering. Factors that increase energy requirements in the cold include:

- Increased basal metabolic rate (BMR, see page 3).
- Shivering.
- Working in cold weather gear.

To meet energy needs consume a diet that is high in CHO (roughly 60% of your total daily kcals). This will replace glycogen stores (page 7) that are being used to maintain body temperature. Eat frequent high-CHO snacks to help meet your kcal requirements. Keep fat intakes under 30% of your total daily kcals since high-fat diets may cause stomach upset. Keep protein intakes at 10% of your total daily kcals and avoid protein and amino acid supplements because high-protein intakes increase water losses.

Worksheet 12-2. Calculate Your Energy Requirements for a Cold Environment

Your Estimated Energy Requirement (EER) = _____kcal/day.
(from Worksheet 1-2)

A 25% increase in energy requirements equals:

_____ EER x 0.25 = _____ kcal/day.

Your total energy requirement equals:

_____ EER + _____ 25% increase= _____ kcal/day.

e.g., If your EER is 3,000 kcals/day then in a cold environment your energy needs would increase by 3,000 kcals x 0.25 = 750 kcals/day. Your total daily energy requirement would be 3,000 kcals + 750 kcals = 3,750 kcals/day.

Vitamin and Mineral Needs

In addition to increased energy requirements, increased intakes of many of the vitamins and minerals may be useful for maintaining performance when working for prolonged periods in the cold. Vitamin and mineral recommendations have been developed to account for possible increased requirements based on intake data from field studies, urinary excretion of nutrients, and other measures of "nutrient status". Table 12-2 presents the suggested additional amount of some nutrients that may be needed when working in the cold. See Chapter 2, Table 2-2 and Table 2-3 for a list of food sources for these nutrients. In most cases, if you meet your energy requirements by eating all ration components, you should be meeting your vitamin and mineral needs.

Table 12-2. Suggested Additional Intakes of Micronutrients During Cold Weather Training

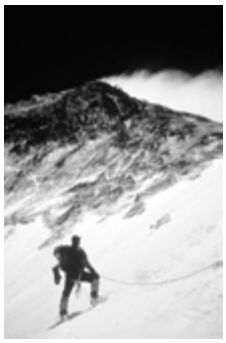
Nutrient	Suggested Increase*	Nutrient	Suggested Increase
Vitamin B_1 (Thiamin)	3 mg	Folic Acid	200 μg
Vitamin B_2 (Riboflavin)	2 mg	Vitamin B_{12}	1 μg
Vitamin B_3 (Niacin)	5 mg	Magnesium	200 mg
Pantothenic Acid	5 mg	Zinc	5 mg

Adapted from Reynolds RD. (1995) Effects of Cold and Altitude on Vitamin and Mineral Requirements. In: Marriot BM (Ed). *Nutrient Requirements for Work in Cold and High Altitude Environments*. Washington, DC: National Academy Press. *Amounts in addition to the RDA (see Chapter 2).

Tips for Maintaining Performance in a Cold Environment

- Check weather conditions, dress appropriately, and avoid profuse sweating.
- Allow for a longer warm-up.
- Replenish CHO and electrolyte losses.
- Drink plenty of fluids and try to avoid substances that cause dehydration (see page 93 and Table 12-1).
- Be aware of the signs of cold injury (see Chapter 13).
- Eat snow only after melting and purifying it.

Altitude



Ascent to altitude can cause a variety of physiologic disturbances due to the drops in temperature and humidity, and the lack of oxygen. Some major concerns are weight loss, disturbances in digestion, and vitamin, mineral and fluid needs.

Physical performance can suffer dramatically with changes in altitude. The lower oxygen concentrations at altitude can reduce aerobic capacity by 1-2% every 100 meters (328 feet) above 1,500 meters (4,918 feet). Many adaptations occur during extended exposure to high altitudes including:

- Increased number of oxygen-carrying proteins in the blood (hemoglobin) and muscle.
- Increased density of blood vessels to and within the muscle.
- Increased rate of respiration.

Adequate nutrition can play a crucial role in maintaining performance.

Energy Needs

Energy requirements are 15-50% greater than at sea level

Virtually all persons who go to altitude experience weight loss and loss of lean body mass. At altitudes below 5,000 m weight loss can be prevented by increased caloric intake; whereas above 5,000 m, a 5-10% weight loss is inevitable. Some reasons for weight loss at high-altitude are:

- Energy requirements are 15-50% greater than at sea level.
- Decreased appetite and sense of taste.
- Loss of body water from increased breathing rate and dry air.
- Impaired absorption of nutrients.
- Acute Mountain Sickness (AMS) - symptoms include headache, nausea, vomiting, fatigue and poor appetite.

Worksheet 12-3. Calculate Your Energy Requirements at Altitude

Your Estimated Energy Requirement (EER) = _____kcal/day
(see Chapter 1)

A 50% increase in energy requirements equals:

_____ EER x 0.50 = _____ kcal/day

Your total energy requirement equals:

_____ EER + _____ 50% increase= _____ kcal/day

A high-CHO diet (60% of total daily kcals) is preferred at altitude because it restores glycogen, requires less oxygen to metabolize than a high-fat diet, and can blunt or delay the severity of AMS symptoms.

Vitamin and Mineral Needs

Vitamin and mineral needs are likely to increase at altitude. In particular, the increased metabolic rate and the lack of oxygen can increase the production of harmful free radicals. These free radicals can slow blood circulation and impair physical performance. Preliminary findings in men indicate that taking 400 IU per day of vitamin E, an antioxidant, at high altitude reduces free radical production and maintains aerobic energy production. Increased amounts of many other nutrients should be considered, especially since food intake usually decreases (see Table 12-2).

Tips for Maintaining Performance at Altitudes

- Plan on decreased physical performance the first few weeks.
- Drink plenty of fluids. Fluid requirements may be as high as 4.25 quarts, or more, each day.
- Listen to your body, be aware of any warning signs of illness or symptoms of AMS and seek medical attention.
- Try to avoid substances that cause dehydration (Table 12-1).

As noted throughout this chapter, meeting energy and fluid requirements are vital for maintaining physical performance in adverse environmental conditions. Being physically fit and eating a healthy diet prior to deployment will greatly improve your acclimation and adaptation to the new environment.

13 Training and Overuse Injuries

In this chapter you will learn about:

- Treatment and prevention of injuries.
- When to seek medical care.
- Returning to duty.
- Overtraining syndrome.

One of the hazards of physical training is becoming injured. Sustaining either a sudden injury or an overuse injury can mean loss of work days, forced rest, and pain for a period of days to weeks. The goal of this chapter is not to have you treat your own injuries, but rather to be informed so that you will seek appropriate help when needed. Central to rapid recovery from training-related injuries is a step-wise reconditioning program which starts immediately after the injury. Such programs are designed to arrest the inflammatory process, promote healing and accelerate the return to full duty.

Injuries: Treatment and Prevention

A variety of injuries can occur during physical training. Table 13-1 has a brief description of acute and overuse injuries, as well as their treatment and prevention. Both sudden-onset and recurring injuries can result in inflammation (localized warmth, swelling, redness and pain). If left unchecked the inflammatory response rapidly leads to:

- Tissue swelling.
- Loss of normal function.
- Decreased range of motion of the joint.
- Stiffness.
- Weakness.

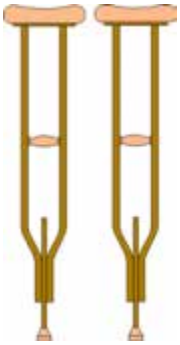
Table 13-1. Injuries, Treatments, and Prevention

Injury	Treatment	Prevention
Delayed-Onset Muscle Soreness - Muscle pain occurring in deconditioned muscle 12-72+ hours after training.	Ice, stretch, warm-up. Do not use NSAIDs.	Resolves as muscle adapts to training. Slowly increase training intensity.
Contusions - Swelling and bleeding (bruising) in the muscle, tendon, or bone due to a direct blow.	Ice	Wear protective gear.
Muscle Cramp - Muscle pain caused by prolonged activity, high heat or humidity, dehydration, and poor conditioning.	Rehydrate (Chapter 2), stretch, massage with ice.	Allow time to adjust to training and climate; drink frequently.
True Fractures - Break or chip in the bone.	Seek medical help.	Use protective gear; recondition.
Stress Fractures - Pain and weakening of the bone caused by excessive stress and use.	Seek medical help.	Reduce high-impact activities, cross-train, use proper gear, slowly increase training.
Sprains - Acute or overuse injury to ligaments (connective tissue that joins bone to bone).	RICE.* Seek medical help.	Follow medical advise; slowly increase training intensity, use proper gear.
Strains, Tendonitis - Acute or overuse injury to muscle or tendons (connective tissue that joins muscle to bone).	RICE. Seek medical help.	See “Sprains.”
Heat Injuries (cramp, exhaustion, heat stroke) - Painful muscle contractions, nausea, fatigue, fever, or dizziness from dehydration and electrolyte depletion; fevers >104°F can damage vital organs and result in death.	Place person in a cool location and rehydrate. Seek medical help.	Acclimate to climate, avoid exercise in extreme heat, avoid substances that cause dehydration (Chapter 12), stay well hydrated (Chapter 2).
Cold Injuries (hypothermia, frost bite, trench foot) - Body temperature <95°F causing shivers, slurred speech, clumsiness, and freezing of exposed body parts.	Gently place the person in dry blankets with another warm person.	Wear proper gear, stay dry, avoid exercise in extreme cold, stay well hydrated (Chapter 2).

RICE = rest, ice, compression, and elevation. See page 102.

The treatment of any injury should focus on controlling the inflammation and allowing full joint range of motion for a rapid return to daily activities. To accelerate healing, you must first decrease the inflammatory process. Treatment steps to achieve this include:

RICE = Rest + Ice + Compression + Elevation



- **Rest** - partial or no weight-bearing of the extremity, using crutches for locomotion. "Relative Rest" means decreasing activities that cause pain and replacing them with activities that are pain-free.
- **Ice** - as soon as possible apply ice, wrapped in a bag or towel, to the injured area. Ice for 20 minutes every two hours on the first day, then 3 times a day until the swelling has decreased. To prevent nerve damage, do not ice for longer than 20 minutes at a time. Never apply ice directly to the skin or to an open wound!
- **Compression** - wrap the injury for periods of 2-4 hours. Never sleep with a compression wrap unless medically advised.
- **Elevation** - place the injury above the level of the heart, allowing gravity to reduce the swelling.

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

In addition to RICE, non-steroidal anti-inflammatory drugs (NSAIDs) are often used to decrease the symptoms due to inflammation and fever associated with injury. Although NSAIDs are usually available over-the-counter, these medications should not be taken lightly. In the case of an acute injury which involves bleeding, bruising, or swelling, NSAIDs should not be started until after the bleeding has stopped (may take days) and the swelling has stabilized. Some side-effects of NSAIDs include:

- Nausea, heartburn, vomiting, ulcers, and bleeding.
- Increased blood pressure.
- Decreases the ability of blood to clot.
- Worsening of asthma.
- Potential kidney damage with long-term use.

Some of the most common NSAIDs are aspirin (Bayer, Aspirin, Ecotrin),

ibuprofen (Advil, Motrin), and ketoprofen (Orudis). Remember: NSAIDs should not be used with alcohol. If you have stomach or gastrointestinal problems, check with your doctor for the appropriate pain reliever.

When to Seek Medical Care

Table 13-1 provides the description, prevention, and treatment for some training injuries. Knowing the differences between these injuries will help you safely administer first aid treatment, should they occur, and help you determine when you need to seek medical treatment. Some conditions demand immediate medical attention, including:

- Numbness.
- Joint dislocation.
- Suspected fracture.
- Any hip pain which causes a limp.
- Back pain that radiates into the thigh, leg or foot.
- Severe pain or pain limiting activity for 3 to 5 days.
- Any lower extremity injury in which the individual is unable to bear weight.

Return to Duty

After the pain and swelling are reduced and full range of motion is possible, ask your physician or physical therapist to design a reconditioning exercise program with the overall goal of **returning to full activity**. The exercises prescribed will be specific to the site and type of injury, and will work towards maximizing:

- Flexibility.
- Strength.
- Endurance.
- Power.
- Speed.
- Specific Duty Tasks.

Overtraining Syndrome

Overtraining can negatively affect physical and mental performance. Moreover, it can increase the likelihood of sustaining an injury. Overtraining is exactly what the word implies: **too much physical activity**.

The **overtraining syndrome** can present with a wide range of physiologic or psychological symptoms which vary widely among individuals (See Table 13-2). Overtraining is generally associated with endurance sports, such as swimming or running. The best indicators of overtraining include a 10-15 beat elevation in (morning) resting heart rate and an altered mood state, such as feelings of frustration, anger, depression or apathy. Cross-training, rest, monitoring of morning heart rate, assessing mood and taking time off from certain physical activities will all reduce overtraining symptoms and injuries. The person who continues training despite the symptoms listed in Table 13-2 will only become more overtrained, continue to have decreases in performance, and will be at an increased risk for injury.

Table 13-2. Symptoms of Overtraining Syndrome

◆ Decreases in performance and strength.	◆ Feeling “burned-out” or stale.
◆ Difficulty making decisions.	◆ Difficulty concentrating.
◆ Chronically fatigued.	◆ Angry and irritable.
◆ Lacking motivation.	◆ Muscle soreness.
◆ Disturbances in mood.	◆ Increased distractibility.
◆ Feelings of depression.	◆ Difficulty sleeping.

14 Supplements and Performance

In this chapter you will learn about:

- Vitamin and mineral supplements.
- Nutritional ergogenic agents; hype versus reality.
- Risks associated with using performance enhancers.
- Ergolytic agents.

Gaining and maintaining physical fitness takes time and dedication. Often, to achieve these goals, people turn to various supplements based on their claims as performance enhancers. However, **no** supplement can replace the benefits of a well-planned exercise routine and a nutritionally-sound diet!

The definition of a nutritional supplement is "a nutrient taken in addition to your diet". An **ergogenic agent** is a substance taken with the intent of improving physical performance. This chapter will address vitamin and mineral supplements, nutritional ergogenic agents (performance enhancers), and substances that can be harmful to your health and decrease physical performance.

Vitamin and Mineral Supplements

Taking a vitamin or mineral supplement may be something you are considering, especially if you find it difficult to eat a variety of foods. Due to the various physiologic functions of vitamins and minerals, the supplement industry has tried to encourage supplement use by physically active people. However, multivitamin and mineral supplements do not appear to enhance performance in healthy, well-nourished individuals. A multivitamin and mineral supplement is useful if:

- You have an existing vitamin or mineral deficiency.

- You have poor dietary habits. In this case, increase the amount of nutrient dense foods and food variety in your diet!
- You are exposed to extreme environmental conditions, such as cold climates or high altitudes (Chapter 12).

Buying Vitamin and Mineral Supplements

The more informed you are about the marketing and manufacturing of supplements the more likely you can save money and still buy a good supplement. Facts you should know before buying a supplement are:

- Amount of Nutrients - Follow RDA/DRI guidelines in Chapter 2, taking too much of certain nutrients can be toxic. If you choose to supplement, take a multi-vitamin and mineral supplement that supplies nutrients in amounts close to the RDA/DRIs. Excessive amounts of a single nutrient can upset your nutrient balance and cause a deficiency of other nutrients. Avoid “high potency” supplements.
- Natural Versus Synthetic Vitamins - Both forms are used by your body. If manufacturers add plant extracts or a bit of the natural vitamin, they label the supplement as “natural” and sell it at a higher price.
- Additives - Many supplements contain additives that may cause headaches or other side effects in some people.
- Store Brands Versus Name Brand - A store brand supplement from a national retailer is of similar quality to a name brand supplement.
- Disintegration Rate - Supplement disintegration in the gut should meet the U.S. Pharmacopoeia (USP) standards (found on the label) of 30 to 45 minutes. This does not apply to time-release or chewables.
- Check the expiration date of the supplements you buy.
- Stress tablets are a marketing ploy.
- Men should not take iron supplements, unless directed by their doctor.

Nutritional Ergogenic Agents

Taking performance-enhancing supplements is a personal choice. Table 14-1, which lists some popular ergogenic agents grouped by type (identified in bold), their claimed benefits, and research findings, is designed to educate you as a consumer. Many of the ergogenic agents listed in this table are classified as nutritional supplements. When marketed as a nutritional supplement, these substances are not regulated by the Federal Drug Administration (FDA). Often this means that the performance claims and the risks associated with using these substances have not been thoroughly tested.

Table 14-1. Claims and Risks of Ergogenic Agents

	Name	Claims	Benefit / Risk / Side Effect
Energy Enhancers	Inosine	Increases endurance and strength, facilitates post-exercise recovery, increases oxygen release to tissues.	No benefits demonstrated; may cause an increase in free radical production.
	Coenzyme Q10 (COQ10)	Raises heart enzyme levels to increase aerobic energy production.	No benefits in normal, healthy people.
	Desiccated Liver	Increase energy and performance by supplying extra vitamins and minerals.	No benefits demonstrated.
	Bee Pollen	Improves performance and post-exercise recovery because it is a natural food with numerous nutrients.	No benefits demonstrated; may cause allergic reactions.
Fat Burners Lean Body Mass	L-Carnitine	Delays fatigue by increasing the use of fats for energy.	No benefits demonstrated; diet meets needs; not depleted with exercise; may cause nausea, vomiting and cramps.
	Gamma Oryzanol, Ferulic Acid	Increases testosterone and lean body mass.	No benefits demonstrated; the plant sterols are not readily absorbed by the body.
	Hydroxy-Methyl-Butyrate (HMB)	Slows muscle breakdown during intense training, increases strength.	Research is inconclusive.
	Chromium Picolinate	Increases muscle mass, burns fat by enhancing the function of insulin.	Benefits are questionable; may cause stomach upset, anemia, or DNA damage.

Table 14-1. Claims and Risks of Ergogenic Agents

	Name	Claims	Benefit / Risk / Side Effect
Growth Hormone (GH) Releasers	Arginine, Lysine, Ornithine	Stimulate GH release.	Some benefits for Arginine and Lysine, but not Orthinine; may cause gastrointestinal (GI) upset, potential amino acid imbalances, and decreases in GH.
	Branched chain Amino Acids (Leucine, Isoleucine, Valine)	Stimulate GH, enhance muscle strength, endurance, and aerobic capacity by providing fuel to muscle and sparing muscle protein.	Some benefits demonstrated; may cause diarrhea and cramping.
	Free Amino Acids	More readily absorbed in gut.	Little benefit demonstrated.
	Dibencozide, Cobamamide	Promotes growth.	No benefits demonstrated on performance.
Glycogen Sparers	40-30-30, high fat/ protein diets	Increase endurance by promoting fat metabolism.	Some benefits; potential long-term risks are increased blood cholesterol and heart disease. Diet change 24-48 hr. before event leads to decrease in performance.
	Medium Chain Triglycerides	Increase energy and decrease body fat because they are easier to absorb and use as fuel than triglycerides.	No benefits demonstrated; may cause GI problems.
	Ginseng	Reduces fatigue, increases energy and work capacity.	No benefit demonstrated; may cause allergic reaction or excitability; may contain alcohol.
	Lactate	Delays fatigue by maintaining blood glucose levels.	Some benefits demonstrated.
	Caffeine	Delays fatigue, burns fat, increases performance by elevating fatty acid levels in blood.	Some benefits; may cause irritability, GI pain, tremors, loss of concentration, and interfere with iron absorption. No increase in anaerobic or maximal aerobic capacity. Fewer benefits seen in habitual users.
	Choline	Delays fatigue, reduces fat, improves physical and mental performance.	Benefits questionable; may cause nausea, diarrhea, and “fishy” body odor.

Table 14-1. Claims and Risks of Ergogenic Agents

	Name	Claims	Benefit / Risk / Side Effect
Intercellular Buffers	Phosphate Salts	Delay fatigue and increase oxygen transport to muscle.	Results questionable; may cause GI upset.
	Aspartate Salts (Magnesium/ Potassium)	Increase aerobic capacity, delay fatigue by neutralizing ammonia produced during exercise.	Results are inconclusive.
	Citrate	Increases endurance and delays onset of fatigue by buffering hydrogen ions produced during metabolism.	Some benefits demonstrated; may cause GI upset, diarrhea, nausea. Avoid large doses.
	Sodium Bicarbonate	Delays fatigue during short, high intensity exercise by buffering lactic acid.	Some benefits demonstrated; may cause cramps or diarrhea.
Testosterone Enhancers	Glandulars (grounded organs)	Ingesting animal organs high in testosterone leads to greater lean muscle mass.	No benefits demonstrated; may cause your own production of testosterone to decline.
	Sapogenins (Smilax, Diascorea, Trillium, Yucca, Sarsaparilla)	Ingesting testosterone precursors leads to greater testosterone concentrations and muscle mass.	No benefits demonstrated; may cause light-headedness or aggression.
	Yohimbine	Aphrodisiac and purported to cure male impotence. Increases muscle mass and decreases body fat.	No demonstrated increase in testosterone levels; conflicting results with regard to impotence; may cause dizziness, nausea, headaches, or depression.
	Boron	Increases production of testosterone.	No benefits demonstrated; may cause rashes nausea, vomiting, diarrhea, lethargy.
	Androstenedione, Androstenediol, Norandrostenediol Andro	Increases energy, strength, muscle mass, and possibly greater sexual arousal and sense of well-being. Termed “prohormones.”.	Considered a steroid; banned by many organizations; long-term risks are not well known. Risk of failing drug tests. “Natural” does not mean “safe”!
	DHEA	Slows aging, builds muscle, burns fat, boosts libido by increasing testosterone in body.	Little or no benefits demonstrated with respect to performance; side effects include acne, nausea, virilization. May increase risk of some cancers.

Table 14-1. Claims and Risks of Ergogenic Agents

	Name	Claims	Benefit / Risk / Side Effect
Miscellaneous	Octacosanol (Wheat Germ Oil)	Improves aerobic capacity by enhancing central nervous system function.	Some benefits demonstrated in reaction times but not aerobic capacity; may cause allergic reactions.
	Glycerol	Improves endurance by increasing blood volumes and decreasing core temperatures.	No benefits demonstrated; may cause cellular dehydration, nausea, vomiting, diarrhea.
	Omega-3 Fatty Acids	Improve aerobic capacity.	No ergogenic effects have been demonstrated.
	Creatine	Increases stores of Creatine phosphate in muscle used for ATP-PC anaerobic energy system.	Some benefits demonstrated during short-term, high intensity exercise, but negated if ingested with caffeine.
	Tyrosine	Maintains cognitive performance during cold, stressful, or distracting conditions.	Benefits demonstrated.
	Glutamine	Promotes muscle growth, prevents fatigue, overtraining, and immune deficiency.	No performance benefits demonstrated.
	Glucosamine Sulfate with Chondroitin Sulphate	Component of connective tissue; has anti-inflammatory properties which increase recovery from musculoskeletal or overuse injuries.	Has potential for preventing and treating injuries, however, is not yet endorsed by doctors because of the lack of research.
	Melatonin	Increases mental and physical performance by enhancing quality of sleep.	Benefits demonstrated; may cause sleepiness and fatigue at time of administration, but not upon awakening.
	Steroids and Steroid Alternatives	Increase muscle mass.	Risks include aggressiveness, acne, changes in behavior/ emotions, injury to connective tissue, impaired immune function, tumors, shrinking of testicles, decrease sperm and testosterone production, and masculinization in women. Use banned by the military.

Other sources of information include the **Ergogenics Pamphlet** (http://www.usuhs.mil/mim/ergopam.pdf); the Alcohol Tobacco and Firearms web site at http://www.ATF.treas.gov; the Federal Drug Agency at http://www.fda.gov (select the "Food" icon); and the Federal Trade Commission at http://www.ftc.gov (search "consumer publications"). Be aware of substances that are banned by the military and various athletic associations.

Ergolytic Agents

Ergolytic agents are those substances which impair physical and/or mental performance. When using these substances, you are undoing the benefits gained through training. Hopefully, by avoiding these substances, you can maximally improve your physical fitness and performance.

Table 14-2. Ergolytic Agents and Performance

Name	Common Beliefs	Side Effects / Risks
Alcohol	Relaxes, increases self-confidence, alters perception of fatigue.	Heavy drinking can cause severe dehydration and decrease performance.
Stimulants: amphetamines, ephedrine	Improve performance by increasing central nervous system arousal.	Banned by the military; increases heart rate, increases blood pressure; may cause dizziness, stomach upset, irritability, insomnia, and death.
Cigarettes or Smokeless Tobacco (Nicotine)	Buzz leads to improved performance and reaction time.	Increases heart rate and blood pressure, leading to decreased performance.

15 Training Issues for Women

In this chapter you will learn about:

- Guidelines for exercise during pregnancy and lactation.
- Eating Disorders
- Osteoporosis.

Guidelines for nutrition and exercise for optimal health and performance are the same for women and men. However, special issues, such as pregnancy, will alter these practices. Seek the advice of your physician, Registered Dietitian, Health Promotion personnel, or contact the American College of Obstetricians and Gynecologists (ACOG) at (202)863-2518 for more information on women's health.

Pregnancy and Lactation

Pregnancy is one of the most physiologically stressful events undergone by healthy women. Because exercise is also a physiologic stress, there have been concerns about the effects of exercise on the health of the mother and child during pregnancy. To address these concerns, ACOG has established guidelines for exercise during pregnancy. The general consensus is that women in good health may continue (or start) exercising during pregnancy. However, each woman should consult her physician for personal recommendations.

Proper nutrition and routine exercise during pregnancy is important for your health and the health of your baby. Table 15-1 outlines general nutrition and exercise guidelines that you should follow during pregnancy.

Table 15-1. Nutrition and Exercise Guidelines for Pregnant Women

Nutrition Guidelines	Exercise Guidelines
Choose nutrient dense foods (Chapter 3, page 23).	Exercise at least three times per week. Ideally, start this before your pregnancy or during the first trimester. Consult your doctor.
Eat according to the Food Guide Pyramid to meet your increased energy needs (Chapter 3).	Monitor exercise intensity according to perceived exertion or effort (Chapter 5). Target heart rate zone is not accurate since heart rate is higher during pregnancy.
Get adequate folate intakes prior to and during pregnancy to prevent birth defects (Chapter 2, Table 2-2).	Try swimming as it is an excellent, low-impact aerobic exercise and the water helps regulate body temperature.
Talk to your doctor about the proper amount of weight to gain for your pregnancy.	Stop exercise if you feel short of breath, feel any pain, feel dizzy or faint, or have contractions.
Meet nutritional demands for both pregnancy and exercise. You should not attempt to lose weight.	Avoid supine (lying on your back) exercises after the first three months of pregnancy.
Drink adequate amounts of water for both hydration and dissipation of heat.	Avoid activities that may result in trauma to the abdominal area, such as contact sports.
	Avoid exercises requiring balance, especially during the last three months of pregnancy.
	Avoid exhaustive and maximal exercise.
	Avoid exercising in environmental extremes.
	Avoid saunas, stream rooms, and whirlpools.

Exercise guidelines adapted from the AGOC exercise guidelines.

There are some contraindications to exercise during pregnancy. If you have any of the contraindications listed below, discuss them with your doctor.

- High blood pressure.
- Anemia.
- History of premature labor.
- Third trimester breech.
- Extremely sedentary lifestyle.
- Multiple spontaneous abortions.
- Irregular heart beats.
- Premature labor.
- Diabetes.
- Extreme obesity or underweight.
- Incompetent cervix.
- Unexplained complications.

- Thyroid, cardiac, vascular, or lung disease.
- Carrying more than one baby.
- Bleeding or abnormal symptoms during this pregnancy.

After the baby's birth, gradually resume exercise, ultimately building up to your pre-pregnancy levels of duration and intensity. To lose weight after your pregnancy, do so according to the guidelines in Chapter 1 and the **Navy Nutrition and Weight Control Self-Study Guide** (NAVPERS 15602A).

Nutrition and Exercise Guidelines for Lactating Women

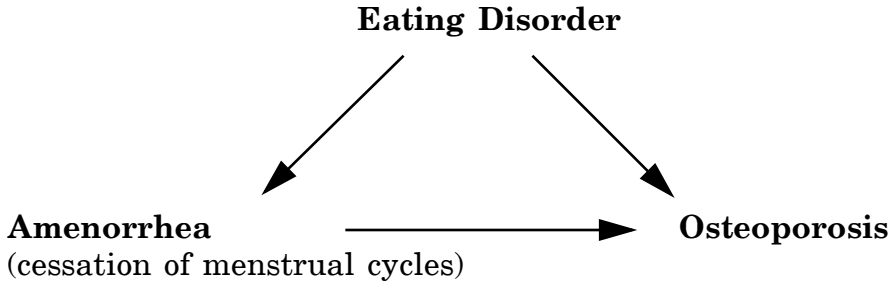
Consult your baby's pediatrician or your family physician with questions and concerns you have about your and your baby's diet.

- Energy needs are higher when breast feeding than during pregnancy. Consume adequate kcals (roughly an extra 500 kcal per day).
- Choose nutrient dense foods (Chapter 3, page 23).
- Drink adequate fluids to prevent dehydration.
- Consume adequate calcium (see Chapter 2).
- Lactic acid production during exercise can affect the taste of breast milk, so breast feed prior to exercise.
- If you drink coffee, drink less than 2 cups a day; the caffeine may cause your baby to be sleepless and irritable.
- Avoid alcohol; alcohol enters the breast milk and can decrease the baby's appetite.
- Avoid cigarette smoking; smoking decreases milk production.

Female Athlete Triad

The Female Athlete Triad is a trio of associated disorders found among female athletes trying to balance the pressures of body image and physical performance. The triad (Figure 15-1), marked by inadequate food intake, menstrual abnormalities, and bone loss, can be fatal if left untreated. Therefore, a healthy relationship between food, body image, and performance must be established.

Figure 15-1. The Female Athlete Triad



Some signs of the Triad are:

- Dieting excessively to lose weight.
- Occurrence of stress fractures.
- Compulsively overexercising.
- Irregular or absent menstrual cycles.
- Self-esteem governed by body weight.

From FS Kaplan. Prevention and Management of Osteoporosis. **CIBA Clinical Symposia**. 47(1); 1995.

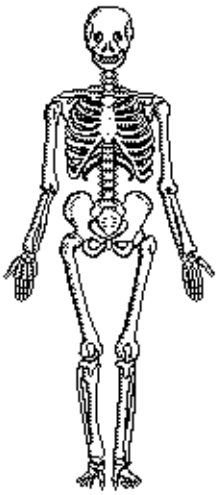
Eating Disorders

Eating disorders are more prevalent than one might think, especially among young female athletes. An eating disorder results in inadequate intakes of kcals and nutrients to replenish the energy used during daily activities. Two common types of eating disorders are Anorexia Nervosa and Bulimia Nervosa. Some behaviors people with eating disorders engage in are starvation, self-induced vomiting, excessive exercise, and the misuse of laxatives or diuretics. Both disorders are extremely damaging to the mind and body, and, if untreated, can lead to death. These disorders can have long-term health consequences by affecting the heart, liver, kidneys, and bone. In addition, these behaviors severely limit physical and mental performance.

Amenorrhea

Amenorrhea is the cessation of menstrual cycles. A women is considered amenorrheic when she misses three or more consecutive menstrual cycles. In well-nourished women, heavy physical training should not result in amenorrhea. When non-pregnant, premenopausal women become amenorrheic it may reflect malnutrition.

Osteoporosis



The decreased levels of female hormones during amenorrhea can lead to calcium loss from the bones and increase the likelihood of developing **osteoporosis** later in life. Osteoporosis is a major cause of bone fractures in the elderly. Bone density throughout the adult lifespan is greatly impacted by the amount of bone formed prior to the early thirties. Therefore, amenorrhea and eating disorders in young adults can negatively affect bone health for life. Prior to menopause, a healthy diet (including adequate calcium intakes) and the performance of weight bearing activities are the two factors that have the greatest positive influence on bone health (see Chapters 3, 4, 5, and 7). For more information on bone health, ask your doctor or health care provider.

16 | Age and Performance

In this chapter you will learn about:

- Age-associated changes in metabolism and body composition.
- Countering age-associated changes in physical performance.

Aging is a natural process that most, if not all, people would like to avoid. Most people associate aging with gaining weight, getting weaker, and not being able to perform many of the activities they did in their youth. Many of these conditions are actually the result of **inactivity**, not aging. Although there are several inevitable physiologic changes that will occur as you age, the degree of these changes can be manipulated through sound dietary and exercise practices.

Changes in Metabolism and Body Composition

Maintaining a healthy body weight and body fat percentage throughout your adult life is key to maintaining health and fitness as you age. This often seems easier said than done, considering basal metabolic rate (BMR, see Chapter 1) declines as you age.

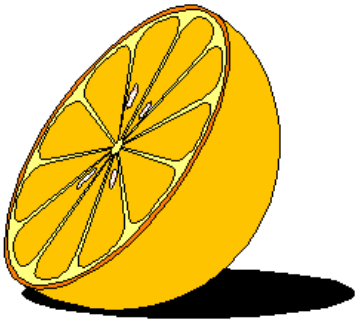
> With aging, expect to see a gradual decline in BMR, possibly resulting in needing 100 fewer kcal a day with each passing decade.
>
> Taken from Tufts University Health and Nutrition Letter. November 1998; 16(9): 6.

The loss of muscle mass as you age is directly responsible for the decline in BMR. Muscle is metabolically active, which means that it requires a set number of kcals each day to maintain its mass. On average, people lose some muscle mass each year after the age of 35 years. This results in fewer metabolic demands and less total daily kcal requirements. However, the amount of muscle mass that you lose is dependent upon how much physical activity you perform as you age, particularly activities that require muscle strength such as strength training. By engaging in strength training exercises you will preserve and possibly gain muscle mass, leading to a 10% to 15% boost in your BMR!

Along with a decrease in muscle mass, inactivity can also lead to an increase in body fat. This occurs if the number of kcals consumed is greater than the number of kcals expended through physical activity, as explained in the energy balance equations in Chapter 1. This simultaneous increase in body fat and decrease in muscle mass leads to a greater body mass index (BMI) and is associated with an increased risk for heart and blood vessel diseases, obesity, diabetes, and other diseases (see Chapter 1).

Any alterations in energy expenditure, either through changes in BMR or changes in physical activity level, need to be countered by changes in kcal intake to keep your net energy balance at zero and to maintain your current body weight. Therefore, a combination of sound nutritional practices and regular physical activity will enable you to maintain a healthy body weight and body composition and remain physically fit as you age.

Nutritional Needs



The Dietary Guidelines for Americans and the Food Guide Pyramid (outlined in Chapter 3) were designed to provide basic nutritional information and serve as educational tools for Americans over 2 years of age. Therefore, these guidelines should be followed to ensure good nutrition throughout your life. An important point to note is that although the age-related decline in BMR results in the need for fewer daily kcals, the requirements for nutrients such as vitamins, minerals, and proteins do not decrease with age (see Chapter 2). Therefore, proper food selection is essential to meet this challenge. Some ideas to help you meet your nutrient requirements without eating extra kcals include following the 5-A-Day campaign (eat at least five fruits and vegetables a day) and eating nutrient dense foods (see Chapter 3 and Appendix A).

Countering Age-Associated Changes in Fitness

Ever heard the saying "use it or lose it?" This is true for physical fitness. Whether it is muscle strength or aerobic endurance, if you do not remain physically active as you age you cannot maintain the muscle mass or heart adaptations you need for peak performance (review the effects of detraining listed in Chapter 4). Though aging can lead to decreases in fitness levels, the amount of decline is strictly dependent on your exercise routine. Therefore, age itself does not predispose you to have large decrements in physical performance.

Some gradual changes you can expect in your physical performance as you age are listed below.

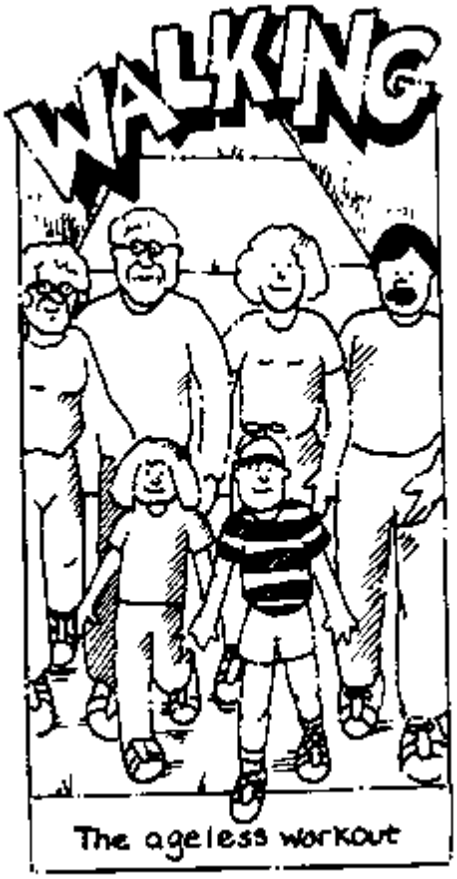
- **Aerobic Capacity** - Declines in aerobic capacity, about 5% to 15% per decade, can start occurring after the age of 30. This is due to a combination of less physical activity, a lowering of the maximal heart rate, and decreases in the elasticity of the blood vessels. Declines in aerobic capacity can be minimized by maintaining a regular aerobic exercise routine. In particular, maintaining your exercise intensity, even if you exercise less frequently each week, will enable you to preserve much of your cardiorespiratory fitness as you age (see Chapters 4, 5, and 6).
- **Anaerobic Performance** - Declines more than aerobic capacity mainly because people tend to perform less near-maximal exercise as they age. This decline can be minimized by performing speed work in addition to your aerobic conditioning (see Chapter 5 for performance-related workouts). Training for speed is only necessary if you want to maintain your performance-related fitness or are still participating in competitive sports (see Chapters 4 and 5).
- **Muscle Mass and Strength** - Both muscle mass, particularly the fast twitch fibers, and muscle strength decline after the age of 40. Losses can be minimized and even reversed if strength training exercises are performed regularly. As with aerobic fitness, the intensity of the strength exercises will determine the degree of your training benefits and slow the loss of muscle as you age (see Chapters 4, 7, 8, 10, and Appendix C).

- **Flexibility** - Connective tissue around your joints can become less elastic with age. However, no measurable declines in flexibility will occur if you regularly perform stretching exercises. Maintaining your flexibility is important as this determines the range of motion of your joints and decreases the feeling of stiffness in your joints. Flexibility also serves an important role in injury prevention and may reduce symptoms of arthritis. (See Chapters 4 and 9.)

Other fitness issues to be aware of as you age include the following:

- **Warm-Up and Cool-Down** - Longer warm-up and cool-down times are needed to optimize performance as you age, particularly if you are participating in strenuous exercise. These longer warm-up and cool-down times will help prepare your body for the upcoming exercise and reduce your risk of injury (see Chapter 4).
- **Recovery from Workouts** - You will need to allow for longer recovery times from strenuous workouts and competition as you age. You may actually notice this before you notice a decline in your performance. Listen to your body and allow for adequate recovery time by following a hard workout with a couple rest days or light workout days. In addition, allow your body adequate time to adapt to increases in your workout. Again, maintaining your intensity is more important than exercising more frequently to maintain your fitness. Also, pay attention to the warning signs of overtraining (see Chapter 13).
- **Recovery from Injuries** - As with recovery from a strenuous workout, you will need more time to recover from training injuries. Be patient and allow yourself to fully recover. This will help you avoid future injuries (see Chapter 13).
- **Cross-Training** - No specific exercise is better than another to offset all the health and fitness changes mentioned. However, many of these concerns can be addressed by cross-training, or altering the types of exercises you perform, throughout the week (see Chapter 5). By cross-training you can improve and maintain your aerobic fitness while recovering from intense workouts or while taking a break from weight-bearing exercises. This will help prevent overtraining and overuse injuries (see Chapter 13) while you remain physically active. Consider making cross-training a regular practice in your exercise routine, if it is not already.

As you grow older your responsibilities, interests, leisure time activities, as well as your level of motivation may affect how physically active you are. However, it is important to remember that a sedentary or inactive lifestyle, combined with poor eating habits, can increase the risk for developing obesity, heart disease, strokes, diabetes, some types of cancers, high blood pressure and osteoporosis. Adopting sound eating and exercise habits (the earlier the better) can help reduce the risk for developing the above mentioned diseases. Chapter 17 provides information on how to develop and maintain healthy habits.



17 Adopting Healthy Habits

In this chapter you will learn about:

- Setting SMART goals.
- Reaching goals.
- Evaluating progress.
- Staying motivated and overcoming setbacks.

Forming habits to enhance physical performance and for achieving a healthier lifestyle is both personally and professionally rewarding. Using the information provided in the preceding chapters, you can set goals, develop healthy habits and achieve your objectives. For example, if your objective is to improve cardiovascular fitness, use the information provided in Chapters 4, 5, 6, and 11 to design your a plan of action. Remember, effective programs for enhancing physical performance and overall health include both sound nutrition practices and appropriate physical training.

The process of developing and maintaining healthy habits can be challenging. It is a gradual process which requires commitment, effort and perseverance. Ultimately, the payoff will be in the form of enhanced job-related physical performance, being in great physical shape, and lowering your risk for developing chronic health problems as you get older. Everyone ages: steps you take now will last a lifetime!

Setting "SMART" Goals

As you go through the process of changing and adopting healthy habits, you are actively taking charge of your health. Begin by setting **S**pecific, **Measurable**, **A**ction-oriented, **R**ealistic and **T**imed (SMART) goals to meet your fitness and health-related objectives. A SMART goal should be:

- **Specific** - The more specific the goal, the easier it is to plan your routines to reach the goal. If you have a general goal, pick a specific area to focus on. For example, define "I want to increase my running distance" to "I will increase my running distance by one mile." Another example, restate "I want to increase my dietary fiber intake" as "I will add one additional serving each of fruits and vegetables to my daily diet".
- **Measurable** - Your specific goal should be easy for you to measure so you can chart your progress. Taking the running example above, you can easily measure the distance you run to determine if you are meeting your goal. As for the fiber example, you can record your fruit and vegetable intake (see Appendix A).
- **Action-oriented** - When defining a specific goal state exactly what actions you must do to achieve the goal. This becomes your plan to reach your goals. For example, "I will increase my run by a quarter mile every two weeks until I am able to run an additional mile."
- **Realistic** - Be realistic in your expectations of yourself and what you expect to gain. Taking large or long-term goals and breaking them into smaller, more manageable goals to keep you motivated and focused on your actions. For example, train for and run a 5k race, then build up to a 10k race.
- **Timed** - Time lines provide direction in planning short-term goals and actions to reach long-term goals and objectives. Using the running example above: two weeks is the deadline for increasing run distance by a quarter mile, and two months is the long-term deadline for increasing distance by one mile.

Table 17-1 lists a number of general nutrition and fitness-related goals to assist you in identifying your own goals and in designing and setting "SMART" goals as described above.

Table 17-1. Some General Nutrition and Fitness-Related Goals

General Nutrition-Related Goals	General Fitness-Related Goals
❑ Read food labels when buying foods.	❑ Health benefits (lower cholesterol, lower blood pressure, and lower stress).
❑ Eat foods according to their serving sizes.	❑ Improve/maintain heart and lung (cardiovascular) fitness.
❑ Eat at least 5 servings of fruits and vegetables each day.	❑ Improve/maintain muscular strength.
❑ Include foods that are good sources of calcium.	❑ Improve performance of job-related physically-demanding tasks.
❑ Follow the U.S. Dietary Guidelines.	❑ Maintain healthy body weight and body fat.
❑ Drink plenty of fluids to maintain fluid balance.	❑ Improve/maintain flexibility.
❑ Eat more dietary fiber.	❑ Have strong bones.
❑ Reduce saturated fat and cholesterol intakes.	❑ Improve physical appearance.
❑ Other:_____	❑ Other:_____

Reaching Goals

The more specific and realistic your goals, the easier it will be to develop and follow action plans to meet these goals. More than likely, unforeseen events will lead to altered plans; expect this and keep your ultimate goals in mind when replanning. Next incorporate your plan into your daily routines. At first you will have to consciously make efforts to follow your plans, but, after continuous practice, these plans will become your new habit. The following points and the steps and actions listed in Table 17-2 will help you reach your goals:

- Start simple: pick a goal that you feel will be easy to achieve.

- Work toward one goal at a time.
- If you notice that you are having difficulty achieving a goal, revise your plan and alter your strategy.

Table 17-2. Steps and Actions To Take To Reach Your SMART Goals

STEPS	ACTIONS
Develop	Develop an support system of friends, family and/or coworkers who will encourage you.
Make	Make change a priority; Make time; Remember you control your off-duty schedule.
Create	Create a plan of action -- one that works for you, motivates you and fits in your schedule.
Monitor	Monitor your progress -- use the tracking charts provided in Appendixes A and B.
Reward	Reward yourself when you meet a goal.
Use	Use long-term vision. Remember healthy habit will greatly enhance the quality of your life in later years.

Adapted from National Cancer Institute and Centers for Disease Control and Prevention (http://5aday.nci.nih.gov/).

Maintaining Healthy Habits

Once your "new" habit becomes a part of your routine and is performed without forethought or effort, you are maintaining, rather than adopting, this habit. Maintaining healthy habits during interruptions in your regular routine (such as vacations or illness) can create challenges of its own. So how can you maintain

your routine when faced with setbacks?

- Anticipate and try to avoid setbacks or upsets to your routine.
- Plan in advance how you will handle interruptions (e.g.vacation) to your schedule.
- Motivate yourself to restart your routine when things "return to normal". For example, give your workout buddy $20 before you go on vacation to keep on your behalf until you restart your exercise routine.
- Reward yourself once you have achieved maintenance for your goal. The reward should be appropriate for the goal attained (preferably non-food). For example: put $1 in a piggy bank for every workout you complete for a month and use it to buy yourself new exercise gear or a ticket to your favorite sporting event.
- Enhanced fitness builds self-confidence which is a powerful motivator!

Ultimately, your perceptions of the health and fitness benefits associated with healthy eating practices and regular exercise are important for maintaining healthy lifestyle behaviors. We hope that the information provided in this guide motivates you to personally follow healthy nutrition and physical fitness practices and to educate fellow navy personnel to do the same.

Appendix A: Ideas for Healthy Food Choices

Make gradual changes to your diet. Eating healthfully requires making overall smart food selections throughout your life. Choosing a food that is less nutritious every once in awhile does not mean your diet is bad; just make those foods the exception in your diet, not the rule.

Table A-1. Healthier Food Selections

	Try:	In place of:
Grains	Whole grains and pastas, and brown rice.	Bleached, white, or processed varieties.
	Cooking pastas and rice in broths.	Cooking pastas and rice in water with butter.
Vegetables/ Fruits	Low-fat or non-fat salad dressings or vinagrette on salads.	Creamy salad dressings.
	Vegetables marinated in herbs and lemon or lime juice.	Adding butter to vegetables.
Meats	Canadian bacon or ham.	Bacon.
	Ground turkey, extra-lean ground beef, or Lean, trimmed red meats.	Ground beef.
	2 egg whites.	1 whole egg.
	Poultry or fish.	Marbled red meats.
	Steaming, Broiling, Baking, or Grilling.	Frying.
Dairy	Low-fat or non-fat sour cream, cottage cheese (whipped until smooth), or yogurt.	Sour cream.
	Skim milk.	Whole milk or nondairy creamer.
	Low-fat cheeses.	Cheese.

Table A-1. Healthier Food Selections

	Try:	In place of:
Fats	Applesauce for baking.	Oil (1:1 substitution).
	Wine or broth-based sauces.	Cream and butter sauces.
	Canola, olive, and safflower oils.	Animal fats, coconut oil, and palm oil.
	Cocoa.	Chocolate.
	Spray butter or margarine.	Butter.

5-A-Day Challenge

Some ideas to help you increase the number of fruits and vegetables you eat each day to meet the 5-A-Day challenge are: (see Table 3-1 for serving sizes.)

- Eat fruit or drink fruit juice at breakfast.
- Snack on fruits and vegetables (especially bite-sized portions such as baby carrots or dried fruits) throughout the day.
- Include one or more side servings of vegetables at lunch and dinner.
- Eat at least one **Vitamin A-rich fruit or vegetable** - good food sources include apricot, cantaloupe, carrot, mango, papaya, pumpkin, spinach, sweet potato, romaine lettuce, mustard greens, winter squash, kale, and collards.
- Eat at least one **Vitamin C-rich fruit and vegetable** - good food sources include orange, grapefruit, kiwi, apricot, pineapple, cantaloupe, strawberry, tomato, mango, plum, broccoli, cauliflower, brussel sprouts, peppers, collards.
- Eat at least one **Fiber-rich fruit and vegetable** - good food sources include apple, banana, berries, figs, prunes, cherry, kiwi, orange, date, pear, cooked beans (kidney, lima, pinto, black, lentils), black-eyed peas, peas, carrot, potato, and corn.
- Eat at least one **Cruciferous vegetable** (from cabbage family) - examples include broccoli, cauliflower, brussel sprouts, bok choy, red and green cabbage, kale, and turnip.

Remember: 5 fruits and vegetables a day is the minimum - more is better!

Worksheet A-1. Nutrition Tracking Guide

Food Groups	Date: _____	Date: _____	Date: _____	Date: _____
Grains & Cereals 6-11 servings				
Fruit 2-4 servings				
Vegetable 3-5 servings				
Meat & Meat Substitute 2-3 servings				
Dairy 2-3 servings				
Fats, Oils, & Sweets	Use Sparingly	Use Sparingly	Use Sparingly	Use Sparingly

Note: See Chapter 3 for recommended number of servings and serving sizes. Check off the number of servings you eat each day from each of the food groups. 1 circle = 1 serving.

Appendix B: Sample Workout

This is a general cardiovascular and strength workout. Feel free to substitute or add exercises according to the guidelines described in Chapters 5 and 7. Use Worksheet B-1 and Worksheet B-2 to design your workouts and chart your training progress.

Table B-1. Sample Workout

Sequence	Activity	Frequency	Intensity	Time
Warm-up		before exercise	50% maxHR	5 min.
Aerobic	Walk, Run, Swim, etc.	3 to 7 days/week	60 to 75% maxHR	30 to 60 min
Cool-down		after exercise	100 bpm	5 min.
Strength		3 days/week (Mon, Wed, Fri or Tues, Thurs, Sat)	2 sets of 12 repetitions	20 to 45min
Legs	Squats			
	Leg Curl			
Chest	Chest Press			
Back	Seated Row			
Shoulder	Lateral Raise			
Triceps	Triceps Extension			
Biceps	Biceps Curl			
Lower Back	Back Extension			
Abdominals	Ab Crunch			
	Side Crunch			
Stretch		3 to 7 days/week	30 seconds X 2	10 min
	Quadriceps			
	Hamstring			
	Pretzel			
	Butterfly			
	Chest			
	Upper Back			
	Rock-n-roll			
	Lizard			

Note that the duration of this workout is dependent on the number of exercises that are performed and the length of the aerobic exercise. Perform the number and duration of exercises that are appropriate for your fitness level and adjust the routine as your fitness improves.

Worksheet B-1. Aerobic Exercise Log

Date:							
Type							
Heart Rate							
Time							
Comments							
Date							
Type							
Heart Rate							
Time							
Comments							
Date							
Type							
Heart Rate							
Time							
Comments							
Date							
Type							
Heart Rate							
Time							
Comments							

Under "Comments", list the type of workout you performed (i.e., intervals, fartleks), how you felt during exercise, your perceived exertion (6-20 on the Borg scale), or any other measure that you use to track your progress.

Worksheet B-2. Strength Exercise Log

	Exercises:	Date:_____ set x rep / wgt	Date:_____ set x rep / wgt	Date:_____ set x rep / wgt	Date:_____ set x rep / wgt	Date:_____ set x rep / wgt	Date:_____ set x rep / wgt	Date:_____ set x rep / wgt	Date:_____ set x rep / wgt
Chest		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
Back		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
Shoulders & Arms		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
Legs		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
Lower Back & Abs		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
		/	/	/	/	/	/	/	/
Remember to stretch!									

See Chapter 7 for strength training guidelines. Rep = repetition; Set = the number of reps performed without resting; wgt = weight lifted.

Appendix C: Strength Exercises

Legs

Squats

Place barbell across shoulders on upper back, not directly on neck. Keep head up, back straight, feet slightly wider than shoulder-width apart, and point toes out. Keep back perpendicular to deck. Count 1: Squat in a controlled motion until knees are over toes, but no lower than having your thighs parallel to deck. Inhale squatting down. Count 2: Return to start position, exhaling while standing up. Variation: 3/4 Squat - Squat until knees are at a 120˚ angle (half of the normal squat). Return to start position. Works quadriceps, hamstrings, gluteals, calves.

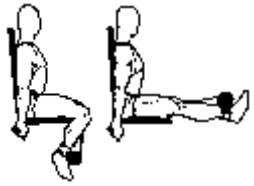
Lunge

Stand with feet shoulder-width apart, bar resting on back of shoulders. Count 1: Take big step forward with one leg. Count 2: Squat straight down until the front leg's thigh is parallel to deck. Inhale when lunging. Do not let front knee bend so it moves in front of toes. Count 3: Stand up. Count 4: Push back to start position, exhaling when standing up. Repeat with other leg. Variation: Walking Lunge - perform lunges while alternating legs as you walk across the deck. Works hamstrings, quadriceps, gluteals, calves; can use dumbbells placed at your sides

Leg Press

Keep hips and back flat against support pad. Count 1: Slowly lower platform until knees are at a 90˚ angle. Inhale lowering platform. Count 2: Return to start position, exhaling while raising platform. Do not lock your knees. Works quadriceps and hamstrings.

Leg Extensions



Sit on machine with feet under foot pad, lightly hold seat handles for support. Count 1: Keeping feet flexed, raise weight until legs are extended but knees are not locked. Exhale while extending legs. Do not bounce the weight. Count 2: Slowly return to start position, inhaling while lowering legs. Do not let weight drop. Works quadriceps.

Standing Calf Raises

Place shoulders under pads of machine, balls of feet on foot rest. Count 1: Stand straight with knees slightly bent, rise up on toes as high as possible, keeping the balls of your feet in contact with the machine. Exhale lifting up. Count 2: Return to start position, inhaling while lowering weight. Do not lock knees. Works calves.

Seated Calf Raises

Place balls of feet on foot rest, pads resting on top of thighs. Count 1: Raise heels as high as possible. Exhale lifting up. Count 2: Slowly drop heels as low as possible. Inhale lowering weight. Works calves.

Legs

Leg Curls

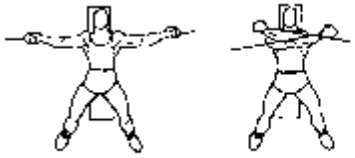
Place heels, with feet flexed, under foot pads so the pads are at the back of heels, not calves. Count 1: Curl legs up, bringing ankle pad close to your gluteals. Exhale curling legs up. Count 2: Return to start position, inhaling while extending legs. Do not lift hips or arch back during lift. Works hamstrings.

Chest

Incline Dumbbell Press

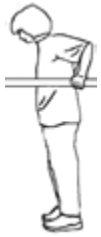
Lie on 20˚ incline bench. Feet flat on deck. Hold the dumbells in front of shoulders, palms out. Count 1: Press dumbbells straight up until arms are extended. Exhale raising weight. Keep elbows slightly bent. Lower back should stay on the bench and back should be straight. Count 2: Return to start position, inhaling while lowering weight. Works chest, shoulders and arms.

Cable Flys



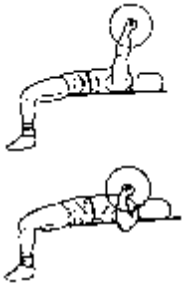
Lie on bench with feet flat on deck. Grip cable handles with arms extended, palms up, and elbows slightly bent. Count 1: Bring arms up and over your chest, crossing them over your chest. Exhale while pulling cables across chest. Elbows should remain slightly flexed; but do not bend them more to pull the cables. Count 2: Return to start position, inhaling while extending arms. Keep upper arms in line with shoulders and collarbone during movement. Works chest.

Dips



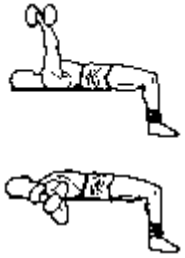
Rest hands on parallel bars. Extend arms; legs are not to support your weight unless needed for assistance. Count 1: Bend the elbows until shoulders are level with the elbows. Inhale while lowering body. Count 2: Extend arms to return to start position. Exhale while lifting body. Works triceps, chest and shoulders.

Bench Press



Lie on bench with feet flat on deck. Hold barbell at arms length above mid chest with palms facing out. Count 1: Lower barbell until it barely touches your chest by bringing your elbows straight down and behind you. Inhale while lowering barbell. Do not bounce the bar off your chest. Count 2: Return to start position, exhaling while raising barbell. Variation: Use dumbbells. Works chest, shoulder and arms.

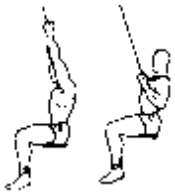
Dumbbell Flys



Lie on bench with feet flat on deck. Hold dumbbells at arms length above upper chest with palms facing each other. Count 1: Keeping elbows slightly bent, lower dumbbells out to each side of chest in semi-circular motion. Dumbbells should be even with sides of chest. Inhale lowering dumbbells. Count 2: Return to start position, exhaling while raising dumbbells. Works chest.

Back

Curl Grip Pulldowns

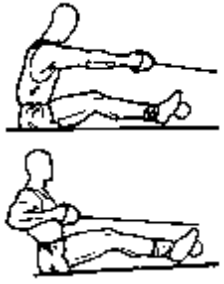


Grab pulldown bar using underhand grip, arms extended shoulder-width apart. Sit on pad and keep back straight. Count 1: Pull bar down until it touches top of chest. Exhale on pull down. Do not swing or rock lower back during movement. Count 2: Return to start position, inhaling as you extend your arms. Works back and biceps.

T-Bar Rows

Using a T-bar row machine, step onto foot supports and lie torso flat on support pad. Reach down and grab one set of handles on the T-bar with an overhand grip, hands shoulder width apart. Center and hold T-bar in extended arms. This is your start position. Count 1: Lift bar toward chest, pulling elbows straight up and behind you. Keep torso still on the support pad. Exhale when raising the T-bar. Count 2: Inhale while fully extending arms. Works back and arms.

Seated Rows



Place feet against a stationary foot rest with knees slightly bent. Hold pulley bar at chest height with arms extended. Keep back straight. Count 1: Pull bar to middle of chest, keeping forearms parallel to deck. Exhale pulling arms back. Do not rock backwards or forward during movement. Count 2: Return to start position, inhaling while extending arms. Works back and arms.

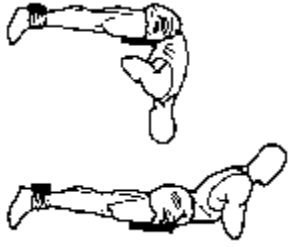
Lat Pulldowns

Grab pulldown bar using overhand grip, arms extended shoulder-width apart. Sit on pad and keep back straight. Count 1: Pull bar down by bringing elbows down to your sides until the bar touches your upper chest. Exhale on pull down. Do not arch your lower back during this exercise. Count 2: Return to start position, inhaling as arms extend. Works back and biceps.

One Arm Dumbbell Rows

Place left knee and hand on bench, extend right leg on deck. Keep back straight. Extend right arm straight down below right shoulder and hold dumbbell in right hand. Count 1:Pull dumbbell straight up to rib cage by bringing elbow straight up and behind you. Exhale raising dumbbell. Do not turn your torso. Count 2: Return to start position, inhaling while lowering dumbbell. Switch sides and repeat. Works back and biceps.

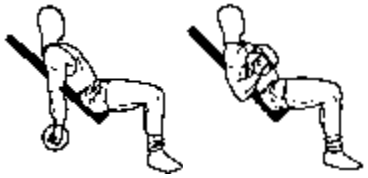
Back Extensions



On a back extension bench, place your hip bones just over the front end of the front pad and your ankles under the rear pads. Count 1: Slowly bend at the waist, lowering your head to the deck. Bend at the waist and keep your back straight. Inhale when lowering torso. Count 2: Slowly lift your torso up until your back is parallel to the deck. Exhale when raising torso. Works lower back. For beginners, see the lower back exercises on page 69 and 80.

Arms

Rotating Dumbbell Curls



On incline bench, hold dumbbells with arms extended down, palms facing back. Count 1: As you begin to lift dumbbells, rotate hands so palms face up before they pass the bench pad. Keep palms up as you bring dumbbells up to shoulder. Exhale raising dumbbell. Count 2: Return to start position, rotating your palms to face back after they pass the bench pad. Inhale while lowering dumbbell. Works biceps.

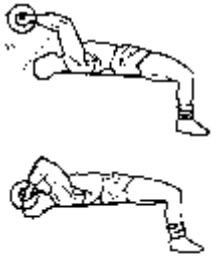
Barbell Curls

Stand with feet shoulder width apart, back straight. Grab barbell with underhand grip, shoulder-width apart. Extend arms down, placing barbell against upper thighs. Count 1: Bend elbows and lift barbell toward chest. Keep elbows and arms close to sides. Do not throw weight up by arching back and swinging barbell. Do not rock elbows forward. Count 2: Return to start position. Exhale raising barbell, inhale lowering barbell. Works biceps.

Triceps Pressdown

Grab bar or rope with hands close together in center of body, elbows at 75° so forearms are not quite parallel to deck. Push rope down until arms are straight, elbows remaining close to your sides. Exhale while pushing down. Count 2: Return to start position, inhaling while bringing forearms up. Works triceps.

Tricep Extension with Barbell



Lie on bench with feet flat on deck, head at top of bench. Hold barbell above head with hands approximately 6”apart, palms up. Count 1: Lower bar to forehead, bending elbows. inhale lowering barbell. Upper arm should remain stationary. Count 2: Return to start position, exhaling while raising barbell. Works triceps.

Wrist Curls

Grab a dumbbell or barbell palms up and sit on the edge of a bench. Place elbows on bench edge between knees. Let wrists hang over bench. Count 1: Curl wrists up to raise weight toward elbow. The motion should resemble a semi-circle. Exhale raising dumbbell. Keep forearms flat against bench through entire exercise. Count 2: Return to start position, inhaling while lowering weight. Works wrist flexors.

Reverse Wrist Curls

Grab a dumbbell or barbell palms down and sit on the edge of a bench. Place elbows on bench edge between knees. Let wrists hang over bench. Count 1: Curl wrists up to raise weight toward elbow. The motion should resemble a semi-circle. Exhale raising dumbbell. Keep forearms flat against bench through entire exercise. Count 2: Return to start position, inhaling while lowering weight. Works wrist extensors.

Shoulders

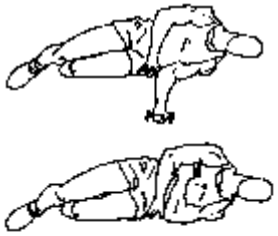
Upright Rows

Hold barbell with narrow overhand grip. An E-Z curl bar is suggested. Hands should be no more than 6 inches apart. Stand straight, hold barbell against upper thighs at arms length. Count 1: Keeping bar close to body and back straight, pull bar upward until just under chin. Arms should form a slight "v" at top of movement. Exhale raising bar. Keep elbows out and up. Count 2: Return to start position, inhaling while lowering bar. Works shoulders.

Shoulder Press

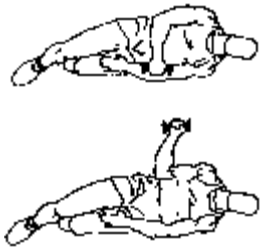
Sit with back straight and against support pad; keep feet flat on the deck. Incline bench 5-10˚, if possible. Raise dumbbells to shoulder height, palms facing forward. Keep elbows out. Count 1: Raise dumbbell overhead until arms are extended, slight bend in elbow. Count 2: Return to start position. Exhale raising weights, inhale lowering weights. Works shoulders.

Internal Rotators



Hold a dumbbell in left hand and lie on a bench on your left side. Bend left elbow 90°. Count 1: Rotate left upper arm so left hand is lifted up toward your right side. Exhale on lift. Do not move torso during exercise. Count 2: Return to start position, inhaling while lowering your left forearm. Works internal shoulder rotators. Switch sides to work right shoulder.

External Rotators



Hold a dumbbell in right hand and lie on a bench on your left side. Bend right elbow 90°. Count 1: Rotate right upper arm so right hand moves down toward left side. Inhale while lowering right forearm. Do not move torso during exercise. Count 2: Rotate right upper arm so right hand moves up above your right side. Exhale when lifting weight. Works internal shoulder rotators. Switch sides to work right shoulder.

Diagrams adapted from *Strength Training for Sports,* Applied Futuristics[SM], 1994 with permission from Fred Koch.

The following key points will help you perform most exercises correctly and help prevent many of the common training errors listed in Table C-1.

- Understand which muscle groups you are targeting during an exercise, i.e., which joints need to move to perform the lift?
- Think of strength training as keeping your balance and posture while moving a weight. Focus on your muscle contractions, not the weight. This makes you aware of how your muscles work.
- Practice new exercises with a light weight until your form is perfected.
- Always perform slow, controlled movements.

Table C-1. Examples of Common Training Mistakes

	Exercise	Common Mistakes	Proper Form
Chest	Bench Press	Bouncing the bar off the ribs - uses momentum to lift the bar and can break ribs.	Lower bar to within 1 inch of the chest, pause, then lift.
	Bench Press/ Chest Fly	Lifting the lower back and hips off bench when lifting the weight - weight too heavy, this motion increases stress on the spine.	Decrease the weight to be lifted, keep lower back and hips on the bench.
Shoulders & Arms	Lateral Raises, Biceps Curls	Arching the back when lifting the weights - uses momentum to lift the back and can cause back pain and injury.	Decrease the weight to be lifted. Keep a natural curve in the back, bend knees, and push chest out. Lift and lower the weight with control.
Back	Lat Pulldowns/ Seated Rows/ T-bar Rows	Rounding shoulders and bending forward at the waist when pulling the weight - uses body weight, not lat muscles to pull the bar; puts lots of stress on the spine.	Squeeze shoulder blades together, push chest out, back straight, and pull bar down to chest.
Legs	Squats/ Lunges/ Leg Press	Squatting or bending knees beyond the tips of toes causes the heel to lift off deck and increases the stress on the knees as they move past the toes.	Keep heels flat on deck and squat/ lunge. Stop when knees are directly above toes.

General training mistakes that you should be aware of and avoid include:

- Locking joints at the end of their range of motion. This places a lot of stress on the joint. You should extend the joint as far as possible without locking it during your exercises.
- Moving your legs or “bouncing” during exercises. If you have to move or bounce body parts that are not directly involved in the exercise to lift a weight, then the weight is too heavy. Lower the weight and check your form by focusing on how your body is moving; do not focus on lifting the weight.
- Lifting and lowering weights rapidly. This can lead to injury. Slowly return the weight to the starting position, as this is the part of the workout that results in the greatest training effects!

Appendix D: Resources

This manual and the companion self-study guide "*Peak Performance through Nutrition and Exercise*" can be found on the internet at both the Uniformed Services University of the Health Sciences (under Academics, Military and Emergency Medicine, Human Performance Lab) and the Navy Environmental Health Center (NEHC) Health Promotion web sites (addresses listed on page 141). In addition, other health promotion materials for Navy personnel can be found on NEHC's web site.

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- US Dept. of Agriculture and US Dept. of Health & Human Services. *Nutrition and Your Health: Dietary Guidelines for Americans*, 4th ed. 1995.

World Wide Web Sites (http://...)

US Navy (Link to Navy Commands)	www.navy.mil (www.navy.mil/nol)
Uniformed Services University of the Health Sciences (USUHS), Human Performance Laboratory	www.usuhs.mil/acad/index.html (select "Human Performance Laboratory" under Military and Emergency Medicine"
Navy Bureau of Personnel PRT standards Navy Nutrition and Weight Control Self-Study Guide	www.bupers.navy.mil /services/ under "new PRT" /services under "Navy Nutrition..."
Navy Environmental Health Center Health Promotions-(NEHC) Fitness Site Nutrition Site	www-nehc.med.navy.mil/hp/index.htm - .../hp/fitness/index.htm .../hp/nutrit/index.htm
Naval Health Research Center (NHRC)	www.nhrc.navy.mil
American Alliance on Health, Physical Education, Recreation, and Dance (AAHPERD)	www.aahperd.org
American College of Sports Medicine (ACSM)	www.acsm.org
American Council on Exercise (ACE)	www.acefitness.org
American Dietetic Association	www.eatright.org
American Heart Association (AHA)	www.aha.org
American Running and Fitness Association (AR&FA)	americanrunning.org
Centers for Disease Control (US surgeon general's report)	www.cdc.gov (/nccdphp/sgr/summ.htm)
National Academy of the Sciences Dietary Reference Intakes (DRIs)	www.nas.edu/ 276a.html and 287e.html
National Coalition to Promote Physical Activity (NCPPA)	www.ncppa.org
National "5-A-Day" campaign websites	5aday.nci.nih.gov www.5ADAY.com

National Institutes of Health (NIH) Office of Dietary Supplements (ODS)	odp.od.nih.gov/ods/default.html
National Strength and Conditioning Association	www.nsca-lift.org
SCAN's Sports, Cardiovascular and Wellness Nutritionists	www.Nutrifit.org
US Department of Agriculture (USDA)	www.usda.gov
Shape Up America!	www.shapeup.org
US Food and Drug Association (FDA)	www.fda.gov
US Federal Trade Commission	www.ftc.gov
US Dept. of Health and Human Services	www.dhhs.gov

Note: Addresses for web sites may change. If you are not able to access a site, try to contact the parent organization or search for their new site using a web browser.

Glossary

acclimation -	adaptations that occur within the body when exposed to a new environment.
aerobic capacity -	maximal amount of aerobic activity that can be done
aerobic energy system -	process of making energy (ATP) that requires oxygen.
amenorrhea -	the cessation of menstruation not due to pregnancy or menopause; can be seen in women athletes whose nutritional intake is not adequate; one component of the female athlete triad.
anaerobic energy system -	process of making energy (ATP) without using oxygen.
antioxidants -	compounds that prevent breakdown (oxidation) of substances in the body; nutrients such as Vitamin E and C have antioxidant properties.
basal metabolic rate -	the amount of energy (kcals) required to maintain life when the body at rest (BMR).
body composition -	a description of the amount of body weight that is lean body mass (muscle, bones) and the amount of body weight that is fat.
body mass index (BMI) -	An index that looks at body weight in relation to height.
Calorie -	a measure of energy used to describe the energy consumed in foods and expended through physical activity; Calorie with a capital "C" is the same as kilocalorie (kcal).
carbohydrates (CHO) -	a macronutrient that supplies 4 kcals per gram; primary nutrient found in the grain, vegetable, and fruit food groups of the Food Guide Pyramid.
carbohydrate loading-	nutritional training method used by endurance athletes to increase the amount of glycogen stores in their muscles before a competition.
cardiorespiratory fitness -	ability of the heart, lungs, and blood vessels to deliver oxygen-rich blood to and remove waste products from the exercising muscles; the more trained the person, the higher the cardiorespiratory capacity; see aerobic capacity.
cholesterol -	a substance made by the body that serves as a base for hormones such as estrogen and testosterone, is a part of all cells, and is consumed in the diet by eating animal products.
dehydration -	a depletion of bodily fluids that occurs when not enough fluids are drunk to replace those lost through breathing, urination, and sweating.
detraining -	a loss of training adaptations that occurs when training stops; can be avoided, stopped or reversed through physical training.
electrolytes -	minerals in the body that help regulate fluid balance, are part of nerve conduction, and other essential bodily functions; examples include sodium, potassium, and chloride.

energy balance -	net metabolism balance of the total kcals eaten minus the total kcals expended through basal metabolism and physical activity.
ergogenic agent -	nutritional supplement taken with the purpose to enhance physical performance; examples include creatine, ginseng, caffeine and DHEA; many claim to improve performance but few have been demonstrated to be beneficial; may have health risks associated with long-term use.
ergolytic agent -	supplement taken with the purpose to enhance physical performance but actually decreases performance; many have health risks associated with long-term use; examples include alcohol and nicotine.
fat -	a macronutrient that supplies 9 kcals per gram; primary nutrient found in oils and butter; placed at the top of the Food Guide Pyramid.
female athlete triad -	cessation of menstrual cycles, loss of bone, and eating disorders seen in some women who participate in strenuous physical activity.
FITT Principle -	combination of four training factors (frequency, intensity, time, and type) that determine how an individual adapts to physical training.
flexibility -	the range of motion around a joint.
fluid balance -	net amount of fluid consumed minus the fluid lost through breathing, urine, and sweat.
glucose -	a simple CHO that serves as the main fuel to make energy (ATP) in the body.
glycogen -	a storage form of glucose found in muscles and liver.
heart rate (HR) -	the number of heart beats per minute.
kilocalorie (kcal) -	a measure of energy used to describe the energy consumed in foods and expended through physical activity.
kilogram (kg) -	metric measurement for weight; 1 kg = 2.2 pounds (lbs).
lactic acid (lactate) -	a by-product of the anaerobic energy system.
ligament -	connective tissue that holds one bone to another bone.
macronutrient -	a nutrient that supplies kcals for energy metabolism; the three macronutrients are carbohydrate, protein, and fat.
metabolism -	chemical and physical processes that are required to maintain life.
METs -	metabolic equivalents; arbitrary unit of work in relation to rest; e.g., rest is 1MET, so if you exercise at 5METs you are expending 5 times the kcals you do at rest.
micronutrients -	nutrients that are needed in small amounts to aid in metabolism and other important bodily functions. micronutrients do not supply any kcals; the two classes are vitamins and minerals.

minerals -	class of micronutrient; examples of minerals are calcium, sodium, and potassium.
muscle endurance -	the ability of a muscle or muscle group to generate a less than maximal force over a period of time.
muscle fiber -	an individual muscle cell; there are three types of muscle fibers categorized according to their capability to produce energy.
muscle strength -	the maximum force generated by a muscle or muscle group.
nutritional supplement-	a substance taken in addition to eating food to increase the amount of a particular nutrient or group of nutrients in the body. Some substances may also be taken in an attempt to improve physical performance.
osteoporosis -	a common bone disorder that is characterized by low bone density and weakened bones; people with osteoporosis have a greater risk of fracturing bones.
overhydration -	a gain of body water that occurs when too much plain water is drunk in an attempt to replace the fluid and electrolytes lost through sweating during strenuous and prolonged exercise; can be avoided by drinking a carbohydrate-electrolyte drink, such as a sports beverage, or eating a snack when exercising for more than 60 minutes.
overload -	placing greater-than-normal physical demands on the body with the intent of improving physical fitness and capability; this overload should be progressively increased.
overtraining syndrome -	a set of symptoms that are experienced when too much or too intense a physical activity is performed without adequate rest.
oxygen consumption -	measure of the intensity of a physical activity. Maximal oxygen consumption (VO_{2max}) is a measure of the maximum work that an individual can perform both aerobically and anaerobically.
physical activity -	movement of the muscles that results in energy expenditure.
physical fitness -	the ability to perform physical activity.
pounds (lbs) -	a measure for weight; 2.2 lbs is equal to 1 kilogram (kg).
protein -	a macronutrient that supplies 4 kcals per gram; primary nutrient found in the dairy and meat / meat substitute food groups of the Food Guide Pyramid.
repetition -	one lifting and lowering of a weight or resistance during muscle training; often abbreviated “rep.”
set -	a series of repetitions performed one after another without a rest period.
SMART goals -	defined goals that are specific, measurable, action-oriented, realistic, and timed.

specificity of training -	a principle which describes that training adaptations are optimized in a specific physical activity when that activity is performed in training sessions.
target heart rate zone-	a recommended heart rate range specific to each person, dependent on age and fitness level, that is within a safe intensity level to exercise.
tendon -	connective tissue that holds a muscle to a bone.
Valsalva maneuver -	when an individual holds his breath and bears down. This is impedes blood flow, increases blood pressure, and can be dangerous.
vitamins -	class of micronutrient; can be fat or water soluble; do not provide energy but are needed in many important functions; excessive intakes can be toxic.
waist-hip-ratio (WHR)-	a ratio of the waist circumferences (in inches) to the hip circumference (in inches); used to describe the distribution of body fat.
WATT -	measurement of work that describes the amount of kcals expended in a given time period; i.e., kcals/min.

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