Aqua Group Exercise Instructor

Instructor Manual
2020 Edition

NATIONAL AEROBICS & FITNESS TRAINERS ASSOCIATION

COURSE: AQUATIC FITNESS AEROBIC INSTRUCTOR

LOCATION: Gym or Fitness Club setting that has a pool.

PURPOSE: This course is designed to meet the needs of novice instructors and fitness leaders with minimal experience in water exercise. The workshop will include both theoretical and practical experience. The participants will also be provided with training in leadership and technical skills necessary to be able to lead an aqua aerobic group exercise program which is safe, effective and motivational.

OBJECTIVES:

*Define the major components of physical fitness: flexibility, muscular endurance, muscular strength, body composition and cardiovascular endurance.
*Define the Principle of Progressive Overload
*Define the Principle of Adaptation
*Define the Principle of Specificity
*Define the Principle of Variability
*Define the Principle of Reversibility
*Explain the American College of Sports Medicine's Guidelines
*Compare static and ballistic stretching.
*Define ATP
*Define Glucose Transport
*Define Synthesis
*To learn the three Energy Systems
*Define the Cardiovascular System and how it works.
*Define Cardiovascular Disease.
*List and define the 4 Major types of cardiovascular disease.
*List and define Primary Risk Factors to Cardiovascular Disease.
*List and locate the major muscles of the body.
*Define the muscle types.
*Define the Planes of Motion.
*Define the Anatomical Directions.
*Define the Terminology Related to Movement.
*Briefly review over temperature and how it relates to exercise.
*Define Newton's Laws of Motion
*Describe and define leverage and resistance
*Identify the idea water depth and what factors play a role.
*Explain Reaction Time
*Describe how to modify exercises in the water.
*Describe the precautions an instructors should take in regard to air temperature and humidity.
*Compare the body's physiological reactions to different water temperatures.
*Define thermal warm-up and its importance.
*Compare how the body dissipates heat in land and water exercises.
*Discuss how to design an aqua aerobics class

*Discuss how to be an effective instructor.
*List the pros and cons for deck vs in the pool teaching.
*Identify the benefits of thermal warm-up, stretch, cardiorespiratory warm-up, aerobic phase cool down, toning and post-stretch.
*Discuss Medical Screening and its importance.
*Review Pool information and safety concerns to be aware of.
*Define Heart Rates.
*Calculate a water exercise target heart rate.
*Define how to monitor intensity levels. (Borg Scale, Modified Karvonen and Borg/McWaters Scale)
*Review emergency training and injury prevention.
*Explain the different types of equipment that can be used in an Aqua Aerobic class setting.
*Review over the music tempos that should be used when teaching Aqua Aerobic classes.
*Have knowledge of the legal issues an aqua aerobics instructor should be aware of.
*Define Special Populations

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AQUA AEROBIC OUTLINE SCHEDULE

8:30am -9:30am	:	Physiology of Cardiovascular Endurance Heart Rate Monitoring Perceived Exertion Aquatic Karvonen Formula McWaters Metabolism Review Energy, ATP, Phosphagen, Anaerobic, Aerobic
	:	Basic Anatomy and Kinesiology Muscles and Joint Actions Sliding Filament Theory Types of Muscles Muscle Principles
9:30am -10:30am	:	Safety & Exercise Injury Prevention Safe Instruction Proper Alignment High Risk Movements Heat Dissipation Water Temperature Water Resistance Pool Considerations Electrical Shock Pool Safety Equipment Usage and Safety Special Populations Aquatic Fitness For Multiple Sclerosis Aquatic Fitness For Back Pain Aquatic Fitness For Over 50 Aquatic Fitness For Arthritis
10:30am -12:00	:	Physical Laws Applied to Water Exercise Motion Newton's Law of Motion Inertia, Acceleration, Action/Reaction Frontal Resistance Hand Positions Levers Buoyancy Hydrostatic Pressure Drag and Turbulence Surface Tension

12:05pm-12:30pm : LUNCH

12:30pm - 2:30pm : Warm Up
Discussion of the Purpose of a Warmup
Discussion of High Risk Movements
Safe Instruction
Demonstration of a Proper Warm Up
Body Alignment
Differences in Warmups for Special Populations

: Cardiovascular Session
Purpose
Deep Water VS Shallow
High Risk Movements
Special Populations
Demonstration of a Cardiovascular Class
Heart Rate Check

: Flexibility Session
Purpose and Importance of Flexibility Training
Special Populations
Heart Rate Check

: Cool Down
Purpose
Special Populations
Demonstration of a Cool Down
Heart Rate Check

Choreography Principles
Leadership Skills
Becoming An Effective Instructor
Class Formats
Teaching Techniques

2:30pm-3:00pm Practical Testing

3:00pm – 3:30pm Review

3:30pm - 5:30pm Written Exam

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COURSE OUTLINE

1. **Introduction & Overview**
   Introduction of instructor and qualifications. Overview of the workshop according to the outline and the purpose of the course. The instructor will distribute any additional handouts and introduce the AFAA participants.

2. **Physiology of Cardiovascular Endurance**
   *Define Cardiovascular Disease
   *List and define the 4 major types of cardiovascular disease
   *List and define the Primary Risk Factors to Cardiovascular Disease (According to Cooper)
   *List and define the Contributing Risk Factors to Cardiovascular Disease (According to Cooper)
   *Define Wellness and Health
   *Compare and Contrast Wellness and Health
   *Define Physical Fitness
   *Define the Health-Related Components
   *Define the Motor Related Components
   *Define Aerobic
   *Define Anaerobic
   *Compare and Contrast Aerobic and Anaerobic
   *Define Cardiovascular Fitness
   *Diagram the heart and lungs and show how the blood flows
   *Review the American College of Sports Medicine's Guidelines

3. **Metabolism Overview**
   *Define ATP
   *Define Glucose
   *Define Synthesis
   *List and define the 3 Energy Systems (Phosphagen, Anaerobic Glycolysis, and Aerobic Glycolysis)

4. **Anatomical Kinesiology**
   *Define the concept of Anatomical Kinesiology
   *List the rationale as to the Prescription of the Fundamental Science, Individual Differences, and Efficient of Movement
   *Define anatomy, physiology, kinesiology, and biomechanics
   *List and define the Planes of Motion
   *List and define the Anatomical Directions
   *List and define the terminology related to movement
   *List and define the Properties of Muscle Tissue
   *Define muscular force
   *Define the Principle of Pre-Tension
   *Define the Principle of Angle Pull
   *Define the All or None Law
   *Define muscular contraction (Isometric, Isotonic, Isokinetic, Concentric, and

Eccentric)
*Define the Principle of Opposition
*List and define the two roles' muscles play
*List and define two-joint muscles
*List and define the muscles and their action
*Define the function of tendons and ligaments
*Define Flexibility and its importance. (Static, Dynamic, Ballistic, and PNF)

5. **Safety and Exercise**
*Define the difference between acute and chronic injuries
*Define R.I.C.E. and its importance
*Describe the symptoms and first aid procedures for heat cramps, heat exhaustion, and heat stroke.
*List the signs and symptoms of overtraining.
*List and define First Aid response to exercise related injuries.
*Explain the precautions that should be taken in reference to temperature and humidity
*List the body's reaction to water temperatures and the which temperature is the safest
*Review over water depth and the appropriate water depths for the different types of aqua exercise
*Discuss the body's ability to dissipate heat
*List health problems that may require precautions
*Review the American College of Sports Medicine Guidelines
*Review Medical Screening and its importance
*List the medications or other substances which may alter the cardiorespiratory response to exercise
*Current CPR Certification and its importance (American Red Cross, American Lifeguarding Association or American Heart Association)
*Current Lifeguarding Certification and its importance (American Red Cross, American Lifeguarding Association and American Heart Association)

6. **Physical Laws Applied to Water Exercise**
*Define Newton's Laws of Inertia, Acceleration and Action/Reaction
*Give examples of how each of Newton's Laws apply to water exercise
*Describe ways to increase or decrease the intensity of a workout using Newton's Laws of Motion
*Define leverage and resistance
*Explain the difference between air and water resistance
*Explain how to use the limbs as levers in the water
*Define buoyancy, the dependent factors and the benefits
*Define Drag, Form Drag, Wave Drag, and Frictional Drag.
*Identify the ideal depth of the water for aquatic exercise

7. **Practical Practice**
*Go over the guidelines and their importance for an Aqua Aerobic Exercise Class (Before Class, Thermal Warm-up, Stretch, Cardiorespiratory Warm-up, Aerobic Phase, Cooldown, Toning and Post Stretch)

8. **Heart Rates & Perceived Exertion**
*Define Resting Heart Rate and how to find it

*Define Target Zone
*Define Minimum and Maximum Target Heart Rate Zones
*Calculate a water exercise target heart rate zone by using the Karvonen Formula
*Explain why Aquatic Heart Rates may be lower than Aerobic Dance Heart Rates
*Describe the preferred method of taking hearts rates during Aqua Exercise
*Define Perceived Exertion (Borg Scale & McWaters)
*Define Respiration Rate
*Define "talk test."
*American College of Sports Medicine Guidelines

9. **Becoming an Effective Instructor**
*Define effective teaching.
*List and define effective and ineffective teaching.
*Define Law of Effect
*Define Law of Readiness
*Define Law of Frequency
*List both verbal and nonverbal skills of an effective instructor
*List both verbal and nonverbal skills of an ineffective instructor

10. **Designing Aquatic Classes & Movement and Choreography**
*Review the differences between "ground" teaching to water teaching
*List and define the Rules of Adaptation and Specificity
*Review the components of an Aqua Aerobic Class (Before, Thermal Warm-up, stretch, cardiorespiratory warm-up, aerobic phase, cool-down and final stretch)
*Define movement and its elements (space, direction, form, speed, levels, quality, effort, and relationship)
*Define choreography
*List the different types of aqua aerobic classes (Water walking, Water jogging, Water Aerobics, Water Step Aerobics, and Water toning)

11. **Teaching Techniques & Music**
*Define teaching
*List the pros and cons of deck vs in pool teaching
*Considerations of music (participants preference, acoustics, environment, and type of class)
*List the factors that will affect the timing and use of music (Body type, Body dimension, Water depth, participants fitness level, and effort exerted by participants)
*Review over the BPM's that are used for aqua exercise

12. **Special Populations**
*Review the American College of Obstetricians and Gynecologists exercise guidelines for pregnant women.
*Define Special Populations and precautions need to be taken in regards to an aqua exercise class.(Arthritis, Chronic Fatigue, Diabetes, Hypertension, Obesity and Asthma)

13. **Pool Safety & Equipment**
*List the dangers and their solution associated with slippery, rough, and sloped pools.
*List the dangers and their possible solutions associated with pool edges, gutters,

and sides.
*List the precautions that should be taken when using electrical equipment.
*Review the checklist for Emergency situations
*Review over the different types of Aquatic Equipment that is available
*Review the guidelines in using the equipment

14. **Legal Issues**
*Terminology
*Conditions of Liability
*Informed Consent
*Waivers of liability
*Medical History Forms
*Professional Liability Insurance
*Define Duty of Care
*Define Standard Care
*Explain the 1976 U.S. Copyright Act

15. **Closing Comments/Written Exam**
*Go over Continuing Education Requirements and which organizations the CEU's can be obtained through.
*Written Exam & Course Evaluation
*After all exams are completed, the participants may leave or ask further questions in reference to workshop, or any other subject related to fitness.

Chapter 1
Introductions to Aqua Aerobics

Welcome to the field of aquatic fitness—a vast array of programming options to enhance health and well-being for all ages and abilities. Although water exercise can encompass a wide variety of activities, this manual specifically targets vertical exercise in both shallow and deep water. Exciting trends continue to emerge in the fitness industry, and aquatic fitness is at the forefront with reduced-impact yet challenging options for group exercise, small-group fitness, and personal training. The properties of water further enhance the benefits of many popular fitness formats, such as cycling, equipment-specific training, circuits, intervals (including HIIT), boot camp training, martial arts, yoga, Pilates, muscle conditioning, walking and jogging, functional fitness, and programs specific for various chronic conditions. Aquatic fitness no longer targets just the senior population. Safe and effective programs can be found for all age groups, including infants, children, teens, young adults, and, of course, the baby boomers. This manual provides an excellent resource for fitness professionals and students seeking knowledge in aquatic fitness applications, education, and training. NAFTA sincerely hopes that the following pages inspire you to review, learn, and update those skills necessary to share the benefits of aquatic fitness with others effectively. As an association comprised of aquatic fitness professionals, therapists, personal trainers, athletic trainers, coaches, facility directors and managers, and aquatic fitness participants – may we all work together in the pursuit of a healthier global community.

Chapter 2
Physical Fitness
Medical Screening and ACSM Guidelines

Physical Activity, Exercise and Physical Fitness

The American College of Sports Medicine (ACSM) defines physical activity as movements of the body created by skeletal muscle contractions that result in a substantial increase of energy expenditure compared to resting levels.

Exercise is a type of physical activity consisting of repetitive movement that is planned and structured to maintain or improve one or more fitness components.

Physical Fitness is the ability to carry out daily tasks with vigor and alertness without undue fatigue and with ample energy to engage in leisure time pursuits and to meet the above average physical stresses encountered in emergency situations.

Physical Activity Guidelines for Americans

- Regular physical activity reduces the risk of many adverse health outcomes.
- Some physical activity is better than none.
- For most health outcomes, additional benefits occur as the amount of physical activity increases through higher intensity, greater frequency, or longer duration.
- Most health benefits occur with at least 150 minutes (2 hours and 30 minutes) a week of moderate intensity physical activity, such as brisk walking. Additional benefits occur with more physical activity.
- Both aerobic (endurance) and muscle-strengthening (resistance) physical activities are beneficial.
- Health benefits occur for children and adolescents, young and middle-aged adults, older adults, and those in every studied racial and ethnic group.
- The health benefits of physical activity occur for people with disabilities.

The benefits of physical activity far outweigh the possibility of adverse outcomes.

Health and Motor Related Components to Fitness

Health Related

Absolute Strength

Dynamic Strength

Flexibility

Cardiovascular Endurance

Body Composition

Neuromotor Exercise

Motor Related

Coordination

Agility

Power

Balance

Speed

Accuracy

Guidelines for Exercise FITT

Frequency, Intensity, Time and Type

- **Frequency: amount**
    - Frequency is how often you exercise or train.
    - Cardiorespiratory Endurance. Moderate-intensity cardiovascular exercise at least five days a week, or vigorous-intensity training at least three days per week, or a weekly combination of three to five days a week blending moderate and vigorous activities.
    - Muscular Strength and Endurance. Two to three days per week for each major muscle group. Additionally, at least 48 hours should separate the training sessions for each muscle group to allow adequate recovery and muscle development.
    - Flexibility. At least two to three days per week is recommended, with the greatest benefits seen with daily stretching. Stretching is most effective when muscles are warm.
    - Neuromotor Exercise. At least two to three days per week is recommended.
- **Intensity: how hard**
    - Intensity is how hard you exercise.
    - Cardiorespiratory Endurance. Moderate or vigorous-intensity exercise is recommended for most adults, although deconditioned individuals may benefit from light to moderate intensity exercise.
    - Muscular Strength and Endurance. Intensity of training will vary based upon the individual's experience with resistance training, age, ability levels and overall goals (endurance, strength or power). For strength gains, two

to four sets of 8-12 repetitions (resistance equivalent to 60-80% 1RM) are recommended for most adults. A single set of 10-15 repetitions (resistance equivalent to 40-50% 1RM) is recommended for strength improvements in deconditioned and older adults who are beginning an exercise program. For endurance training, two or more sets of 15-25 repetitions with an intensity that should not exceed resistance equivalent to 50% 1RM are recommended.

- Flexibility. Stretching exercises should be performed to the point of mild discomfort within the individual's range of motion. This is generally perceived as the point of tightness.

- Neuromotor Exercise. An effective intensity has not been determined.

- **Time: how long**

  - Time refers to duration, or how long you exercise.

  - Cardiorespiratory Endurance. Accumulate 30-60 minutes per day of moderate intensity exercise to accumulate a weekly total of at least 150 minutes, or 20-60 minutes per day of vigorous intensity exercise to accumulate a weekly total of at least 75 minutes, or a combination of moderate and vigorous exercise to achieve the recommended target volumes of exercise. Recommended durations can be achieved through one continuous session or bouts of exercise (10 minutes or more) throughout the day. Individuals unable to perform the recommended duration of exercise may still benefit from a shorter duration.

  - Muscular Strength and Endurance. No specific length of time for train-ing has been determined for optimum effectiveness.

  - Flexibility. Hold static stretches 10-30 seconds for most adults; 30-60 seconds may be more beneficial for older adults. Perform each stretch 2-4 times to achieve approximately 60 seconds per joint. Note, in the pool both static and dynamic stretches may be used based upon environmental concerns.

  - Neuromotor Exercise. 20-30 minutes or more per week is currently suggested.

- **Type: what type of movement**

  - Type describes the mode of exercise being performed.

    - **Cardiorespiratory Endurance**. Rhythmic activities that use large muscle groups and can be maintained continuously (aerobic). Aerobic activities are varied, and aquatic options include swimming, deep-water running, many shallow-water exercise programs (e.g., kickboxing, martial arts, and aquatic dance formats), aquatic cycling, and walking (shallow water and underwater treadmills). Selected activities should reflect the individual's interests and goals and be chosen to accommodate the level of fitness and skill.

- **Muscular Strength and Endurance**. All adults should participate in a resistance-training program that includes a combination of multi-joint exercises (involving more than one muscle group) and single-joint exercises. Various types of resistance equipment can be used; aquatic options include drag, buoyancy, weighted, and rubberized (bands, loops and tubing). Aquatic equipment is discussed in more detail in chapter 4 and appendix C.

- **Flexibility**. A series of flexibility exercises targeting the major muscles using a variety of techniques is suggested to improve joint ROM. Environmental considerations of the pool, in particular water and air temperatures, can influence the choice of stretching techniques used.

- **Neuromotor Exercise**. Specific exercises that involve balance, agility, coordination, gait training, or proprioception skills provide neuromotor exercises. Examples include multifaceted activities such as Tai Chi and yoga.

Medical Screening

Medical Screening should be required for the adult population. The purpose of the medical screening is to systematically collect data to determine whether an individual has risks that may impair their ability to exercise. As an aerobics instructor, the risks you want to be able to determine are: Orthopedic, Cardiovascular, Psychological, and Chronological.

The screening methods can range from sophisticated to practical and inexpensive to expensive and time consuming to time efficient. It really depends on the facility you may work for. Some examples are: treadmill test to 3-minute step for cardiac testing and hydrostatic weighing to calipers for measurement of percentage of body fat.

The purposes of medical screening are to clear a person for exercise, clear for further screening, and to prescribe a safe, effective, and personal exercise program.

Remember, you as the aerobics instructor are not a doctor and only a doctor can diagnose disease. Your role as a Fitness Professional is to gather information, educate your clients about their risk factors, and finally refer high-risk people to their physician before embarking on an exercise program.

Aerobics simply means with oxygen.

Anaerobic simply means without oxygen.

Aerobic activity can be Primary and Secondary. **Primary** meaning you can do it by yourself such as running. **Secondary** means with a group. You are dependent on a group in order to do the exercise. The period of time would be for over 90 seconds. The fuel source is carbohydrates, fats and proteins.

Anaerobic is activity that is for a short period of time and needing no oxygen. Examples would be weightlifting or 1 Repetition Max Effort. The time frame varies from 10-90 seconds to 45-90 seconds. The fuel source is glucose.

Cardiovascular Fitness is the ability to carry out daily tasks with vigor and without undue fatigue and have energy left over for leisure time pursuits and finally enough for emergency situations.

Cardiovascular Disease is a general term for diseases of the heart. There are four major types of cardiovascular disease: Coronary Heart Disease, Cerebrovascular Disease, Congestive Heart Failure and Peripheral Vascular Disease.

Coronary Heart Disease-is the buildup of fatty plague in the coronary arteries. It is referred to as the **heart attack**.

Cerebrovascular Disease-is the buildup of fatty plague or blood clots leading to the brain. This is referred to as the **stroke**.

Congestive Heart Failure-is the failure of the heart muscle to pump as much blood as it receives therefore, creating a pooling effect.

Peripheral Vascular Disease-is the buildup of fatty plague or blood clots leading to the extremities.

ACSM GUIDELINES

Risk Stratification

1) **(Low Risk) Apparently Healthy**-are those individuals who are asymptomatic and apparently healthy with no more than one major risk factor.
2) **(Moderate Risk) Individuals with Increased Risk**-are those individuals who have signs or symptoms suggestive of possible cardiopulmonary or metabolic disease and/or two or more major coronary risk factors. Men $\geq$45 yrs old and Females $\geq$55 yrs old
3) **(High Risk) Individuals with Known Disease**-are those individuals with known cardiac
pulmonary, or metabolic disease.

CORONARY RISK FACTORS

Primary Risk Factors

1) **Hypertension/High Blood** Pressure (resting blood pressure >140/90 mmHg or on any antihypertension medication)
2) **Hypercholesterolemia**
   -Total cholesterol > 200 mg/dl
   -LDL cholesterol >130 mg/dl
   -HDL cholesterol < 35 mg/dl
   -Total cholesterol ratio > 5
3) **Cigarette Smoker**
4) **Family History**
   MI or sudden death before 55 of father or male as first-degree relative
   MI or sudden death before 65 of mother or female as first-degree relative
5) **Diabetes Mellitus** (fasting glucose >140 mg/dl)

6) **Sedentary Lifestyle**
7) **Age**
   Men over 45
   Women over 55
8) **Obesity**

Contributing Risk Factors
1) Stress
2) Elevated Blood Tric. Levels

Contraindications

Contraindications come in two categories: absolute and relative. Contraindications are serious medical problems and the risks of exercise usually outweigh any benefit of exercise.

Absolute
Recent complicated myocardial infarction
Unstable angina
Uncontrolled ventricular arrhythmias
Acute congestive heart failure
Severe aortic stenosis
3rd degree heart block w/o pacemaker
Suspected or known dissecting aneurysm
Active or suspected myocarditis or pericarditis
Thrombophlebitis or intracardiac thrombi
Recent systemic or pulmonary embolus.
Acute infections
Uncontrolled atrial arrhythmia
A recent change in the resting ECG
Significant emotional distress (psychosis)

Relative
Resting systolic B/P >220 mmHg or resting diastolic B/P >115 mmHg
Moderate valvular heart disease
Known electrolyte abnormalities
Fixed rate artificial pacemaker.
Frequent or complex ventricular ectopy
Ventricular aneurysm
Uncontrolled metabolic disease (diabetes, thyrotoxicosis, or myxedema)
Chronic infectious disease (AIDS, Hepatitis, Mononucleosis)
Neuromuscular, musculoskeletal or rheumatoid disorders that are exacerbated by exercise.
Advanced or complicated pregnancy

AMERICAN HEART ASSOCIATION

Major and Contributing Risk Factors for Coronary Heart Disease
1) Major Alterable Risk Factors
   a. Smoking
   b. High Blood Pressure (140/90)
   c. High Blood Cholesterol Levels

1) Desirable below 200 mg/dl
2) Moderate risk 200-239 mg/dl
3) High risk 240 mg/dl

d. Physical Inactivity

2) Major Unalterable Risk Factors
   a) Predisposing heredity
   b) Male sex
   c) Increasing age

3) Contributing Risk Factors
   a) Stress
   b) Obesity
   c) Diabetes

GUIDELINES FOR TESTING

Clients that can be sub-max test are:
1) All apparently healthy males below age 40
2) All apparently healthy females below age 50

Clients that require a max stress test and a medical clearance from a physician
1) All male clients aged 40 and above.
2) All female clients aged 50 and above.
3) Clients in the Increased Risk and/or With Disease Categories

TESTINGS

Max Tests refers to Maximal Cardiorespiratory Testing and is the measurement of maximum aerobic capacity. Physicians currently max test clients on a treadmill test. The Cooper Institute uses the 1.5 mile run or the 12-minute run/walk tests. These tests by Cooper require all-out effort and may not be suited for the general population.

Sub Max Test refers to Submaximal Cardiorespiratory Testing. These tests terminate before exhaustion and do not require an all-out effort. An estimate of VO2 max is made using the assumption that there is a linear relationship between heart rate, oxygen consumption, and workload. An example would be the 3 Minute Step Test.

Chapter 3
Energy Production

The best way to define energy is the ability to do work. The source of energy for all bodily functions comes from the sun. Energy needs to be transformed from light into a form of chemical energy. The transformation begins with the light energy being absorbed by the green plants. This process is called photosynthesis.
Humans can derive energy from both ingesting plants and consuming meat. By consuming meat, humans derive a portion of their energy from what is stored in the meat i.e., carbohydrates, protein, and fat.

ATP

-ATP is called Adenosine Triphosphate.
-Energy must be transformed into ATP before it can be used.
-One molecule holds a considerable amount of energy.
-When the bond breaks, the phosphate group is releases with the end result of ADP (Adenosine Diphosphate Phosphate)
-ATP provides the only source for muscle contraction.
-Carbohydrates and fat storage must first be converted to ATP before it can be used.

THREE ENERGY PATHWAYS (SYSTEMS)

A metabolic progression of chemical reactions from the starting to ending point is called a pathway. Almost every step in any pathway depends on an enzyme for the necessary chemical reaction to occur. The cell is the basic unit of body structure and is where most metabolic reactions occur.

Systems: anaerobic (phosphagen & lactic acid) and aerobic (metabolism of carbohydrates, proteins & fats.) The body frequently shifts between energy systems depending on intensity and duration of exercise performed.

-Phosphagen, Lactic Acid, and Aerobic
-The body posses' three separate systems of energy.
-Each muscle cell contains these systems.
-The systems differ in their complexity, regulation, capacity, power and types of exercise.

PHOSPHAGEN(ANAEROBIC) SYSTEM

-Operates in the absence of oxygen
-Usually short spurt, high energy activities. Carbohydrates. Does not burn fat.
-Relies entirely on chemical source of fuel stored with in the muscle
-Very high intensity exercise
-Can only supply ATP for up to 10 seconds
-Short term, high intensity exercise (short sprint or 1 RM)

ATP-CP System/Phosphagen System. Energy must be transferred to a chemical compound called ATP(adenosine triphosphate) before it can be used.
CP(Creatine phosphate). This is another high-energy compound stored in the muscle, in addition to ATP. CP can be activated instantly and can replenish ATP at rates fast enough to meet energy demands of the fastest and most powerful sports events. However, there is not enough of it made and stored in the muscles to sustain a high rate of ATP resupply for more than a few minutes.

(1) **Fuel Source**-Creatine phosphate. Stored in sarcoplasm (fluid portion of the muscle cell). PC is the first line of defense for resupplying ATP in muscles.

(2) **Regulatory Enzyme**-CK (Creatine Kinase). When ATP is being used rapidly. CK is activated and CP is broken down to replace ATP being consumed.

(3) **Intensity**-High, 95% maximum.

(4) **Duration**-Short, 1-15 seconds. Fatigue due to phosphagen depletion.

(5) **Energy Production**-1 mole = 1 kilocalorie (metabolized energy values from a calorie) 1 mole ATP released in the body = 10 kilocalories. 4.0 moles/min. of ATP.

(a) ***Capacity***. Very limited. Provides an immediate source of energy. Fuel is limited. Capacity is minimal, completely exhausted within seconds.
(b) ***Power.*** Very high, 36-40 kcal/min; energy provided at least twice as fast as other energy systems. Very short time fatigue (1-15 seconds). Fatigue due to depletion of phosphagen.

(6) **Chemical Reaction**-The splitting of CP into Creatine (C) and phosphate (P) results in the release of enough energy to attach phosphate onto an ADP molecule thereby producing ATP. At almost the same instant ATP is produced, its terminal phosphate group is lost. The energy is then transferred into the contractile mechanism of the muscle.

(7) **List Three Examples**-Sprinting, jumping, throwing, kicking & lifting heavy weights.
1. Sprinting & kicking in Soccer.
2. Jumping & spiking Volleyball; and
3. Sprinting, jumping shooting in basketball.

LACTIC ACID SYSTEM (ANAEROBIC)

-Operates in the absence of oxygen
-Fuel source is glucose
-Produces more ATP than the Phosphagen System
-Glucose breaks down to a simpler compound called pyruvate.
-Pyruvate can take two pathways:
*Pathway One(Slow Glycolysis): level of oxygen sufficient, level of energy needed low, transfers to the mitochondria and combusted aerobically.

*Pathway Two (Fast Glycolysis): Oxygen level insufficient, energy level required is high, transformed into lactic acid

-High intensity exercise that lasts between 10-90 seconds (100 meter swim or 400 meter run OR 1000-2000 meters cycling)

-High intensity rallies in soccer, hockey (ice or field), volleyball, and tennis also uses much of this energy system.

Anaeobic glycolysis process, which literally means breaking down of glucose (glyco-sugar; lysis-breakdown) that occurs in the sarcoplasm of muscle cell. When glucose breaks down, the resulting three-carbon compound called pyruvate follows either of two main routes: aerobic or anaerobic. Takes anaerobic lactic acid system if oxygen is insufficient and demand for energy high; "fast" glycolysis.

(1) **Fuel Source**-Carbohydrates, only form that can be used is glucose, coming either from the blood glucose or from stored glycogen within the muscle. Because the supply of glucose exceeds that of muscle phosphagen, the lactic acid system produces more ATP than the phosphagen system.

(2) **Regulatory Enzyme**. PFK (phosphofructokinase) stimulated by the rapid accumulation of ADP and by the rapid depletion of CP.

(3) **Intensity**. High/moderate 85-95%

(4) **Duration**. Short/Medium. 45-90 seconds. Fatigue to lactate accumulation.

(5) **Energy Production**. While producing ATP, simultaneously produces lactic acid. Limiting factor does not fuel production, but lactic acid builds up. The level tolerated by untrained corresponds to a total ATP production of about 1.5 molecules or an energy expenditure of 15 kcal.

(a) ***Capacity***-Limited 12-15 kCal. Muscle becomes too acid to operate, many enzymes are inhibited, and muscle contraction is affected. Maximum capacity is determined by the ability to neutralize or tolerate lactic acid.
(b) ***Power***-High/moderate. 16-20 kcal/min. Maximal power depends on the time required to produce given amount of ATP.

(6) **Chemical Reaction**-Source of fuel for glycolysis is provided by blood glucose or muscle glycogen; priming steps are required (before any ATP can be made, one phosphate group is removed from ATP and attaches to glucose making glucose phosphate. Another mole of ATP donates its phosphate group and the compound splits into two equal parts, every reaction actually occurs twice for every one glucose that originally entered (2 ATP from the input of 1 glucose). The final step is conversion of pyruvate into lactate. Lactate is made in the muscle (sarcoplasm) and diffuses into the blood. For the most part, lactic acid accumulates in active muscle cells until it is released into the bloodstream; from there the liver picks it up and resynthesizes it into glucose.

(a) ***Blood Glucose***-A simple sugar form in which carbohydrates are transported in the blood.

(b) ***Muscle Glycogen***-Form in which digested carbohydrates (glucose) are stored in muscles and liver and utilized as energy.

(7) **List 3 examples**. Sustained high intensity rallies in soccer, lacrosse, field hockey, ice hockey, tennis, badminton, volleyball, and basketball.

Note that lactic acid is not related to muscle soreness, which lasts between 2-3 days. This is called microscopic muscle and connective tissue trauma.

AEROBIC SYSTEM

-Operates in the presence of oxygen
-Fuel sources are carbohydrates, fats, and proteins
-Produces carbon dioxide and water as end products
-Virtually unlimited capacity of making ATP
-Supplies all of the energy for low to moderate intensity exercises
-Supplies energy for sleeping, resting, sitting, walking, and other forms of physical activity
-Three components:

1. First component is Glycolysis.
2. Second component is Krebs Cycle
3. Third component is Electron Transport System

There are three routes: (1) slow glycolysis from carbohydrates, fat oxidation cycle from fat, and protein metabolism from protein* (2) Krebs Cycle, and (3) Electron transport System (ETS). End products are carbon dioxide and water. *While a minimal amount of ATP is formed from pathway 1, its main purpose is to produce acetyl groups (small two-carbon compounds) and a supply of electrons for subsequent actions. It is within the mitochondria (muscle cell composed of sub cellular structures) that most of the ATP is produced aerobically. A mole of carbohydrate (glucose) produces 38 ATP; a mole of fat (steric acid) produces 147 ATP; and a mole of protein (alanine) produces 15 ATP when combusted by the aerobic system.

Glycolysis(ATP Production from Carbohydrates)

-Carbohydrates = glycolysis
-Fat = Fat Oxidative
-Protein = Protein Metabolism

Aerobic production of energy from carbohydrates begins with slow glycolysis. If activity of the mitochondria (which relies in part on the supply of oxygen and the rate at which energy is being produces) is sufficient, the electrons and pyruvates are oxidized (lose electrons) and decarboxylated (lose CO2) forming acetyl groups that enter the Krebs Cycle.

Krebs Cycle

-Purpose is to remove electrons and protons for subsequent reactions.
-Common to all types of fuel

Named after Hans Krebs, the scientist who described it). Also called the Citric Acid Cycle. The cycle is a sequence of chemical reactions that cells use to convert carbon into carbon dioxide. Remaining energy from the pyruvates is extracted in this cycle to form more ATP. The acetyl groups formed from the pyruvates enter into the Krebs.

Cycle resulting in the production of citric acid which goes through a series of reactions including oxidations in which more electrons are removed. These electrons are the driving force for the Electron Transport System (ETS). The citric cycle produces most of the ATP for the cell.

Electron Transport System
-Common to all types of food fuel
-Accounts for 85% of the total ATP produced by the aerobic system
The final sequence of reactions in the aerobic production of ATP. The system consists of a number of reusable electron-carrying compounds that are arranged into specific complexes located in the mitochondria. Electrons pass (flow) from one intermediate to the next, supplying the energy necessary to make a tremendous amount of ATP. Because of coupled process called oxidative phosphorylation, accounts for over 85% of the total ATP produced by aerobic system.

ATP from Fat. Fats are stored in the body in adipose tissue and within skeletal muscle in the form of triglycerides. To be used for exercise, it must first be mobilized into a usable form called a free fatty acid. The fatty acids are released from the fat depots into the bloodstream and travel to the muscles. A fat oxidation cycle occurs within the mitochondria. One revolution of the cycle produces an acetyl group that enters the Krebs cycle, leaving nothing of the fatty acid. It has been completely oxidized to carbon dioxide and water through the aerobic process. Electrons are sent from many sources to the Electron Transport System. Under resting conditions, fatty acids provide the primary source of fuel; with higher intensity exercise, fat metabolism is inhibited, and carbohydrates becomes the preferred source of fuel, used by the aerobic system and the lactic acid system.

ATP from Protein. Protein usually does not provide more than 10-15% of the total energy requirement of an activity. The main source is stored protein in the body is muscle. It is obviously not advantageous to use this source for fuel, which is broken down into amino acids.

Characteristics of the Three Energy Systems

Characteristic	Phosphagen System	Lactic Acid System	Aerobic System
Fuel used	creatine phosphate	carbohydrates	CHO, Fat, Protein
Location Fatigue due to:	sarcoplasm phosphagen depletion	sarcoplasm lactate accumulation	mitochondria glycogen depletion
Capacity	very limited	limited	unlimited
Power	very high	high/moderate	moderate/low
Intensity	very high	high/moderate	moderate/low
% Max	>95% max	85-95% max	<85% max
Time to Fatigue	very short 1-15 seconds	short/medium 45-90 seconds	medium/very long >3-5 minutes
Running Distance	<100 m	400-800 m	>1500 m
Swimming	<25 m	100-200 m	>400 m
Cycling	<175 m	750-1500 m	>3000 m
Rowing	<50 m	250-500 m	>1000 m

Chapter 4
Aerobic Training

Aerobic training can also be termed cardiovascular training. The components of the training are: Frequency, Intensity, Duration, and Mode or Type of exercise.

Frequency refers to the number of days per week a person exercises.

Intensity refers to the target heart rate/range.

Duration refers to the number of minutes spent in the target heart rate range.

Mode or Type refers to the type of aerobic exercise being performed.

Overload-Training occurs when the body is regularly stimulated beyond its normal workloads by progressively increasing frequency, intensity, and duration of exercise. The body responds by increasing its capacity to perform work.

Training Effect-"Physiologic adaptations that occur as a result of aerobic exercise of sufficient intensity, frequency and duration to produce beneficial changes in the body." A training effect will occur when muscles are worked slightly beyond their point of fatigue on a regular basis, with periodic increase in frequency, intensity and duration as a result of adaptation to the workload.

There are two categories of aerobic training: **Primary and Secondary**. They are characterized by how much oxygen is required, the usage of the large muscles in the body, the nature is rhythmical, and at moderate levels of intensity the activity can be maintained over a period of time.

Primary aerobic activities include running, rollerblading, skiing, stair climbing, and brisk walking.

Secondary aerobic activities include group exercise classes such as aerobics dance, racquet sports and basketball.

HEART RATE

Resting Heart Rate-is the pulse rate while still lying down in the morning before rising. Number of the times the heart beats per minute while at rest. The average for women is 78-84bpm and the average for men is 72-78bpm. A person in good aerobic condition generally has a lower resting heart rate. The heart can comfortably perform at least twice its resting values.

Recovery Heart Rate-is the heart rate taken at the end of class after a stretch cool down to gauge when the heart rate has returned to pre-exercise pulse. It indicates the speed at which the heart rate returns to pre-exercise levels; speed improves as cardiorespiratory fitness improves. Generally taken two - five minutes after the completion of aerobic work and can indicate whether or not the cool down period was sufficient. Should be 60% or less of the estimated maximum heart rate.

Where to find the Heart Rate

Carotid Artery which is located in the neck close to the “Adams apple”.

Radial Artery which is located in the wrist.

*Remember do not take your pulse with the thumb because the thumb has a pulse of its own and it would give you a false reading.

Calculation of Target Heart Rates

1) Determine predicted maximal heart range.
   Use the Karvonen Formula: 220-age

2) Subtract the resting heart rate from the predicted maximal heart rate. This is called the heart rate reserve.
   -To find the resting heart rate, to take your pulse for one full minute right when you wake up in the morning before getting out of bed.

3) Multiply your results of Step 2 by the desired intensity level.
   -50-60%
   -60-70%
   -70-85%

4) Add back in the resting heart rate to the results you got in Step 3.
   -This is the target heart rate range.

5) To determine the ten second heart rate range, divide both the numbers by 6.

220 - Age - Resting Heart Rate x % of Intensity + Resting Heart Rate = Target Heart Rate Range

Perceived Exertion

Borg’s Scale of Perceived Exertion was developed by Dr. Gunnar Borg in 1971. This scale can be used for Special Populations who are taking beta blockers because the medication significantly lowers the heart rate in a dose/response manner. Therefore, the Heart Rate Range Calculation would be inaccurate to use.

The Borg Scale (Rating of Perceived Exertion)

RPE
6..... VERY, VERY LIGHT
7
8
9..... VERY LIGHT
10
11… ..... FAIRLY LIGHT
12
13… ..... SOMEWHAT HARD
14
15… ..... HARD
16
17… ..... VERY HARD
18

19
20… ..... VERY, VERY HARD

When using the Borg Scale, the individual is asked to his/her level of perceiver exertion during the exercise session. Most healthy individuals should be able to work between 11-15 during their normal exercise session.

Talk Test

If you are able to carry on a conversation while working out, then you are training aerobically, inability to talk indicates a person is working too hard and should decrease intensity.

ACSM Prescription of Cardiovascular Training

1) Frequency: 3-5 days per week
2) Intensity: 55-90% max heart rate
3) Duration: 15-60 minutes per session
4) Mode or Type of Activity:
   There is no best aerobic exercise than the one that uses the large muscles of the body.
5) Progression
   Progression is broken down into three phases. Remember that these phases are relative to the person's initial fitness level, health, age and their fitness goals.
   a) Initial Conditioning Phase
      1) Intensity - 55-70% max heart rate
      2) Frequency - at least 3 times per week
      3) Duration - 10-15 minutes minimum per session
      4) Period - 4-6+ weeks

   b) Improvement Conditioning Phase
      1) Intensity - 70-90% max heart rate
      2) Frequency - at least 3-5 times per week
      3) Duration - 15-60 minutes per session
      4) Period - small increases every 2-3 weeks for 4-5 months

   c) Maintenance Conditioning Phase
      Review Program and reassess goals

Cooper Institute Exercise Prescription

The Cooper Institute lists four categories in their Exercise Prescription: Aerobic Power, Weight Control, Flexibility, and Strength.

Aerobic Power also termed Cardiorespiratory Endurance

Intensity : 60-85% maximum heart rate
Frequency : 3-5 days per week
Duration : 20-60 minutes per session
Mode : Large muscle movement

Weight Control

Intensity : expend 300 calories per session
Frequency : 3 days initially, work toward 5 days per week
Duration : 20 min. initially, work toward 45-60 minutes
Mode : large muscle movement

Flexibility

Intensity : easy point tension(dynamic stretch)
full extensibility (static stretch)
Duration : 3-7 days per week
complete 10-20 repetitions (dynamic stretch) hold 10-20 seconds (static stretch)
Mode : stretching-dynamic, static, and PNF

Strength

Frequency : 2 to 4 days per week(day of rest between)
Duration : 12 reps so last 2 are difficult
8 to 10 major muscle groups
Initially 1 set and work toward 3 sets
Intensity : endurance (dynamic strength)=less resistance-more reps strength(absolute strength)=more resistance-less reps
Mode : isometrics, isotonic, and isokinetic

AQUA AEROBIC HEART RATE

Taking heart rates is a popular way to assess the demands of exercise because it reflects the body's oxygen uptake. Making sure that the heart rate is in the Target Heart Rate Zone ensures adequate training and prevents over training.

However, heart rate guidelines for exercise on land do not apply in the water. Buoyancy lessens the gravitational pull on the body and the heart does not have to work as hard. Hydrostatic Pressure also affects the heart rates. Hydrostatic pressure is defined as the pressure exerted by the molecules of a fluid upon an immersed body. This pressure affects the body's surface and skin as well as the internal organs of the body. Hydrostatic pressure can decrease swelling and pressure and can affect vascular and respiratory systems. Thus, making this partially responsible for recorded heart rates while in the water.

Many other aquatic factors can affect heart rates during exercise in the water including to be retained and the heart rate to increase.

Body positions can create different demands. The demands of exercise while standing in waist-deep water with both feet on the pool bottom are very different from the demands of exercise while floating in deep water.

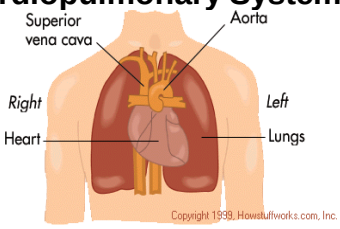
Research on these and other factors concerning heart rates in the aquatic environment is recent. It is generally accepted that heart rates in the water are usually lower than those associated with land aerobics. Research suggests a differential range of 10% to 13% in heart rates in the water versus the land.

J. GLENN McWaters FORMULA

(205-AGE) X 0.7 FOR THE LOWER LIMIT

(205-AGE) X 0.85 FOR UPPER LIMIT

Chapter 5
Cardiopulmonary System



In the cardio (heart) pulmonary (lung) system, air is inhaled from the atmosphere, through the conducting airways to the functional unit of the lungs. A gaseous exchange occurs between the alveoli and capillaries of the lungs. Carbon dioxide returns to the lungs and is exhaled. The newly inspired oxygen travels within the red blood cells from the lungs to the left side of the heart and is pumped throughout the body via the arterial circulation. Exchange of oxygen, carbon dioxide and nutrients in the tissues occurs throughout the body at the capillary level. Oxygen-poor blood is then returned through the venous system to the right side of the heart. The heart contracts and forces blood back to the lungs whereby the process repeats itself.

In the cardio (heart) vascular (vessels) system, blood is carried to and from all other parts of the body through the heart. The blood leaves the heart by way of the aortic arch and travels through smaller and smaller arteries into capillaries, from which oxygen and nutrients pass to the cells of body tissues. Other capillaries then pick up cellular waste products and carbon dioxide. The blood flows into larger and larger veins, merging in the vena cava, which carries the blood back to the heart.

HEART

The heart is a muscular organ located in the chest diagonally behind the breastbone and is divided into right and left sides by a partitioning wall, or septum. The heart is made up of four chambers: the right and left atria (upper chambers) and the right and left ventricles (lower chambers). The superior atria are the blood receiving units of the heart in which is forced through a one-way system of values, the atrioventricular, to the inferior ventricles. The contraction of the ventricle forces blood through the semilunar valves and into the great arteries of either the pulmonary or systemic circulation.

The right side of the heart receives deoxygenated blood as it is returned from the body through the venous system and pumps the blood from the lungs and pumps it via the arterial system, throughout the body.

The heart is entirely contained within a loose yet protective sac, the pericardium. It is composed of three specialized layers of tissue: the epicardium (the outermost layer), the myocardium (the next layer which performs the heart's primary work), and the endocardium (a smooth membrane which lines the cavities within the heart).

Structure and Location

-The heart is a muscle (cardiac) which is located in the chest.
-At rest the heart pumps per minute (cardiac output) an average of 5 liters.
-Divided into the right and left sides.
-The right side receives the deoxygenated blood from the venous system.
-The left side receives the oxygen rich blood lungs.
-Further broken down into the upper and lower chambers and the ventricles.
  *The upper and lower chambers are called the atria which are the blood receiving units of the heart.
  *The blood is then forced to the ventricles through the atrioventricular or AV valves.
  *The contraction of the ventricle's forces blood through the semilunar valve and into the great arteries of either the pulmonary or systemic circulation.
-Composed of three layers of tissue: epicardium, myocardium, and endocardium.
  *Epicardium is a thin membrane located on the outer most layer of the heart.
  *Myocardium is the thickest and strongest in the left ventricle. This tissue is where the primary work is performed.
  *Endocardium is a smooth membrane that lines the cavities within the heart.

Conduction System

-Autorhythmic in nature
-Controlled by a specialized nerve center in the brain
-Conduction begins with an electrical impulse of the sinoatrial node (SA)
-SA located within the right atrium
-SA referred to as the pacemaker because it dictates regulation of the contractions of the heart
-Adult heart beats on the average 60-80 beats per minute

Cardiac Cycle

-The contraction/relaxation pattern produced in the heart.
-Contraction phase is the systole
-Relaxation phase is the diastole.
-Atrial contraction (systole) occurs during ventricular relaxation (diastole).
-Ventricular systole occurs as the atria relaxes.

Blood Pressure

-Normal 120/80 mmHg
-High 140/90 mmHg

Stroke Volume-the volume of blood ejected by each ventricle of the heart during a single stroke. The amount of blood pumped by the heart per beat can increase as much as 50-60% above resting values to meet the physiological demands of exercise. Increases stroke volume is a training effect of aerobic exercise and allows the fit individual to pump more blood per beat, resulting in a lower heart rate for a given workload.

Cardiac Output-the volume of blood pumped by each ventricle in one minute. It is a product of heart rate time's stroke volume. The average adult heart at rest pumps approximately five liters of blood per minute. As a result of adaptation to an exercise stimulus, the cardiac output can increase to almost eight times its resting values.

Venous Return-the massaging action of the muscles in the legs and arms help to move blood back to the heart. Blood return begins in the venules, the smallest venous unit. The veins are thinner and less muscular than arteries and return the blood to the larger structures under low pressure, often moving against gravity. The muscular action of a cooldown period after vigorous exercise assists in the return and will help prevent blood from pooling in the extremities.

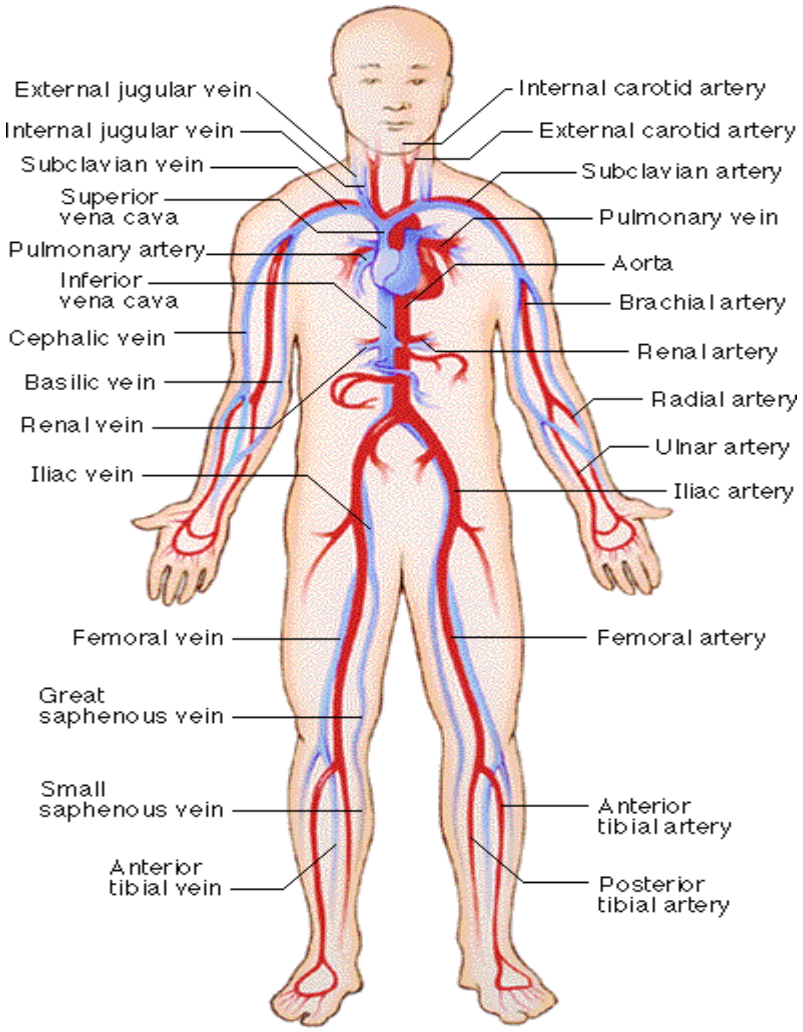
Valsalva Maneuver-a dangerous condition that can occur if an individual holds his breath causing the glottis to close and stomach muscle to contract, forming an unequal pressure in the chest cavity, reduced blood flow to the heart and insufficient oxygen supply to the brain. Dizziness, temporary loss of consciousness may occur. The epiglottis (or glottis) is a cartilaginous structure found in the larynx (which is composed of pieces of cartilage, the largest of which is known as the Adam's apple). The epiglottis partially covers the opening of the larynx and closes during swallowing to prevent food passage into trachea.

Arteries are large vessels with middle smooth muscle layers which carry oxygenated blood away from the heart to the body tissues. They have an elastic, muscular structure capable of expansion and contraction to regulate blood flow. A great number of smaller arteries branch smallest arteries, the arterioles. The arteries constitute a major part of or blood transportation system and function system and function to direct blood flow away from the heart.

Capillaries-microscopic vessels which connect the arterioles to the smallest branches of the veins, the venules. It is here, at the capillary level, that the blood gives up its oxygen food, and fluids to the tissues and the tissues give up carbon dioxide and fluid wastes to the blood. The blood leaving the capillaries, now laden with waste products and oxygen poor, returns to the heart through the venous system.

Veins complement the arteries in function and resemble them but are thinner walled and less muscular. Veins contain a one-way system of valves which prevent backflow of blood. The return of blood to the heart begins in the smallest venous unit, the venules.

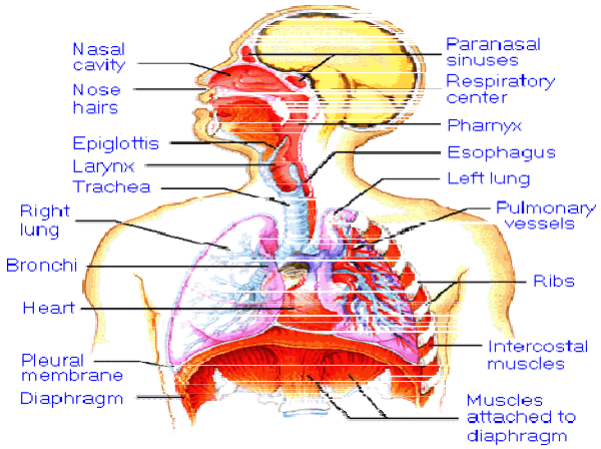
CIRCULATORY SYSTEM



The system which allows the blood to flow through the heart, lungs and body is called the circulatory system. It consists of the blood carrying vessels: the arteries, capillaries, and veins. Arteries carry blood away from the heart to capillaries, which work as exchange vessels for nutrients and gases, and veins transport blood from the capillaries back to the heart.

-Consists of the blood carrying vessels: the arteries, capillaries, and veins.
-System that allows the blood to flow.

PULMONARY SYSTEM



Pulmonary Circulation

The pulmonary system is responsible for providing two major functions: air distribution and gas (such as oxygen and carbon dioxide) exchange. Additionally, it effectively filters, warms and moisturizes the inhaled air. Organs associated with the pulmonary system also produce sound, speech and provide us with a sense of smell. The system is divided into two major components: the conducting airways (mouth/nose, pharynx, larynx and the primary branches of the bronchial tubes), and the functional unit.

The lungs are a pair of pinecone-shaped organs that lie within the chest cavity, one on either side of the heart. A thin layer of moist membranes, called pleura, covers the lungs and lines the chest cavity which allows for smooth inflation/deflation of the lungs. The breathing process begins with the respiratory center of the brain. Nerve impulses signal the muscles of respiration, the diaphragm(a pair of tent-like muscles that separate the lung cavity from the abdominal cavity like a bellows used to fan the flames of the fire), and the intercostal muscles to contract. As the diaphragm contracts, it moves downward and increase the volume within the chest cavity. Contraction of the intercostal muscles pulls the ribs outward, causing further enlargement of the cavity. A vacuum is then created within the space and the negative pressure draws in the outside air. Exhalation occurs as the muscles relax and reverse the process, causing the lungs to contract and force air out.

Flow of oxygen. Air enters the body through the mouth or nostrils into the nasal cavity where it is warmed and humidified. These passages lead to the pharynx (throat) then to the larynx (voice box) and then into the trachea (windpipe). In the chest cavity, the trachea branches into two (right & left) bronchi, which travel into the respective lungs. In the lungs, the bronchus divides into smaller passageways for air known as the bronchioles. The bronchioles consist primarily of smooth muscle and elastic tissue in the walls. It is at this site that the functional unit of the pulmonary system begins. Decreasing into respiratory units, the bronchioles lead to tiny tubes called alveolar ducts. The ducts attach to a cluster of grapelike structures called alveolar sacs which are composed of millions of alveoli. The number, structure and proximity of the alveoli to the structurally similar capillaries allow for an efficient diffusion of gases between air and blood. It is in the lungs that inhaled oxygen passes through the alveoli and enters the blood in the nearby capillaries. Some of the oxygen is absorbed in the blood cell. Oxygen is carried within the red blood cells to the tissues. Hemoglobin then releases.

oxygen to the tissues in exchange for carbon dioxide and is transported back to the alveoli for removal during exhalation.

-Pulmonary arteries receive deoxygenated blood from the right ventricle and then direct it to the lungs making oxygenated blood.
-Oxygenated blood then leaves the pulmonary circulation and returns to the heart via the left atrium and ventricle which then forces it through the aorta, to the body.
Pulmonary ventilation-the rhythmic to and from movement of air into and out of the lungs.

Vital Capacity-the greatest volume of air (voluntarily moved in breath) that can be forcibly exhaled after the deepest inspiration. Research suggests that vital capacity is primarily based on body size and is not significantly influenced by training. We do, however, increase the percentage of the vital capacity used during exercise.

Exchange Vessels
-The exchange of oxygen and other nutrients for waste products occurs in the capillaries.

Venous System
-Contain a one-way system
-Keeps a steady flow of blood
-No back flow occurs
-Required to maintain life.
-Exchange of gasses
-Provides life-sustaining processes
-Has two major functions: air distribution and exchange of gasses
-Divided into two major components: the conducting airways and the functional unit
-Conducting Airways consists of the mouth, nose, pharynx, and the primary branches of the bronchial tubes

Valsalva Maneuver
-Occurs when a person holds their breath during strenuous activity

CORONARY RISK FACTORS

CARDIOVASCULAR DISEASE(CVD)
-is a general term for diseases that affect the heart.
-There are four major types of CVD: Coronary Heart Disease(CHD), Cerebrovascular Disease (CD, Stroke), Congestive Heart Failure(CHF), and Peripheral Vascular Disease (PVD).
*__CHD__-is the buildup of fatty plaque in the coronary arteries. Is the leading cause of death in the United States.(Heart Attack)
*__CD__-is the buildup of fatty plaque and/or blood clots in the arteries leading within the brain.(Stroke)
*__CHF__-is a failure of the heart muscle to pump as much blood as it receives.
*__PVD__-is a buildup of fatty plaque/clots in the arteries leading within the extremities.

PRIMARY RISK FACTORS

Hypertension

-140/90 mmHg
-primary risk factor for CHD, CD, CHF, and kidney disease
-linked to excessive sodium and alcohol intake, obesity, and cigarette smoking
-60 million Americans have
-known as the “silent killer”

Cigarette Smoking

-major risk factor for CHD, CD, PVD, and cancer.
-400,000 deaths per year in the U.S.

Sedentary Lifestyle

-Cardiovascular fitness has a direct relationship to HDL
-Cardiovascular fitness levels have an inverse relationship to blood pressure, LDL, and Body fat

Obesity

Age

-men> 45 years; women 55 or premature menopause without estrogen replacement

Family History

-Males Blood Relative: with MI or sudden cardiac death before 55
-Females Blood Relative: with MI or sudden cardiac death before 65

Diabetes Mellitus

-fasting blood glucose level is ≥ 140 mg/dl on 2 separate occasions
-two types
*Type II-90% non-insulin dependent
*Type I-10% insulin dependent

Elevated Blood Cholesterol

-is important for bile synthesis, formation of hormones, and cell membranes
-HDL, LDL, and VDL
-HDL is the “good” cholesterol
-LDL is the “bad” cholesterol
-borderline total cholesterol=200-239 mg/dl
-greatly elevated 240+ mg/dl
-LDL 130-159 mg/dl is borderline
-LDL 130-159 mg/dl is borderline
-160+ mg/dl greatly elevated
-HDL < 35 mg/dl high risk for CHD

AGE	IDEAL TOTAL CHOLESTEROL LEVEL
< 20	<150 mg/dl
20-29	<180 mg/dl
30 +	<200 mg/dl

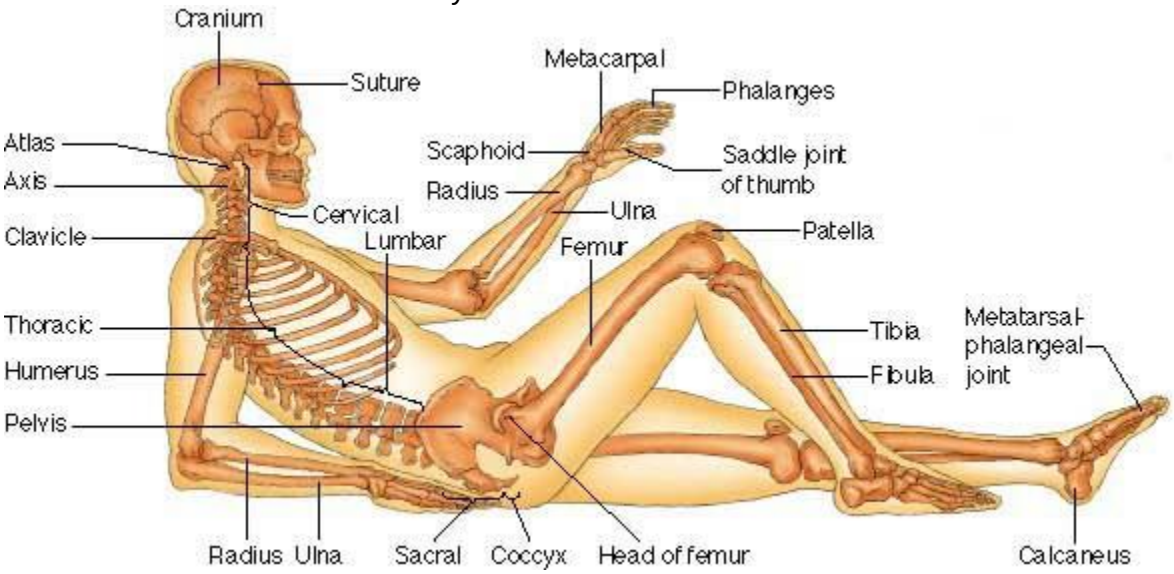
Total Cholesterol: HDL Ratio
Example:
Total Cholesterol = 210 mg/dl HDL = 40 mg/dl
Ratio = 210/40 = 5.25

IDEAL RATIO

WOMEN	MEN
≤ 3.5	≤4.0

Chapter 5
Anatomy

An understanding of the structure and function of the muscular and skeletal systems is necessary to develop any successful physical fitness programs. There are over 650 muscles and 206 bones in the body.



What does Physical Fitness Programming require? Physical fitness programming requires a person to have an in-depth knowledge of the structure and function of the body. Second, it requires that special attention be made toward individual differences. Third, physical fitness programming assumes an initial level of structural integrity. Finally, it requires guidelines for proper exercise technique.

There are four terms a person needs to know when studying anatomical kinesiology. These terms are Anatomy, Physiology, Kinesiology, and Biomechanics.

Anatomy is the study of structure.

Physiology is the study of function.

Kinesiology is the study of structure and function of the Musculo-skeletal system.

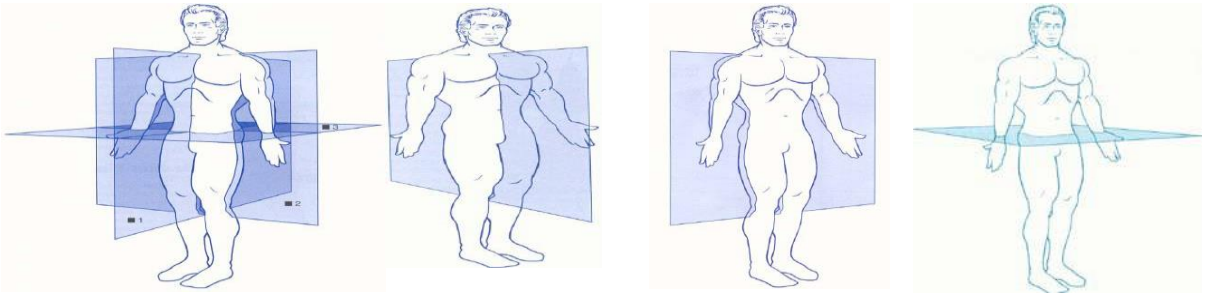
Biomechanics literally means “life movements”.

These terms and their definitions will help one to better understand anatomical kinesiology.

HUMAN MOTION AND ITS STRUCTURE

Under Human Motion and its Structure there are four categories that must be delved upon: Planes of Motion, Anatomical Directions, and Terminology Related to movement, and Properties of Muscle Tissue.

Planes of Motion



There are three Planes of Motion. First, Sagittal Plane which runs along the axis of the body. It divides the right side from the left side. Second, the Frontal Plane which runs along the axis of the body too. This plane divides the body into the front and back halves. Finally, the Transverse Plane which runs through the center of the body. This plane divides the body into the top and bottom halves. The Transverse Plane is also referred to as the Horizontal Plane.

Anatomical Directions

There are eight (8) terms related to Anatomical Directions. Anatomical Direction refers to the direction in which movement is going to or from.

1) **Anterior** refers to the front side of the body.
2) **Posterior** refers to the back side of the body.
3) **Superior** refers to the top part of the body toward the head.
4) **Inferior** refers to the bottom part of the body toward the tail.
5) **Proximal** refers to the closest to the trunk.
6) **Distal** refers to the farthest from the trunk.
7) **Medial** refers toward the mid-line of the body.
8) **Lateral** refers to the side or away from the mid-line of the body.

Movement

There are 15 terms related to movement.

1) **Abduction** refers to the movement of a limb away from the mid-line of the body.
2) **Adduction** refers to the movement of a limb toward the mid-line of the body.
3) **Flexion** refers to a movement which decreases the angle of a joint.
4) **Extension** refers to movement which increases the angle of the joint.
5) **Hyperextension** refers to a movement that takes the joint beyond its normal range of extension.
6) **Rotation** is the turning of a part, usually about its long axis.
7) **Circumduction** refers to the circular movement, usually about its short axis.
8) **Pronation** refers to movement of the palms down.
9) **Supination** refers to the movement of the palms up.
10) **Elevation** refers to movement in the superior position.
11) **Depression** refers to movement in the inferior position.
12) **Inversion** refers to the sole of the foot turned inward.
13) **Eversion** refers to the sole of the foot turned outward.

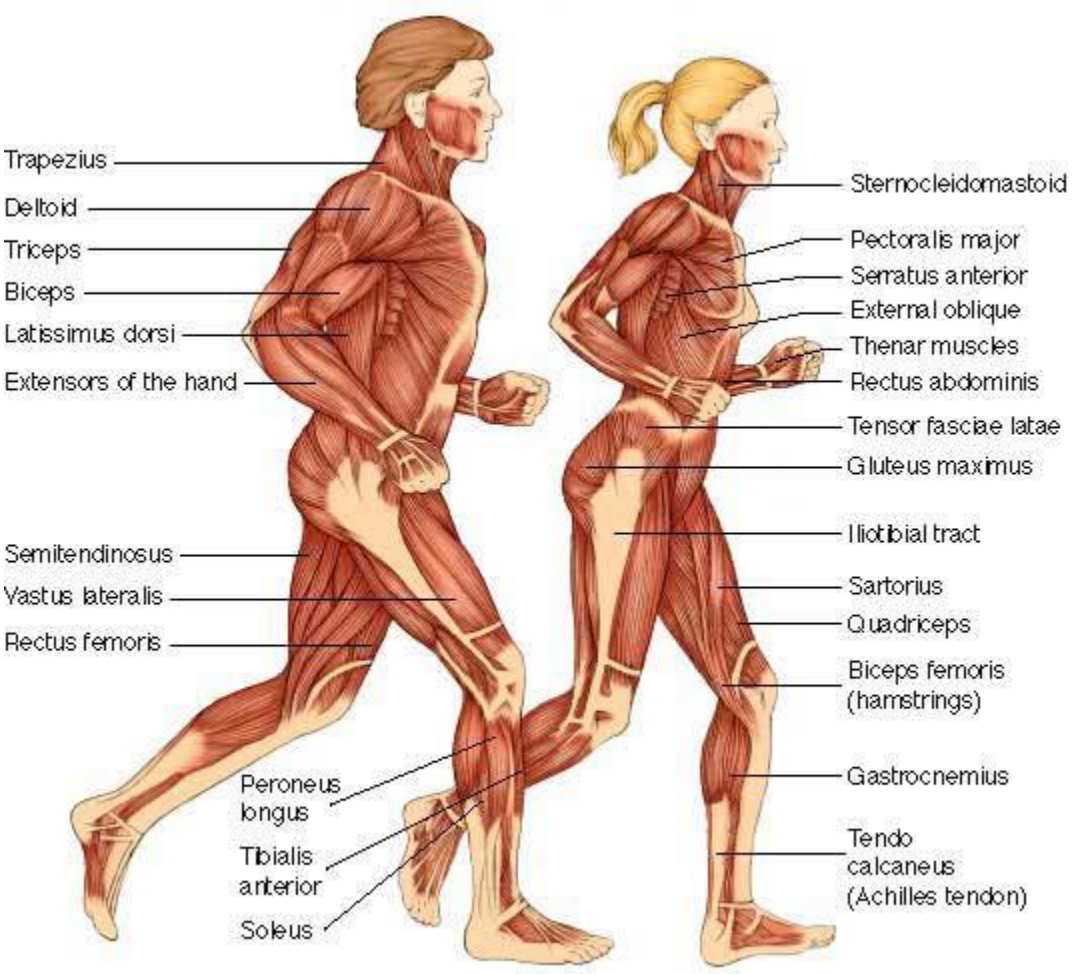
14) **Dorsi-Flexion** refers to moving the foot toward the anterior, toe toward the leg.
15) **Plantar Flexion** refers to moving the foot downward, “planting seeds”.

Properties of Muscle Tissue

There are four unique properties of muscle tissue.

1) **Excitability** is the ability for the muscle to get excited. It receives and responds to a stimulus.
2) **Contractility** is the ability of the muscle to contract from the resting length.
3) **Extensibility** is the ability of the muscle to extend or stretch beyond its normal resting length.
4) **Elasticity** is the ability of the muscle to return from the extension back to its resting length.

MUSCLES



There are over 650 muscles in the body. Out of those 650 muscles, there are three muscle types: skeletal, smooth and cardiac. First, skeletal muscles are elongated cylinders that are anchored to bones. Skeletal muscles pull at them to initiate movement. Second, smooth muscles consist of slender cylindrical fibers and surround nearly all the body’s organs. Finally, the cardiac muscle is found only in the heart.

Before actually naming and defining some of the muscles of the body, one must first understand how the muscles work. What is muscular force? Muscular Force is the force in which the muscle produces and is dependent upon several factors: Principles, Size, and Location.

Muscular Principles

There are three principles to muscular strength:

1) **Principle of Pre-Tension** means that when the muscle is stretched to its limits, it has reached its greatest anatomical potential for developing force.

2) **Principle of Angle of Pull** is a mechanical principle. It means that a muscle can deliver the greatest amount of force when the point of attachment of the muscle is at a right angle to the lever that it is moving.

3) **All or None Law** means that a muscle can contract 100% of its ability or the fiber will not contract all.

Size

Size common sense tells us that a larger muscle fiber has a greater force potential than a smaller muscle fiber.

Location

Location refers to the actual location of a muscle that may provide that muscle with mechanical advantage or disadvantage in generating force.

MUSCLE FIBERS

There are two basic types of muscle fibers found in skeletal muscle: Type I and Type II. Type I are the slow twitch or slow oxidative fibers. Type II is the fast twitch or fast glycolytic fibers.

Type I	**Type II A**	**Type II B**
Slow Oxidative	**Fast Oxidative-Glycolytic**	**Fast Glycolytic**
weakest	stronger	strongest
fatigue resistant	fatigue resistance	fatigue very quickly
high oxidative capacity	high oxidative and glycolytic capacity	high glycolytic capacity
endurance athletes	middle distance athletes	strength/power/speed athletes

MUSCULAR CONTRACTION

There are three types of muscular contraction: Isometric, Isotonic, and Isokinetic.

Isometric also referred to as static is a contraction in which the internal force is developed in the muscle but there is no joint movement.

Isotonic also referred to as dynamic is a contraction in which the internal force is developed in the muscle and there is joint movement. Isotonic has two phases of contraction:

1) **Concentric** which is the phase in which the muscle shortens and resists gravity. An example would be a biceps curl.
2) **Eccentric** which is the phase in which the muscle lengthens while resisting a load. An example would be a triceps extension.

Isokinetic requires special equipment like the Cybex 6000. This is the safest mode of strength training and is used widely in rehabilitative settings.

MUSCULAR SYMMETRY

Simply stated the Principle of Opposition. If an individual works, the biceps must also work the opposing muscles (triceps) equally. This will create a balance between the two muscles. Balance not only "looks" better, but it reduces the chance for injuries. For example, if the abdominal muscles are weak, the back will have to overcompensate which creates back pain and injury.

ROLES THE MUSCLES PLAY

Muscles play 4 roles: Agonists, Antagonist, Stabilizer, and/or Neutralizer.

Agonist is the prime mover and the muscle involved is in "agony". It is the muscle primarily responsible for producing movement.

Antagonist is the muscle which opposes the Agonist or primary mover. It is the muscle that "antagonizes" the Agonist.

Stabilizers are the muscles that fix a joint or part while the movers produce around it.

Neutralizers are the muscles which contract to prevent unwanted actions.

MUSCLES AND THEIR FUNCTIONS

Now that we have listed and defined what muscles do, we can go one step further and individualize the muscles. Specific muscles create specific movements or actions.

Chest, Back, Shoulders, and Arms

Chest

Pectoralis Major are the chest muscles.

1) Action-horizontally adducts the humerus.
2) Joints-the elbow and shoulder
3) Examples: push-ups, bench press, and pec dec.

Back

Rhomboids are located in the upper back region.

1) Action-adducts the scapula.
2) Joints-the elbow and shoulder
3) Examples-prone dumbbell flies and rowing

Trapezius is located in the upper middle back region.

1) Action-adducts and rotates the scapula upward.
2) Joints-elbow and shoulder.
3) Examples-shrugs and prone dumbbell flies.

Latissimus Dorsi is located in the middle, side, and lower back region.

1) Action-adducts the humerus.
2) Joints-elbow and shoulder.
3) Examples-wide grip pull downs and pull ups.

Erector Spinae is located in the lower back and consists of the iliocostalis, longissimus, and spinalis.

1) Action-extends and hyperextends the entire spine.
2) Joints-spine and hip
3) Examples-upper body lifts and back extensions.

Shoulder

Deltoids are located in the shoulder and there are three fibers: anterior, middle, and posterior.

Anterior Deltoid is located in the front of the shoulder.

1) Action-flexes and horizontally adduct the humerus.
2) Joints-elbow and shoulder.
3) Examples-frontal raises

Middle Deltoid is located on the top of the shoulder.

1) Action-abducts the humerus.
2) Joints-elbow and shoulder.
3) Examples-lateral raises

Posterior Deltoid is located in the back of the shoulder.

1) Action-extends and horizontally abducts the humerus.
2) Joints-elbow and shoulder.
3) Examples-rear-delt raises

Arms
Biceps Brachii is located in the front upper arm.
1) Action-flexes the elbow
2) Joints-elbow and shoulder
3) Examples-Preacher curl

Triceps Brachii is located in the back of the upper arm.
1) Action-extends the elbow.
2) Joints elbow and shoulder.
3) Examples-push ups

Abdominal, Gluteus, and Hip

Abdominal
Rectus Abdominus is located in the front of the trunk area and is the entire length of the stomach.
1) Action-flexes and laterally flexes the spine.
2) Joints-trunk and hip
3) Examples-modified sit-ups and crunches.

External Oblique wraps around the trunk.
1) Action-flexes the spine and laterally flexes the trunk and rotates the spine to the opposite side.
2) Joints-trunk and spine.
3) Examples-cross over and side bends.

Internal Oblique wraps around the trunk and beneath the external oblique.
1) Action-flexes the spine and laterally flexes and rotates spine to the opposite side.
2) Joints-trunk and spine.
3) Examples-cross over and side bends.

Hip
Iliopsoas crosses the hip and primarily spanning lumbar region.
1) Action-flexes the hip.
2) Joints-trunk and hip.
3) Examples: walking, running, and full bent knee sit ups.

Gluteus
Gluteus Maximus is located in the buttocks.
1) Action-extends and hyperextends the hip
2) Joints-trunk and hip
3) Examples-half squats, leg press, and hip extension.

Legs
Quadriceps Femoris or better known as the “Quads”. The Quadriceps Femoris consists of the vastus lateralis, vastus medialis, vastus intermedius, and rectus femoris.

Vastus Laterialis is located front of the thigh on the outside.
1) Action-extends the knee.
2) Joints-knee and hip
3) Examples-half squats, leg press, and knee extension.

Vastus Medialis is located in front of the thigh on the inside.
1) Action-extends the knee
2) Joints-knee and hip
3) Example-half squats, leg press, and knee extension.

Vastus intermedius is located in front of the thigh in the middle.
1) Action-extends the knee.
2) Joints-knee and hip
3) Examples-half squats, leg press, and knee extension.

Rectus Femoris is located in front of the thigh.
1) Action-flexes the hip and extends the knee.
2) Joints-hip and knee.
3) Examples-leg press, knee extension, and running.

Hamstring- located in the upper back of the thigh. Hamstrings consist of: semimembranosus, semitendinosus, and biceps femoris.

Semitendinosus is located in the upper back of the thigh between the semimembranosus and biceps femoris.
1) Action-extends and hyperextends the hip and flexes the knee.
2) Joints-hip and knee
3) Examples-knee curls and running

Semimembranosus is located in the upper back of the thigh (the inside hamstring).
1) Action-extends and hyperextends the hip and flexes the knee.
2) Joints-knee and hip.
3) Examples-running and knee curls.

Biceps Femoris is located in the upper back of the leg (the outside hamstring).
1) Action-extends and hyperextends the hip and flexes the knee.
2) Joints-knee and hip.
3) Examples-knee curls and running.

Tibialis Anterior also referred to as the “shin” - located in the lower front of the leg.
1) Action-dorsi flexes the ankle.
2) Joints-ankle
3) Examples-jumping rope, running, walking, and dorsi flexing.

Gastrocnemius also referred to as the “calf”- located in the lower back of the leg.
1) Action-plantar flexes the ankle
2) Joints-ankle
3) Examples-heel raises, running, walking, and hopping.

Soleus is located directly under the Gastrocnemius.
1) Action-plantar flexes the ankle.
2) Joints-ankle.
3) Examples-heel raises, running, walking, jumping rope, and hopping.

Chapter 7
Hydrodynamics

As an Aqua Aerobic Fitness Instructor, one must understand the properties of the water.

Laws of Motion
Laws of motion state that when a person changes location in space then motion occurs. Motion can occur in either in the concentric or eccentric phrase of contraction or by movement of direction.

Inertia is a force needed to move a body at rest, to stop a body that is moving or to change the direction of a moving body. There are two types of inertia: static and dynamic.

Static is when the body at rest stays at rest.

Dynamic is when a body in motion remains in motion.

Acceleration
Acceleration is the speed of the body depending on how much force is applied and the direction of the force. For example, if you push off the bottom of the pool you will travel a certain distance or height. If you were to push off the bottom of the pool with twice as much force as original, you would travel twice as far in the distance.

When exercising in the water, the more force you apply against the water's resistance the more toning benefits you will create for the muscle groups performing the actual movement.

Action & Reaction
Simply stated that for every action there is an equal and opposite reaction.

As we work in the water environment this "Law" still remains true. As you move your arms from the shoulder joint and simulate the front crawl stroke with your body remaining in a vertical position, the Action is the arms pushing against the water and the Reaction is the water pushing back providing the resistance.

The Law Levers
The law of levers states that movement of levers is related to the force applied (effort). The longer the lever, the more intense the movement. It is recommended that when teaching an Aqua Aerobic class to start with the short levers and move to the longer levers. This will help to reduce the risk of injuries occurring.

Buoyancy
Water exerts an upward force against an object that is equal to the weight of the water that would be pushed aside by the object. The extent of the buoyancy is related to the size and density of the person or object in the water.

Buoyancy is dependent upon several factors. These factors are: body size, density, percentage of body fat, lung capacity, depth of immersion.

The body loses approximately 90% of its weight when immersed to the neck, 70%-75% in chest deep water and 50% in waist deep water.

The benefits of buoyancy are: that it reduces the effects of gravitational forces and decreases the amount of body weight compressing the joints.

The center of the buoyancy is the point around which the body's buoyancy is evenly distributed. Usually this is located or associated with the chest/thoracic region. Also, the center of mass must be made aware of which is usually located in the hip area.

Comparing land aerobics exercises with water exercises, we discover that gravity assists or resists movement while in the water the buoyancy assists or resists the movement. We know that any movement toward the surface of the water would be classified as assisted movement. Movement towards the bottom of the pool would be classified as resisted movement.

Drag

Drag is the resistance of water on a body moving through it. There are three types of drag: Form, Wave and Frictional.

Form is the resistance related to the objects shape and profile.

Wave is resistance caused by water turbulence.

Frictional is resistance caused by the surface texture as it moves through the water.

AQUA PHYSICS

GENERAL INFORMATION

Because of water's unique properties, water-based exercise will provide somewhat different benefits than land-based exercise. To allow for those properties, modifications need to be made before using land-based exercises in the water.

WATER RESISTANCE

Water has approximately 12 times the resistance of air. That resistance may slow the exerciser down, but it gives him or her some tremendous benefits.

MOVEMENT SPEED

When moving in the water, exercisers will need to modify the pace of the movements to allow for the water resistance. The speed of the movements must be adjusted so they can be accomplished without jerking or compromising alignment and using a full range of motion. Movements should always be controlled. If the exercise being done causes the body to move out of alignment in an uncontrolled fashion, it is too fast. The speed at which one would jog on land is not the speed at which one should jog in water. Likewise, the speed of kicks done on land should not be used for kicks done in the water. Moving through the water with ballistic, land-based speed movements can cause injuries to the joints and ligaments.

TONING POTENTIAL
Water resistance, while slowing an exerciser down, will also provide excellent benefits. While moving through the water, one will not only receive cardiovascular benefits (by pushing the heart rate or perceived exertion level up into the target zone); one will also receive toning benefits not available on the land. The water resistance acts with equalized pressure on all body parts that are submerged. Any time a limb is moved through the water, additional toning is created because of water resistance.

MUSCLE BALANCE
Muscle balance is another benefit of working in the water. Almost all of the joints in the body have some muscles that flex them and other muscles that extend them. The two muscles that work a joint (flex and extend) are generally thought of as a pair, or muscle pair. The flexors are almost always stronger than the extensors. The extensors generally work with gravity, which does all the work for them; thus, extensors are not usually well developed. If exercise programs contribute to the muscle imbalance already developed, injury could result, especially if those joints are weight bearing.
When participants exercise in the water, they are able to get equalized muscle balance that is not available through any other medium. Due to the flotation effect of water, a person working in the water will use the iliopsoas (hip flexor) muscles when lifting (kicking forward) the leg and will get the additional benefit (not received on land) of using the gluteal and hamstrings when lowering the leg back through the water. The same is true with the bicep and triceps muscle pair and most other muscle pairs in the body. While the triceps gets virtually no work during arm extensions in land-based exercises (gravity does the work), water resistance forces the triceps to work when arm extensions are done in the water. Muscle balance is a tremendous benefit of water exercise.

ENERGY EXPENDITURE
A water workout can give a greater energy expenditure for a workout than a similar land-based exercise would. When walking outside, each step recruits a certain amount of muscle fibers. Each muscle fiber needs a certain amount of oxygen to keep it going. Oxygen consumption correlates with energy and caloric consumption. When the same walking is done in the water rather than on the land, more muscle fibers need to be recruited for each step the exerciser takes. That means more oxygen will be used and there will be greater energy and caloric expenditure.

Water-based exercise can achieve a workout intensity like that of land-based exercises with less heart stress. One of the functions of the heart is to help the body dissipate heat. If the heart has to work at dissipating heat at the same time it is working to deliver oxygen to the muscles, it can become overloaded and work at a higher rate (beats per minute) than necessary for cardiovascular fitness. If the body is cooled by the water and the heart does not have to work at dissipating heat, it is able to concentrate on simply supplying oxygen to the muscles. Thus, a similar workout intensity is achieved while maintaining a lower heart rate.

ARM MOVEMENTS
Arm movements in aquatic exercise can be used in much the same way they are used on land; for variety and fun, for balance, for coordination improvement and to add intensity to the workout. In addition, arm movements can be used for other purposes more particularly suited to aquatic exercise.
Arm movements can be used to help the body move through the water. By pressing the hands from front to back, the exerciser is propelled forward. By starting with the arms to

the right and sweeping left, the participant slides to the right. If the hands are pushed straight down, the body will spring upward. Each of these movements can be reversed for the opposite effect. This is an application of the action versus reaction principle. The benefit of using arms to assist with movement in the water becomes especially apparent when the body presents a large surface area and is therefore resistant to the movement. For example, when the participant is facing straight forward and attempts to jump ahead through the water, the frontal resistance of the body is at its greatest. It is extremely difficult to accomplish this movement without using your arms. As one jogs through water, more territory can be covered if arms are added to the movement to help pull the body forward.

Changing directions can produce swirls of water. Which makes movements more difficult. Appropriate arm movements can assist the body in accomplishing direction changes.
In the water, when the body is at a standstill, it takes more effort to put it into motion than it does to maintain a standstill. Upper-body movements can add to the total effort and make it possible to overcome this resistance.
All the while arms are being used in the water for balance, coordination, movement assists, or fun, they are also developing muscular endurance and strength in the upper body. Pushing, pulling, sweeping, flicking and lifting all work the muscles in the upper and lower arms, the shoulders, the chest, the abdominals and the upper and lower back. If arms are kept submerged while executing the movements, the potential for gains is even greater, as the water resistance acts like weights or bands to increase the difficulty of the exercise. While some movements done outside the water are advantageous for the students and assure that the joint is moved through the full range of motion, the benefits of using arms in the water to increase the workload should not be overlooked.

The position of the hands and upper body can increase or decrease the intensity of various exercises. Because swimming programs train people to move efficiently in the water, it is sometimes difficult for them to learn to purposely increase the water resistance to make a workout more difficult.

Presenting a small surface area against the water makes arm movements easier to perform. For example, turning the hands so that they slice through the water requires less effort from the upper body than if the hands are flattened to the direction of the movement. By choosing the appropriate hand position for each movement, aquatic exercisers can do one movement but develop different degrees of conditioning, depending on the workload they place on the muscle.

In addition to affecting the particular muscles in use, arm movements can affect the cardiorespiratory demands on the body during exercise. Greater demand is placed on the heart and lungs as they work harder to meet the muscles' needs for oxygen, nutrients and waste removal. This is accomplished simply by adding arm movements rather than letting arms hang in the water. Cardiorespiratory conditioning can be boosted even further by cupping or flattening the hands as the arms move through the water.

WATER BUOYANCY AND CUSHIONING
The cushioning effect is another benefit of exercise in the water. Because of the 90% apparent weight loss in shoulder-depth water, participants are able to exercise with less

biomechanical stress during each foot strike or impact. This allows them to exercise longer and more frequently and to gain more benefits without the likelihood of injury.

SPECIFIC INFORMATION

All of the preceding information about aquatic exercise relates to physical laws and principles of water that are continually in force around participants as they work. Those physical laws and water principles must be considered together when discussing aquatic exercise as aqua physics.

PHYSICAL LAWS

INERTIA

Newton's first law states that a particle left to itself has constant velocity. Stated differently, inertia is the tendency of masses to resist changes in motion. A mass at rest tends to remain at rest; a moving mass tends to remain in motion at a constant speed unless acted upon by an outside force. In order to overcome inertia, a force must be applied.

The force to overcome inertia may be used to alter the intensity of a workout. By using fewer repetitions, moving through the water and changing directions, the exerciser increases the intensity of the workout by repeatedly applying force to overcome inertia. If he/she does several repetitions of the same movement, stays in place, or keeps the movement facing in one direction, intensity is decreased by minimizing the need to use force to overcome inertia.

One specific example of the use of inertia is changing steps frequently to increase the intensity of a workout. For example, four jogs followed by four knee lifts would require more energy than eight jogs followed by eight knee lifts. Once jogging has started, the body or mass wants to continue the movement unless acted upon by a force. The more frequent step changes require more energy. Remember, however, that heavy exercisers have far more inertia than light ones. Step changes must be planned far enough in advance to allow participants to overcome inertia and begin a new movement.

There are three different types of inertia: (1) stationary inertia, (2) moving inertia (momentum) and (3) inertia lag (drag or friction). Beginning from a motionless position in the water, an exerciser will have to overcome stationary inertia. When the exerciser is already moving and needs to continue to exert energy to keep moving, he/she is overcoming moving inertia. Inertia lag refers to loss of forward momentum and requires extra energy to increase the forward momentum again.

ACCELERATION

Newton's second principle states that the acceleration of a particle is directly proportional to a force acting on the particle, inversely proportional to the mass of the particle and has the same direction as the resultant force. In other words, the acceleration of an object depends on its mass and on the applied force. Some force is required to move something from a state of rest through the water, the faster the movement, the greater the force.

The principle of acceleration applies at the start of the movement. This means that a strong person jumping forward in the water will cover ground more quickly than a weak one. On the other hand, heavy exercisers will have to exert more energy (apply more force) than light ones in order to achieve the same acceleration.

The principle of acceleration also applies when sudden bursts of energy are needed. Since acceleration is inversely proportional to the mass, a small person may be able to accelerate more quickly, but a large person will have to use more muscle power to accelerate at the same speed. Acceleration is directly proportional to the force applied. This means that a strong student or a student willing to put more effort (muscle power) into a new move will achieve a higher intensity. Students who jog or walk easily through the patterns will not achieve the same intensity as students who apply sudden bursts of power to each jog by pushing up and out of the water.

ACTION VERSUS REACTION

Newton's third law states that if a particle exerts a force on a particle, then particle 2 exerts an equal and opposite force on the first particle. In other words, for every action, there is an equal and opposite reaction.

Using this law, the exerciser can increase intensity through the use of impeding arm movements and decrease intensity through the use of assisting arm movements. For example, if students jog backward with their arms sweeping forward, this action will assist the body in moving in the opposite direction, a reaction. To increase the intensity of the workout, the student should hold their arms under the water airplane style, while attempting to jog backward and cover the same distance as before. The arm movement (action) impedes progress (reaction) and increases the intensity of the workout. The law of action versus reaction is also used in aquatic exercise to improve or maintain proper body alignment. When an exerciser pushes back with his or her hands in order to assist his or her forward movement through the water, he /she maintains alignment as well assists the movement. If he/she swings his or her arms forward as he/she moves forward, he/she will likely fail to maintain good body alignment because the water will resist not only the body but also the arms, allowing the head, shoulders and feet to move forward but impeding the forward movement of the torso. Such a body position compromises safety.

If a student is strong enough to maintain good body alignment (with shoulders centered over hips and abdominals contracted during the movement) the law of inertia can be used to increase the intensity of the workout. As the student jogs in place, he/she can pull his/her arms back, which will make the body want to move forward. Trying to keep the body stationary while the arms are trying to force it to go forward will increase the intensity.

LEVERAGE

The law of leverage sounds complicated, but its applications are clear and easy to understand. The law states that the product of the force times the length of the force arm is equal to the product of the resistance times the length of the resistance arm. Put simply, this means that the shorter things require less force and effort than longer things to be moved the same amount of distance through the same resistance. For example, moving the arm when it is extended straight from the elbow requires about twice as much force as moving the arm when it is bent at the elbow, if it is moved the same distance and is bent in a way that doesn't complicate resistance. Jumping-jack arm

movements done with the arm straight provide a higher-intensity workout than the same arm movements done with the arm bent at the elbow, “chicken wing” style, even though the movements are essentially the same. Forward leg lifts, (kicks) require more energy than forward knee lifts, even though the movement is mechanically the same. The only difference in both cases is that the limb is longer, increasing the length of the resistance arm which increases the intensity of the workout.

Almost all moveable joints in the body act like third-class levers. The joint itself is the fulcrum and the effort is applied at the exact point where the working muscle is attached to the moving bone. The resistance arm of the lever is the distance from the fulcrum (joint) to the place where the resistance is felt. In the case of aqua exercise, the water itself is the resistance.

When using levers, the workload can be increased in two ways: by lengthening the resistance arm or by increasing the resistance itself. If a student wants to increase the intensity by lengthening the resistance arm, he/she should move fully extended limbs. This can be accomplished by switching knee lifts to forward kicks, for example. If reduced intensity is desired, the resistance arm should be shortened.

WATER PRINCIPLES

RELATIVE DENSITY

Relative density, also specific gravity, is the ratio of the mass of a given volume of a substance to the mass of the same volume of water. The specific gravity or relative density of water is 1. Anything with a relative density greater than 1 will sink; anything with a relative density less than 1 will float; anything with a relative density equal to 1 will float just below the surface of the water. Since the specific gravity of a human body with lungs fully inflated is generally less than 1 (between .95 and .974), people float. But with lungs emptied, human relative density is between 1.050 and 1.084. Humans therefore sink when all air is expelled.

Students with more muscle mass will have a higher relative density and are more likely to sink. Students with more fat mass will have a lower relative density and are more likely to float.

ARCHIMEDES’ PRINCIPLE

Archimedes’ principle states that when a body is completely or partially immersed in a fluid at rest, it experiences an upward thrust equal to the weight of the fluid dispersed. This is also called buoyancy.

A body in the water is subjected to two opposing forces: gravity and buoyancy. Buoyancy is an upward thrust that act in the opposite direction of the force of gravity, which pulls the body down.

The force of gravity relates to the body’s density. The more compact or dense the body is, the less buoyant it is. A dense object, such as a rock, weighing 150 pounds will sink, while a person weighing 150 pounds will not sink.

Buoyancy is measured by volume, so it is determined by how much water is displaced. When the lungs are filled with air, the body will be more buoyant. Increasing lung capacity through aerobic exercise will eventually increase a body’s buoyancy. High

percentages of body fat also make the body more buoyant because fat has a density significantly less than the .97 to .95 characteristic of the overall body.

Buoyancy increases with volume; therefore, the larger something is, the greater its displacement qualities. A long-lever limb will be more buoyant than a short-lever limb. The force of buoyancy affects not only the body in total but also individual limbs.

The force of buoyancy offsets the force of gravity to the extent possible. When the weight of a floating body equals the weight of the displaced fluid, the center of buoyancy (generally the chest area when the lungs are inflated) and the center of gravity (generally the hip area) are in the same vertical line. When the weight of the submerged part of the body is not equal to the weight of the liquid displaced, the center of buoyancy and the center of gravity are not in the same vertical line. The body, limb or object will roll over until it reaches a state of equilibrium, with the center of buoyancy and the center of gravity in a vertical line. Changing the center of gravity by lengthening or shortening the limbs will help the body reach equilibrium.

If the body is suspended in water, as with swimmers or deep-water runners, it rotates around the center of buoyancy (the chest area) rather than the center of gravity (the hip area). Water exercisers in shallow water must keep the center of buoyancy and the center of gravity in a vertical line to maintain proper equilibrium and alignment.
Three concepts regarding buoyancy will affect instructors in aquatic exercise programming: buoyancy assisted, buoyancy resisted, and buoyancy supported.

- Buoyancy assisted describes a movement that is assisted by buoyancy. This will occur when the move is in the same direction as the force of buoyancy. When a student lifts his or her arms up to the water surface, the force of buoyancy assists that movement. Likewise, when a student lifts his or her leg toward the surface of the water, that movement is buoyancy assisted.
- Buoyancy supported describes a movement that is perpendicular to the force of buoyancy. In this instance, the water simply supports the body or the extremity. A participant standing in the water is experiencing buoyancy support.
- Buoyancy resisted describes a movement that opposes the force of buoyancy. Returning limbs from flexion to extension or anatomical position is a buoyancy-resisted movement. When a student lifts his or her leg toward the water surface, the movement is being assisted by the force of buoyancy because it is moving in the same direction as that force. While the limb is near the surface of the water, it is supported by the force of buoyancy, as is the rest of the body in a vertical position. When the leg is returned to the beginning position, the muscles must work harder because it is a buoyancy-resisted movement. Returning the limb to anatomical position opposes the force of buoyancy.

In short, anything moving up toward the surface of the water will be buoyancy assisted. Anything moving down through the water will be buoyancy resisted.

HYDROSTATIC PRESSURE

Hydrostatic pressure is the pressure exerted by any fluid on anybody at rest. Since there is no resting position in the water, some scholars believe that the synergistic and fixator muscles must constantly act to stabilize the body. This pressure is equal on all surfaces of the body; however, it increases with the depth of the water. At the surface, the hydrostatic pressure is 14.7 pounds per square inch. For every added foot of depth,

the hydrostatic pressure increases by .433 pounds per square inch. This pressure causes venous blood to return to the heart easily rather than to pool in the lower body, causing lower heart rates in aquatic exercise than land-based exercise without losing aerobic benefits.

VISCOSITY

Viscosity characterizes the behavior of a fluid. Namely it is a type of resistance that occurs between the molecules of a liquid and thus affects how it flows. The higher the viscosity, the greater the resistance. Molasses, for example, have a much greater viscosity than water, which is in turn more viscous than alcohol.

Water acts as resistance to movement, as water molecules tend to adhere to the surface of a body moving through it. When the viscosity is higher, the flow of fluid is slower, and resistance to movement in that fluid is higher. Viscosity generally decreases as temperature increases because molecules move further apart. The viscosity of water always decreases as temperature increases. Air is less viscous than water; therefore, there is more resistance to movement in water than on land.

RESISTANCE

Since water is denser than air, it has more resistance and is therefore more difficult to move through. This is perhaps the most basic of water principles. To fully understand the property of resistance, consider how this force acts on a body in both vertical and horizontal manners.

- Surface tension – Overcoming surface tension is an example of the water acting as a force on the body in a vertical manner. Surface tension is the force exerted among the surface molecules of the water, probably due to cohesion, which binds molecules of the same matter. Surface tension manifests itself as a sort of elastic skin at the surface of the water. This is simple to understand if you think about bugs striding across the water. They move without breaking the surface tension of the water. Surface tension acts as a slight resistance when a limb or a body is partially submerged. Moves that continually break the surface of the water will be more difficult than those that don't. In swimming, the crawl and backstroke are more difficult than the breaststroke and the elementary backstroke. Moving the arms up and breaking through the water surface during aquatic exercise is more difficult than keeping them below the surface.
- Frontal resistance – Frontal resistance is an example of overcoming horizontal forces acting on the body. The more surface area facing the water and meeting it head on, the greater the resistance. For example, there is more frontal surface area when walking forward through the water than when walking sideways because more surface area hits the water. There is more frontal surface area when the hand pushes flat against the water than when it slices through the water. This extra resistance increases the intensity of the exercise.
- Drag Forces – Drag forces are present when moving through any medium. Those that act on the body in the water include eddy drag, skin resistance and tail suction.
    1. Eddy drag is the resistance that occurs along the side of the limb or the body when it moves through the water. As the limb movers, small eddies or currents are created alongside of it. These whirlpools increase along with the amount of resistance if the limb is slightly bent.

2. Skin friction is caused by the resistance of the water immediately next to the body. Fluid sticks to the surface of a body in motion and forms another layer. This resistance increases the intensity of the workout.
3. Tail suction is caused by the water not being able to fill in behind the poorly streamlined rear end of the body or a limb so the body must pull along a certain number of water molecules.

All of these forces that act on the body in the water will be enhanced if the body is not streamlined.

STREAMLINED VERSUS TURBULENT WATER MOVEMENT

Movement through water is either streamlined (lamellar) or turbulent. Water resistance that is due to turbulent flow is greater than that due to streamlined flow. In streamlined flow, resistance is proportional to velocity. In turbulent flow, resistance is proportional to velocity squared.

As an object moves through water, a pressure difference develops between the front and back of the object. The pressure builds up in front of the object while it decreases behind it. A water pressure differential produces a flow of water into an area of reduced pressure, which is known as the wake. Eddies form in these wakes, and flow is impeded. This tends to draw the object back. The faster the movement, the greater the drag, and therefore, the greater the resistance to the movement. If the wake hits the side of the pool or another wake, the rebound causes more turbulence.

FORCE ABSORPTION

The body produces force through acceleration, leverage and several other systems (musculoskeletal, cardiorespiratory). The force that is produced during water exercise has to be absorbed by the pool bottom and water. In shallow-water exercise, the force is reabsorbed in an equal and opposite reaction by the hip, knee and ankle joints that give upon impact with the pool bottom. Because the movement of the body or limb down through the water is slowed or cushioned by the water, the force is lessened, and the body is less likely to experience biomechanical injuries.

SUMMARY

Understanding the physical laws and water principles that affect participants as they work in the water is important to aquatic exercise instructors. With such knowledge, instructors will be able to increase or decrease the workout intensity for each participant in a safe, logical manner.

However, instructors must remember that none of these physical or water principles acts individually. A combination of forces will always be at work, affecting the participant's movement in the water. Understanding each principle individually will give the instructor the knowledge base to understand how they interact and provide students with the best exercise program.

Chapter 8
Strength Training

What is strength? Strength is the ability of a muscle or group of muscles to generate force. There are two types of strength: Absolute and Dynamic.

Absolute Strength is the maximal amount of force that can be generated by a muscle or group of muscles during one maximal effort. Examples: The Bench Press Test or Leg Press Test.

Dynamic Strength also referred to muscular endurance is the ability of the muscle or group of muscles to contract repeatedly over time. Examples: 1Minute Sit-ups and Push Up Tests.

Muscles are made up 75% water and 25% protein. The protein filaments are called actin and myosin. Actin and myosin are located in the sarcomere.

Refer back to Section H for: Muscle Fibers, Properties of Muscle, Roles Muscles Play, and Types of Muscular Contractions.

Where do strength gains result from? Strength gains result from: Hypertrophy and Motor Unit Recruitment.

Hypertrophy is an increase in the size of muscle fibers. Younger individuals tend to gain strength mostly here.

Motor Unit Recruitment refers to the percentage of muscle fibers in a given muscle that can be used at one time. Older individuals gain strength mostly here. Sedentary individuals only recruit approximately 40% of muscle fibers for one maximal effort.

TRADITIONAL STRENGTH TRAINING

There are several methods of strength training. Listed below are some of the traditional methods that can be read in most any fitness books.

DELORME-WATKINS is a 3-set routine. First, find the 10 Repetition Max (10 RM) for the desired lifts.

-1 set of 10 reps using 1/2 10 RM
-1 set of 10 reps using 3/4 10 RM
-1 set of 10 reps using 10RM
-progressively add resistance keeping reps same

BERGER
-3 sets (4-8 reps)
-progressively add resistance keeping reps the same

PROGRESSIVE RESISTANCE
-1 set to failure (usually 12 reps)

SUPER SET
-two exercises performed in a row without any rest.
-exhaust agonist
-exhaust antagonist

TRI SETS
-three exercises performed in a row

GIANT SETS
-four or more exercises performed in a row.

PYRAMID TRAINING
-10 reps at 50% 1 RM
- 8 reps at 60% 1 RM
- 6 reps at 70% 1 RM
- 4 reps at 80% 1 RM
- 2 reps at 90% 1 RM
- 1 reps at 100% 1 RM

Which one is the best form to gain strength? No one system is better than the other. The bottom line is total work performed. Unfit individuals will show absolute and dynamic strength gains and fit individuals show more specificity of training.

FITNESS PRINCIPLES APPLIED TO STRENGTH

Principle of Overload in order for adaptation to change to occur, the muscle must be challenged into performing more work than it is to perform.

Principle of Progression refers to the overload and how it should be done gradually to get the best Improvement in muscular strength.

Principle of Specificity refers to the specific muscle must be exercised to improve those particular areas.

SAID-Specific Adaptation to Imposed Demand-you can vary the workload in terms of: resistance and repetitions.

Rate of Development - expect 3-5% initial strength gains per week with a beginner.

10 PRINCIPLES OF RESISTANCE TRAINING

1) **R.OM**. - When exercise completes an entire Range of Motion with the resistance.
2) **Speed**-It should take 1 second to complete every 90 degrees of joint motion.
3) **Breathing**-Exhale during the exertion.
4) **Repetitions**-8-12 reps are recommended for general strength gains.
5) **Rest Between Sets**-60-90 seconds rest is recommended.
6) **Rest Between Repitions**-1-2 seconds is recommended.
7) **Recommended Sets**-1-3 sets are recommended per body part.

8) **Increasing Workload**-2-5% increase in workload is recommended when deemed appropriate.
9) **Intensity**-Attempt to reach momentary muscle failure. Remember to "Train, don't strain."
10) **Muscle Balance**-Balance the muscles by equally working the opposing muscles.

The following pages are examples of what can be formatted into your exercise class.

1) Push ups
   a) Full: toes on the ground and lean forward and put your hands on the ground about shoulder width apart
   b) Modified: Same as above, except knees on the ground.
   c) Benefits: shoulders (Deltoids), upper arms(Biceps and Triceps), and Chest (Pectorals).

2) Sit ups
   a) Full: Lie flat on your back with knees bent and feet on the floor, raise yourself up and touch your knees.
   b) Crunches: Same as above, except do not raise yourself up all the way just crunch up
   c) Benefits: abdominal muscles (Abdominal Rectus and Internal and External Oblique)

3) Half Bent Knees
   a) In standing position, place feet shoulder width apart and place hands on hips or straight out in front. Squat until the knees are parallel to the floor.
   b) Benefits: Thighs(Quadriceps)

4) Heel Raises
   a) In a standing position, place feet shoulder width apart, hands on hips and stand erect. Raise up on your toes as far as possible and lower down until your heels touch the floor.
   b) Benefits: calf muscles(gastrocnemius and soleus) and ankles

5) Straight Leg Lifts
   a) Lie on your side and lift the top leg up without rolling the hip forward or backwards. Support yourself with your hands.
   b) Benefits: outer thigh(quadriceps) and hips

6) Chair or Step Dips
   a) Sit on the floor with your back to the step or chair. Place your palms on the step/chair, keeping your arms straight bend at the elbows and slowly lift and lower yourself.
   b) Benefits: Triceps and chest muscles (pectorals)

7) Chin-ups
   a) Use the underhand grip and start from a hanging position and pull yourself up to where your chin passes the bar.
   b) Benefits: biceps

8) Flexed Arm Hang

a) Using the underhand grip and place your chin above the bar and hold yourself there until you can hold it no longer.
b) Benefits: triceps and biceps

9) Back Bends
   a) Lie on the floor on your stomach and place your hands on your head. Slowly lift yourself and hold for approximately 5 seconds then lower yourself slowly.
   b) Benefits: Lower Back, Erector Spinae

10) Triceps Extension
   a) Using no weight, dyna tubing, or free weights, stand sideways supporting the body with the opposite hand on the leg. Using the other hand, bend the arm at the elbow and using the resistance equipment in hand, bend the forearm back and forth. Remember to contract the muscle on the extension and release the contraction on the flexion.
   b) Benefits: Triceps

11) Biceps Curl
   a) Placing arms in front with or without resistant equipment bend the elbows to create elbow flexion. Palms in the supination position, bend the forearm up to the shoulder and back down to full length of the muscle at rest.
   b) Benefits: Biceps

12) Shrugs
   a) In a standing position, place the arms at your side either having resistance equipment in your hands or not lift the shoulders to the ears. Remember proper body alignment: Shoulders back and down.
   b) Benefits: Traps

13) Side Bends
   a) Stand erect with proper body alignment and do side bends.
   b) Benefits: Oblique (Internal and External)

AQUA STRENGTH TRAINING

The definition for strength training in the water is aimed specially at bodybuilding. One can perform actual weight-lifting moves, such as squats, biceps curls, and elbow extensions in the pool during this workout. All major muscle groups must be strengthened during the workout, this will create muscle balance and reduce the chances of injuries.

Benefits
The benefits of strength training are increased muscular strength and muscle mass. Strength training also will improve muscle balance along with increasing the structural integrity of muscles, connective tissues and bones.

After the age of 20, a body can lose approximately one pound of muscle every two years provided there is not a strength-training program being performed on a regular basis. Think about those numbers, if a person weighed 160 pounds at 20, by the age of 40 that same person would have replaced 10 pounds of muscle with 10 pounds of fat. Also,

remember that the metabolic rate goes down by approximately 50 calories per pound of muscle loss. Using the same example, that 40-year-old needs about 500 calories less per day than at the age of 20.

Strength training is really important for women because it helps curve off osteoporosis which is a potentially crippling condition caused by the loss of bone mineral.

Format
Begin with thermal warming and pre-stretch. No cardiorespiratory warm-up is needed because this is not a cardiorespiratory workout. The goal is to work the muscles and not necessarily the heart, even though the heart does receive a minimal workout.

Movement
Use slow and controlled moves with a minimum of momentum. It is important to perform the strength training moves in a slow and controlled manner. Fast movement could place too much stress on the muscles, connective tissues, and joints. Fast strength training is less effective and more dangerous than slow strength training.

ROM
Full range of motion should be used in strength training. This will ensure a full contraction in the agonist and a complete stretch of the antagonist. To test for full range of motion in a joint, contract the muscle and move the joint without any equipment.

AQUA AEROBIC CONCERNS

Water Depth
Strength training exercises are usually best performed in water of midriff to armpit depth and the lower body exercises are performed along the edge of the pool. The pool edge allows for the participant to hold on while performing the exercises and creating more balance.

Concerns
Injuries can also occur in the water if students begin with too much resistance or too large a ROM or even if they move too fast. All exercises must be performed at a controlled slow movement. Correct form is vital to ensure that the move is safe. A natural curve of the spine and keeping the feet parallel, knees soft, abdominal contract, chest lifted, and shoulders back and down is correct body alignment when performing strength training exercises.

The muscles must always be warmed, lubricated, and prepared for the work they are getting ready to be performed.

Hyperextension of the lumbar area of the spine, hip flexors, knees and elbows should be a avoided.

Guidelines
The American College Sports Medicine has set specific guidelines for resistance training programs. The guidelines state the frequency should be at least twice a week and is to be considered a minimum standard. It takes approximately 48 hours for the body to repair and rebuild itself. Therefore, taking too little between workouts can be counterproductive.

The ACSM goes further to recommend a minimum of 8 to 10 different exercises for major muscle groups with 8 to 12 repetitions which is equivalent to 1 set. A general rule is that resistance is too much if the participant cannot repeat the exercise at least 8 times in a row.

The guidelines also state, “Resistance strength training of a moderate intensity, sufficient to develop and maintain muscle mass, should be an integral part of an adult fitness program.”(1990, p.1)

MUSCLE BUILDING—ONE PIECE OF THE PUZZLE TO YOUR COMPLETE PICTURE OF PHYSICAL FITNESS

There are four basic components to an overall fitness program—muscular strength, cardiovascular endurance, flexibility, and nutrition (body composition- lean body mass). Think of total fitness as a jigsaw puzzle – if one piece is missing, your puzzle is not complete. When you slip the missing pieces into place, you've got the complete picture of physical fitness. This publication addresses the muscle building (strength) component of a physical fitness program.

WHY IS MUSCLE BUILDING SO IMPORTANT?

Muscle building can help you lose weight and keep it off. Skeletal muscles make up approximately 44.5% of total body weight in men and 35-42% total body weight in women. And unless we perform regular appropriate training stimulus, our muscles gradually decrease in size and strength and our metabolism slows, resulting in weight gain. Our muscles are responsible for over 25% of our calorie use (even when we are asleep). So, this decrease in muscle mass causes a corresponding decrease of ½% a year in our metabolic rate. However, for each pound of muscle you put back onto your frame, you speed up your resting metabolism by 50 calories, so you burn more calories even when you're exercising—you'll burn an extra 350 calories a week without any additional effort. This makes it easier to drop unwanted pounds in the future and keep off excess weight permanently. And since you'll be using those muscles during your exercise program—which requires calories for fuel—you'll be burning off fat too.

Muscle building will make it easier to do the everyday things in life, such as twisting the top off a jar, lifting groceries, and even moving furniture. And you'll experience other positive changes you may not readily connect with increased strength. For example, strengthening your lower back, upper back, and abdominal muscles will improve your posture. Because you'll be able to stand up straighter, you'll appear thinner, more attractive, and more confident. That weak ankle that used to wobble and ache after a day on your feet will no longer bother you because stronger calf muscles will offer more support to your ankle joint. And that low back pain you used to experience from sitting at your desk all day will lessen as you gain strength in your abdominal muscles. And that low back pain you used to experience from sitting at your desk all day will lessen as you gain strength in your abdominal muscles.

Muscle building will reshape your body. As you tone your body, your muscles will become tighter, more compact, shapelier, and more attractive. Your clothes will be looser even though your weight may not change much. That's because muscle is denser than fat, which means it takes up less room—one pound of muscle will take up a third less space than a pound of fat. In effect, you will redistribute your weight so your physique will take on more perfect proportions. If, on the other hand, you're too thin, adding new muscle will build shapely new curves.

Many women shy away from muscle building exercises for fear it will make them big and bulky. In order for your muscles to reach epic proportions, you'd have to spend hours and hours in a gym, five or six days a week, and hoist enormous weights. Even then there's a good chance you wouldn't bulk up! Very few women possess high amounts of testosterone—the male hormone responsible for increasing muscle size—to add much girth to their arms and legs, or any other body parts for that matter!

THE BASICS

HERE ARE SOME BASICS YOU'LL NEED TO KNOW TO GET YOU STARTED. It looks like a lot of stuff to review, and you're probably anxious to get in there and start pumping. But if you think "safety first and take the time to go over what you REALLY NEED TO KNOW, you will not find yourself in a position where you injure yourself in the very beginning and have to lay off exercising for an extended period of time.

WARM THEM UP, COOL THEM DOWN, AND STRETCH THEM OUT!

Always WARM-UP aerobically for about 5 to 10 minutes before an exercise session. Warming up your body increases the blood flow to your muscles, raises your body temperature, and gets your heart pumping. If you skip this preparation time, you are asking for a injury. Keep it simple and move both your feet and your arms—march in place, walk on your treadmill, climb your stairs, ride your exercise bike—be creative. Then, STRETCH out the muscle groups you will be working on (warm muscles stretch better than cold ones). This will give your muscles and your tendons a greater range of motion and prevent them from tearing or pulling as you lengthen them against resistance.

When you've completed your session, cool-down and stretch again. The cool- down is equally as important as the warm-up. Just as your body needs to prepare for training, it also needs to come down after a hard workout. Choose gentle, low-intensity rhythmic body movements, and most importantly, keep your legs moving! This movement will act as a pump to get the blood flowing away from your muscles and back to your heart, and will prevent cramping, dizziness, nausea, and sudden changes in blood pressure. It may also save you from extreme muscle soreness or injury. The ending STRETCH will promote flexibility and allow the muscles you have been contracting to return to their normal length.

BALANCE THEM OUT AND PAIR THEM UP!

In selecting the exercises, you will be performing during your session, remember the principle of BALANCE. Always work the opposing muscle group to prevent muscle imbalance—a condition that will cause the stronger muscle groups to compensate for the weaker ones. This imbalance leaves the weaker muscles wide open for injury and prevents you from maintaining a stabilized posture, Have you ever noticed how some male body-builders overtrain their chest muscles and neglect the muscles in their back- after all, it's the pec muscles that get the girl's attention, right? What they end up with is gorilla posture- the shoulders and arms round forward due to over developed chest muscles and the palms face backward. Their back muscles are weak and overstretched due to an imbalanced workout and are not able to keep the shoulder blades and in against the resistance of the tight pecs to maintain a balanced posture.

So, if you're going to work your "Bi's" or biceps (the muscles on the front of your upper arm), be sure to work your "tri's" or triceps (the muscles on the back of you upper arm). If you are working your "pecs" or pectoralis (the muscles on the front of your torso), be sure to work your "taps" and "lats" or trapezius and latissimus dorsi, respectively (your back muscles).
If you're working your shoulder muscles, be sure to include exercises that include all three "delts" or deltoids – the front, top, and back. If it's your "abs" or rectus abdominis and obliques (the muscles that flex and rotate the spine), be sure to work your erector spinae (the muscles that extend the spine). Other muscle groups to match are the "quads" and "hams" or quadriceps and hamstrings (the muscles on the front and back of the upper thigh, respectively) and the "inners" and "outers" or the adductors and abductors, respectively (also located on your upper thighs). Don't forget to apply this same principle to the minor muscle groups of your body, including your ankles and wrists, and your calves and shins.

MAINTAIN PROPER BODY ALIGNMENT WHILE EXERCISING!

All exercises should be done in “good form” with proper body alignment. Body alignment (posture) is a physical skill which requires practice and training like any other skill. Training the postural muscles of our torso to maintain a *neutral spinal alignment* is a vital aspect of fitness and preventive medicine. In a neutral spinal alignment, there is a slight inward curve at the neck and low back with a slight outward curve of the mid-back. This is the safest alignment for standing, sitting, and lifting. Therefore, one of the most important “exercises while you exercise” is to maintain a neutral spine. You must use your abdominals, back muscles, neck and shoulder girdle muscles to stabilize this neutral position.

People tend to fall out of neutral alignment when they are fatigued. When tired and in a standing position, you tend to allow the pelvis to tilt forward causing too much inward curve in the low back. When you are tired in a sitting position, you tend to let the pelvis tilt backward, losing the natural inward curve. A fatigued posture causes physical stress, muscle imbalances and eventually pain from degeneration or injury. DO NOT KEEP ON PERFORMING AN EXERCISE WHEN YOU ARE TOO EXHAUSTED TO CONTINUE MAINTAINING PROPER FORM!

ALWAYS MAINTAIN PELVIC NEUTRAL ALIGNMENT AND AN ERECT TORSO IN ALL POSITIONS WHEN PERFORMING ANY EXERCISE. The correct form for exercising in a standing position is abdominals contracted, pelvis in neutral alignment, rib cage lifted, shoulders back and down, and knees relaxed (bent, not locked). When exercising from a bent forward position, bend (flex) from the hip joint, instead of from the waist (waist bending will flex or round the spine causing stress on the lower back muscles and ligaments). When lying face up on the floor, make sure your back does not arch- tuck your pelvis under achieve a neutral spine position, allowing your low back to come in contact with the floor. And be extra careful not to hyperextend (arch) your spine in an unsupported position when the spine is not stabilized.

BEFORE YOU PICK UP THAT DUMBELL…

If you’re just getting started, be sure to perform all the exercises without weighted resistance until you are comfortable with the movements and are able to maintain good form. You will most likely feel uncoordinated at first because it takes time and practice to establish a communication pathway between your muscles and your brain (neuromuscular activity) and may find it difficult to perceive or be aware of just how your body part is moving through space. You may think or “sense” that your head and neck are in good alignment only to look in the mirror and discover that you are maintaining a forward head posture. Or you think that your back is in neutral alignment when bending forward, only to find when you peek in the mirror that it is rounded. So do not be too eager to grab the weights. First learn to focus on the muscle you will be working on and to relax the tension in the muscles you will not be. Get familiar with the new “sense” of how it feels to be in a proper body alignment.

HOW MUCH WEIGHT DO I NEED, AND HOW MANY REPETITIONS SHOULD I DO?

Here’s the area that allows you to design your own program and to progress at your own speed. Industry guidelines state that for a muscle building program to be effective you must select exercises for a t least 8-10 major muscles groups (remember the balance principle) and perform the repetitions (reps) for at least 8-12 times for a minimum of 1 set. Do this 2 times per week at a minimum, allowing between 24 to 48 hours rest before you exercise the same muscle group again. The amount of weight you choose will set the intensity. The weight should challenge you to complete the last 2 reps. If you are unable to do this while maintaining proper body alignment, the weight is too heavy. If your goal is to tone or firm your muscle, select a lighter weight an increase the number of sets you perform. I f you want to add size to your muscle, select a

heavier weight and do fewer reps. As you train using your selected number of sets and weight, you will eventually reach a plateau and will not progress any further unless you adjust these variables. You must work the target muscle groups to the point of fatigue for the exercise to be effective.

TO GET THE MOST OUT OF THE LIMITED TIME YOU HAVE TO DEVOTE TO EXERCISING, you will want to tire the target muscles in less than 20 repetitions. If you're not doing that, you're spending too much time in your exercise session and not using enough resistance.

MAKE SURE YOU STAY HYDRATED

You'll need to drink plenty of water before, during and after exercise. Your body needs it for the metabolic processes occurring during exercising. If you feel thirsty, you're already dehydrated. Every pound of weight you

Lose while exercising represents two cups of sweat. If this is not replaced during exercise you decrease your work capacity. You may be dehydrated even before you begin- if your urine is dark colored and not clear and copious, increase your daily intake!

WEAR PROPER ATTIRE

Wear clothing that will allow your skin to " breathe" and dress according to the weather or exercising environment. Select footwear that will provide support and protect your feet from impact and abrasion.

REMEMBER TO BREATHE

Be sure to breathe when performing the exercises. This may sound like a really silly reminder, but many people have a tendency to hold their breath when lifting something heavy, a habit that can have dire consequences. When you hold your breath on the exertion (a reflex called the "Valsalva maneuver") the air passageway is closed off against pressure, resulting in increased pressure in the chest which interrupts blood flow to the coronary arteries and oxygen supply to the brain. In healthy individuals, this may result in dizziness, slowing of the heartbeat, or a temporary loss of consciousness. For the individual predisposed to cardiovascular disease, the maneuver could trigger cardiac arrest and result in death. NEVER HOLD YOUR BREATH. REMEMBER TO EXHALE ON THE EXERTION, AND INHALE ON THE RETURN PHASE.

"SLOW AND CONTROLLED"—THE THEME SONG TO EXERCISE

Perform the exercises slowly without the use of momentum to lift the resistance. If you lift too quickly, you'll feel the exercise working your joints, not your muscles. If you don't notice it while it's happening, you're sure to feel it later. A slower contraction will allow more motor neurons within the muscle to "fire" working a greater percentage of the muscle. A controlled speed will also allow a consistent application of force throughout the movement. Also maintain control in the lowering phase of the contraction. By slowing it down even more and applying extra resistance you will increase muscle length.

IT HURTS SO GOOD!

Some muscle soreness is a normal consequence of proper training, at least initially. You should feel a pleasant sort of muscle fatigue after a good workout-NOT sharp and agonizing pain. This soreness will occur after your first few workouts, but if you break in slowly, the amount of soreness should be minimal. As time goes on and your muscles become used to working out, it should disappear altogether. When you hear body builders speak about being ripped, they're not kidding! When you exercise against resistance your muscles swell and tear microscopically. When these tiny rips repair, your muscles become stronger, firmer, and shapelier. That's why you need 24 to 48 hours rest between workouts for the same muscle group. It's this constant

cycle of tearing down and building up that helps you achieve maximum tone. However, no workout should make you feel as though you just ran your body through the garbage disposal. If you can't walk down the stairs under your own weight and stand completely upright the day after a workout you've definitely overdone, it. Go easy for the next few days and do as much gentle stretching as you can.

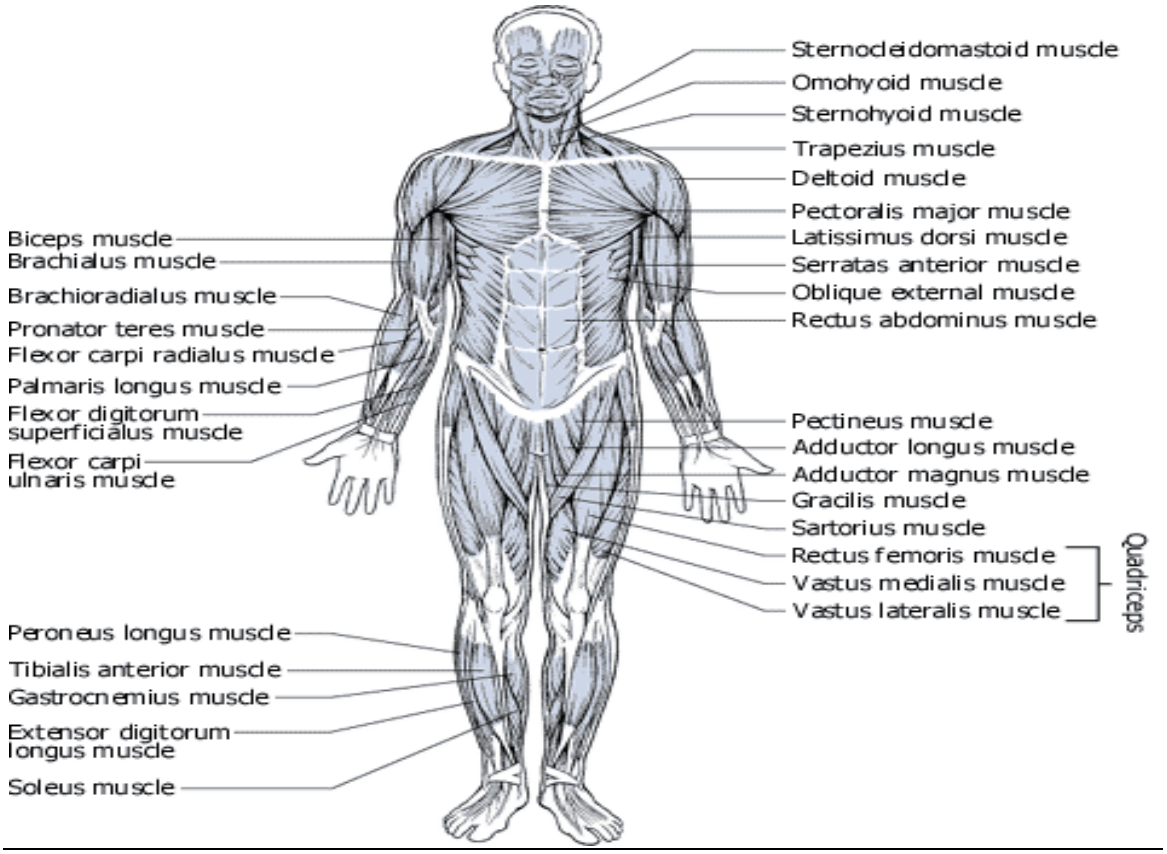
DON'T GO FOR THE BURN

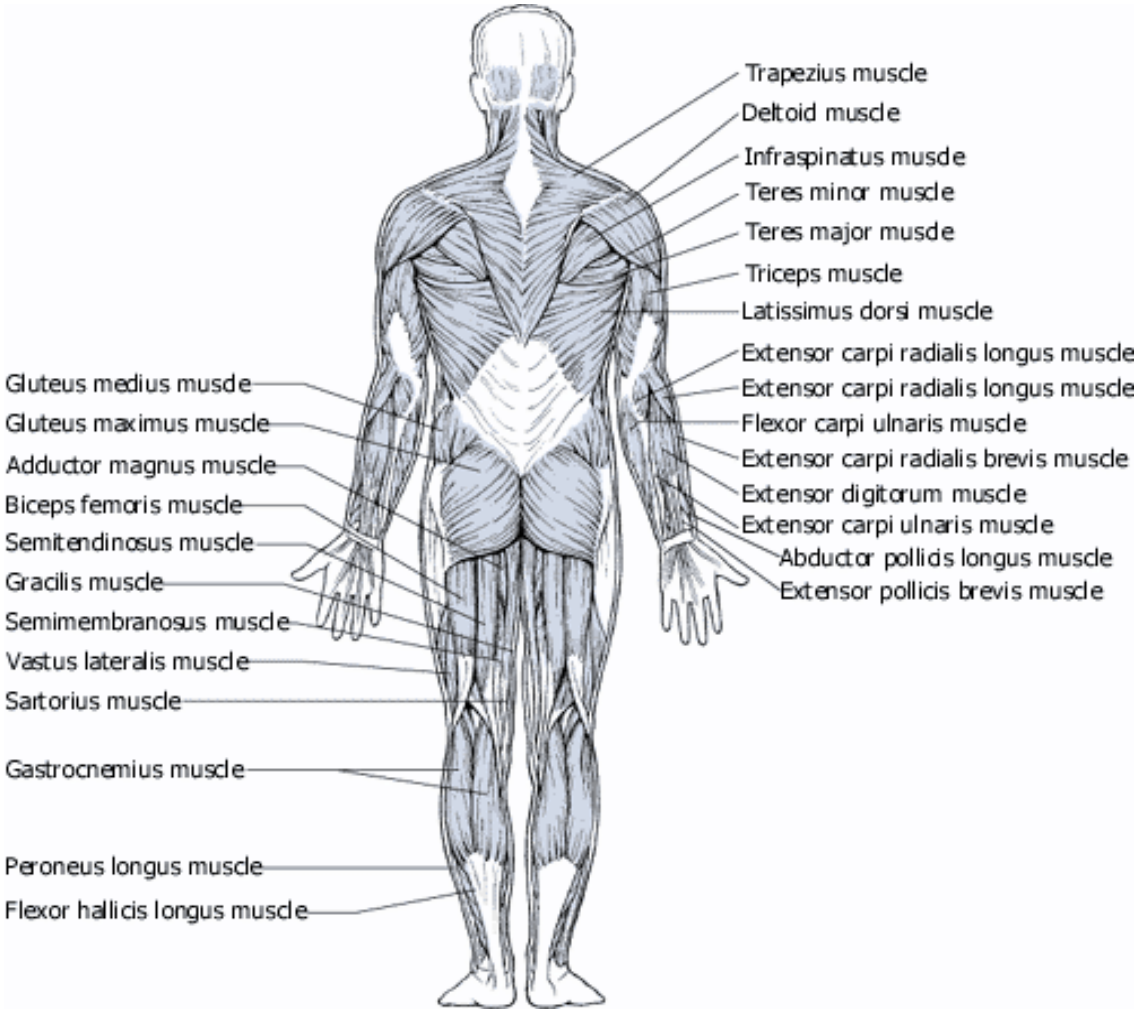
You may experience BURNING sensation in the muscles you are working. This is lactic acid build-up and is an accumulation of waste by-products your muscles are making as it converts calories from fat, protein and carbohydrates into energy to fuel your working muscles. It is your muscle's signal to you that it can no longer produce enough energy, and soon you will be unable to continue contracting that muscle. It is this burn that is thought to be responsible for muscle soreness. When you experience the burn, allow your muscle to rest so it has time to carry away the waste by-products and refuel your muscle cells.

SO, LETS GET STARTED!

You've learned the basics and are now ready to begin exercising. Remember not to add weight at this time. Let your own body weight and gravity furnish the resistance. Select your exercises based on the balance principle, assume the proper body position, execute the movement remembering to breathe, and stop when you have completed the set number of repetitions,

become fatigued or can no longer maintain the proper form.




Trapezius muscle
Deltoid muscle
Infraspinatus musde
Teres minor muscle
Teres major musde
Triceps muscle
Latissimus dorsi muscle
Extensor carpi radialis longus muscle
Extensor carpi radialis longus muscle
Flexor carpi ulnaris muscle
Extensor carpi radialis brevis muscle
Extensor digitorum muscle
Extensor carpi ulnaris muscle
Abductor pollicis longus muscle
Extensor pollicis brevis muscle
Gluteus medius musde
Gluteus maximus muscle
Adductor magnus muscle
Biceps femoris muscle
Semitendinosus muscle
Gracilis muscle
Semimembranosus muscle
Vastus lateralis muscle
Sartorius muscle
Gastrocnemius muscle
Peroneus longus muscle
Flexor hallicis longus muscle

THE EXERCISES

Because most muscle groups are composed of many muscles, to effectively work that group you need to select exercises that isolate or target each muscle in the group, or a section of the muscle fibers. Please keep this in mind when selecting exercises and incorporate a variety of movements for each muscle group into your routine.

The Arms

Biceps. The bicep muscle group is located on the front of the upper arm. Their main function is to flex the elbow. It is also a powerful supinator (palms up) of the forearm. Because the long head of the muscle crosses the shoulder joint, it can also flex the shoulder. By changing the position of the palms in the Biceps Curl exercise, you can target various portions of the muscle.

BICEPS CURL

The Setup. Sit or stand, maintaining proper body alignment. With your palms facing forward, hold a dumbbell in each hand. Let your arms hang down naturally at your sides.

The Move. Exhale while bending your arms at the elbows to lift the weights up to shoulder level. Pause briefly, and inhale while slowly lowering the weights to the start position, getting a full extension of the elbows without locking them. (Variations: Start with palms at your side and lift and lower or rotate to palms up position as you lift upward, reversing rotation as you lower the weights.)

The Focus. You should feel tension in the fronts of your upper arms as you lift the weights upward. Perform the movement from your elbow only and keep the upper part of your arms and elbows at your sides.

TRICEPS. The triceps muscle group is located on the back of the upper arm. It is the principal extensor of the elbow. Any exercise done with your arms up over your shoulders emphasizes the inner part of the muscle, while exercises done with your arms behind your body emphasizes the outer part. To develop balanced triceps, perform both types. The triceps muscle group is much larger than the biceps, composing 2/3 of the upper arm-mass musculature. If your biceps overpower your triceps, you may be prone to tendonitis in your elbow. The triceps play a key role in overhead and forward pushing and pressing movements. A powerful triceps muscle is crucial for sports such as tennis, volleyball, golf, and swimming.

TRICEPS KICKBACK

The Setup: Stand tall and bend your knees a few inches. Bend forward from the hips and hold a dumbbell in your left hand with your palm facing toward your body and place your right

hand on top of your right thigh for support. With your elbow bent, bring your arm up so your elbow rests lightly against the side of your waist.

The Move: *Exhale while straightening your forearm out behind you. Inhale as you return to the starting position. Repeat until reps are completed and do same number of reps with the other arm (you can rotate to a palms back position on the lift as a variation).*

The Focus: *Think of your elbow joint as the hinge of a door opening and closing. Deep your shoulder, upper arm and elbow in place so that only your forearm moves. You'll feel the muscles in the back of your arm contracting as you extend your arm. Keep your wrist in line with your forearm.*

TRICEPS OVERHEAD EXTENSION

The Setup: Stand with your feet shoulder-width apart, assuming proper body alignment. Using one dumbbell, grasp thumbs around the centerpiece of the end of the dumbbell and extend arms overhead, bend at the elbows, and lower the weight behind your head. Your elbows should point upward.
The Move: Exhale as you slowly raise the dumbbell, extending the elbows without locking them. Pause at the top, and inhale as you lower the dumbbell behind your head as low as you can.
The Focus: Keep your upper arm motionless. Keep the elbows high and close to your ears throughout each repetition, and don't rebound from the bottom position.

THE SHOULDERS

DELTOIDS. The deltoid muscle is a triangular muscle that has fibers running in three different directions. One angle drape over the shoulder area (medial), another points down the front of the arm (anterior), while another drapes down the back of the arm (posterior). The parts can function independently as a group. It is responsible for shoulder abduction, adduction, extension, flexion, and lateral and medial rotation. The deltoids come into play just about any time you use your upper body. If you only have time to do one exercise, do the overhead shoulder press because it involves the whole muscle and is a great strength-building exercise.

OVERHEAD SHOULDER PRESS

The Setup: Stand or sit, maintaining proper spinal alignment. Hold a dumbbell in each hand at shoulder height slightly in front of your body with palms facing forward and your elbows pointing straight down toward the floor. The weights should graze your shoulder.
The Move: Exhale while straightening your arms up over your head, gently squeezing your shoulder blades together as you go. Lightly touch the ends of the dumbbells together at the top of the movement, pause, and inhales while returning to the start position.
The Focus: As you're doing this exercise, imagine you're running your hands up and down as invisible wall. You're doing this right if you feel tension in the tops of your shoulders on the upward press.

THE CHEST

PECTORALIS. The pectoralis major is a two-headed fan-shaped muscle that attaches to your sternum. The upper head runs along your collarbone and the lower head connects to the cartilage connecting the upper ribs to the breastbone. The heads attach to the upper arm bone (humerus). A contraction of the upper head of the pecs flexes the shoulder joint, lifting the arm forward and upward. A contraction of the mid and lower fibers extends the shoulder joint, bringing the arm down and in toward the body. In addition to adduction, extension and flexion, the pectoralis is also responsible for medial shoulder rotation. Strong pecs work to pull your arms across your body or push things away. You need them for activities requiring pushing, throwing, or punching. It's best to work your chest muscles in a supine (face up) position. This position is less fatiguing than a upright one which places unnecessary stress on your shoulder girdle muscles as they work to maintain your arms in a horizontal plane. You can target different portions of the muscle by the position of the flat surface as well as the position of the palms.

Include an exercise called the *chest flye* when working the chest to involve the fibers responsible for adduction.

CHEST PRESS
The Setup: Lie on a flat surface in supine (face up) position with a dumbbell held in each hand, palms facing away from the body toward the legs, with weights at mid chest, feet flat. (The inclined position emphasizes the upper pecs, while the flat surface works the mid or upper portion depending on the grip. Turning your palms inward works the upper portion: turning them forward works more of the middle portion.)
The Move: Exhale while raising the weights directly upward until your elbows are fully extended but not locked. Pause and inhale while slowly lowering the weights to the starting position.
The Focus: You should feel the contraction in your chest, not in your upper arm muscles.

THE BACK

TRAPEZIUS. The traps are a broad, flat triangular muscle of the upper back shaped like a trapezoid. They attach to the upper and mid portion of the spine and to the scapula. Because it is very broad, the fibers travel in three different directions and therefore function as three different muscles. The upper portion attaches along the base of the skull and when it contracts, the shoulder blades move up and in; when the middle fibers contract the shoulder blades adduct, and when the lower fibers contract, the shoulder blades move down and in. The trapezius is a postural muscle as well as an active mover. Strong upper-back muscles promote the stability of the head, neck and shoulders. A shoulder shrug exercise is great for working the upper fibers of the traps. *Any exercise that involves the adduction of the scapula and the extension of the shoulder will work both the traps and the lats. The deltoids are also involved in these exercises.*

LATTISSIMUS DORSI. The lats is a wide flat muscle originating at the midpoint of the spine and traveling down to the buttocks. It narrows as it travels toward the upper arm to join the humerus at the shoulder area. It is responsible for moving the upper arm down as you pull our elbow toward your waist (adduction); it helps extend your arm behind you and to medially rotate your arm inward. Any time you pull something toward you, you use this muscle. The lats help to give back its V shape, or its width—well-developed lats will help make a woman's waist appear smaller.

BENT-OVER DUMBBELL ROW
(*works the mid-traps, lats, and rear deltoid)*
The Setup: Place your knee and hand on a padded bench, keeping the knee of your standing leg slightly bent. (Or place your left foot forward, placing your left hand on that thigh for support, bending from the hips.) Hold a dumbbell in your right arm and extend it down by your side, palms in with arm close to your body.
The Move: Exhale and contract your shoulder blade, pulling it in toward your spine, and slowly drawing your elbow up, bringing the weight to waist level while flexing your back muscles to the fullest extent. Continue to raise the weight until the elbow is extended beyond the waist. Pause, inhale, and keeping the arm close to the body, return to the start position and repeat until set is complete. Perform set(s) for the other arm.
The Focus: Before allowing the elbow to bend, bring your shoulder blade in and smoothly continue to lift the weight up.

ERECTORS. The Muscles that run the length of your spine are often grouped together and called the "erector spinae". The muscle group is made up of three pairs of muscles on each side of the spine that run parallel to each other along the length of the spinal column from your neck to your tailbone. You use these muscles anytime you extend, rotate, or laterally flex your spine. Be sure to balance your abdominal workout with erector exercises. Strong erectors stabilize the spine and are critical for performance and injury prevention in activities that require twisting, bending, and reaching movements.

PRONE LEG AND ARM RAISES
The Setup: Lie on your stomach. Maintain a pelvic tilt to keep pelvis in neutral position. Keep your head lowered, and the rib cage, chest and hips in contact with the floor.
The Move: Fully extend one leg and the opposite arm overhead, exhaling and lifting them upward a few inches from the floor. Pause at the top of the movement, and inhale as you lower your arm and leg to the floor. Repeat the selected number of repetitions and switch to the opposite side.
The Focus: Think, "slow and controlled," being sure not to use momentum. Never lift both legs up or lower both legs at the same time.

RECTUS ABDOMINUS AND OBLIQUES. The rectus abdominus muscle is a long, relatively flat, continuous wall of muscle that runs from your rib cage to your pubic bone. It is responsible for flexing your spine-anytime you bend at the middle you're using this muscle. Technically speaking, there are no "upper" and " lower" abs. Though you can initiate a movement at either end, any exercise you do for the rectus works the entire muscle. Any movement that involves a crunching type movement places emphasis on the upper fibers; a reverse curl type movement focus on the lower fibers, and any twisting or bending to the side brings the internal and external obliques into play (these are your true waist muscles). The entire abdominus group is important in attaining proper spinal alignment and pelvic stability in the trunk.

THE BASIC CRUNCH
The Setup: Lie on your back with your knees bent and your feet hip width apart and flat on the floor. Place your hands behind your head so that your thumbs are behind your ears. Don't lace your fingers together. Hold your elbows out wide and tilt your head back slightly.
The Move: Exhale and curl your spine up and forward so that your head, neck, and shoulder blades lift off the floor. There's no need to lift higher. Anything past a 30-40 degree angle involves the hip flexors, not the abs. Hold for a moment at the top of the movement, then inhale and lower slowly to just before the start. Move immediately into the next repetition.
The Focus: During the upward phase, imagine someone is about to drop a weight onto your stomach from a height- you'll need to tense your abs in order to brace yourself for the impact. This focus will cause your lower back to press against the floor where it belongs. You'll feel tension just below your rib cage as you curl upward: this tension will spread through the entire abdominal area as you lift your head; imagine a softball is placed under your chin to prevent this from happening.

THE CROSSOVER CRUNCH
The Setup: Lie on your back with your right knee bent and your left ankle crossed over your right knee. Place your hands behind your head so that your thumbs are behind your ears. Round your lower back into the floor by gently pulling your abdominals in toward your spine and tilting your pelvis gently upward.
The Move: Exhale while you lift your head, neck and shoulder blades up off the floor as one unit. As you curl upward, move (rotate) your right shoulder toward you left knee. Inhale and lower slowly until you are just above the start. Immediately begin the next rep. Complete the set(s) and switch legs and do the same number of reps to the other side.
The Focus: As you curl upward and sideways, pretend you are trying to bump something out of the way with your shoulder. You'll feel this in your abdominals in the upward phase and in your waist on the side you're crossing toward. Twist from the abdominals rather than simply moving your elbow in the direction of your knee. Take care that the entire movement is done with your abs and waist muscles, not by pulling upward on the neck with your hands.

REVERSE CURL
The Setup: Lie on your back with your knees bent. Lift your legs so that your thighs are directly over your hips and your calves are parallel to the floor. Rest your arms at your sides with your palms facing downward. Round your lower back into the floor by gently pulling your abdominals in toward your spine.

The Move: Exhale and lift your tailbone directly upward so that your buttocks rise about an inch off the floor. In this lifted position, roll your hips a few inches back so that your knees travel toward your chest. Inhale and slowly lower to the start. (Do not lower your feet to the floor.)
The Focus: This move is done in one smooth, fluid movement, like a rocking chair being rocked by a soft breeze. Done correctly, it will create a feeling of tension just below your belly button as you lift and rock; this tension will spread through your entire abdominal wall as you reach the end of the set. Don't allow your lower back to arch off the floor as you lower- you should not feel your lower back working. Do this movement slowly to take all the momentum out of it. Lifting just an inch or so upward will actually be more effective than going through a larger range of motion.

THE THIGHS AND BUTTOCKS

If you are short on time, squats and lunges are great multi-function exercises for targeting the quads, hams, and buns. However, these exercises put a great deal of stress on the knee joint, and if you have a problem in that area, it's best to perform exercises that do not use the entire weight of your body as resistance.

GLUTEUS MAXIMUS AND HAMSTRINGS. The major muscle in your buttock area is the gluteus maximus. It is responsible for extending your hip (lifting your leg behind you) and rotating your thigh bone outward when your leg is straight. Any time you stand up, climb stairs, or walk up a hill, this muscle gets a workout. When you work the glutes, you also work a portion of the hamstring muscle. The hamstrings are a two-joint muscle, crossing both the hip joint and the knee joint. The hamstrings are also responsible for extending your leg behind you. In addition, they flex your knee. Hamstrings often show two imbalances- they are short in many individuals, and they are weak in comparison to the quadriceps. When a 150lb. person performs a squat, each quad supports 45lbs. When that same person does a leg curl, the weight lifted is only about 9 lbs. To offset this imbalance, use weighted resistance (such as ankle weights) when exercising the hams. You can save time by combining both leg extension and knee flexion into an exercise to work both muscle groups such as in the Leg Curl and Extension exercise.

KNEELING FOUR-COUNT LEG CURL AND EXTENSION
The Setup: Kneel on your knees and elbows with your weight distributed as evenly as possible. Align your neck with the rest of your spine by tucking your chin in slightly.
The Move: Squeeze your buns together, flex your left foot and, keeping your left knee bent, lift it off the floor until the back of your thigh is parallel to the floor and the sole of your foot is facing directly up toward the ceiling. Leading with your heel, straighten your leg out behind you. Bend your knee and begin curling your leg back to the first position. Lower to start. Repeat until set is completed. Switch legs and do an equal number of repetitions.
The Focus: Done correctly, this movement requires only a brief pause as you move from one position to the next so that it has a smooth continuous feel. You'll feel tension in your buns and back of your thigh as you lift your leg; the tension in the back of your thigh will increase when you curl your leg back to position one. Your thigh should never move above hip level. Pull your abs in toward your spine, allowing the spine to maintain a natural curve.

QUADRICEPS. The quadriceps muscle crosses both sides of the knee joint like reins on a horse, stabilizing the knee cap. It alone is responsible for extending the knee. Quads are the foundation for strong movement, and they are vital for keeping your knees healthy. Since you can't really strengthen the knee, you have to strengthen the muscles around it. Strong quads make it easier to lift heavy objects.

STANDING LEG EXTENSION (WITH BAND)
The Setup: Place an exercise band around both ankles**.** Stand on your right leg. Bend your left knee and lift it till your foot is in front of you and level with the middle of you right calf; flex your left foot so that the sole is facing the floor. You may hold onto a stable object at your side to help keep your balance.

The Move: Exhale. Leading with your heel, straighten your left leg out in front of you, being careful no to lock the joint. At the top of the movement the band will be taut. Inhale and return to the starting position. Repeat for desired number of repetitions and switch legs.
The Focus: Pretend you're kicking a ball slowly away from you as you straighten your leg. You'll feel the muscles in the front of your thigh working as they extend. If you find this movement too difficult standing, you can do it seated.

OUTER THIGHS (ABDUCTORS). The abductor muscle group is responsible for moving your leg away from the midline of your body and it laterally rotates your hip. Several of the outer thigh muscles are also part of the buns, so you should also see the shape of your buns improve as you exercise this area. The abductors play an important role in normal walking. Strong abductor muscles give you the ability to stretch out or support your legs in front of you for long periods of time.

PENGUINS
The Setup: Stand with your feet hip-width apart with an exercise band placed a few inches above your knees. (Placing it lower will place greater stress on your knee joints) Bend your knees slightly and place your hands on your hips. Stand up tall and maintain a natural alignment.
The Move: Keeping both legs straight, exhale and lift your right leg up and out to the side about six inches, until the band is tight and you feel a contraction through your outer thigh. Hold for a moment at the top of the movement and squeeze your buns together. Inhale and return your right foot to the floor. Repeat this movement with your left leg. Continue alternating legs, performing an equal number of reps on each side.
The Focus: This exercise looks like a penguin waddling its way around the North Pole! You're doing it right if you feel continuous tension in your outer hips and thighs. If you find it too difficult, do it without the band. Once you feel the contraction in your outer thigh, there's no need to lift your leg any higher.

INNER THIGHS (ADDUCTORS). The adductor muscle group is responsible for moving your leg in toward the midline of your body and, depending on the angle that your hip joint is in, functions as an internal and external rotator. Most people don't have excess fat on their inner thigh. They're just flabby. Muscles atrophy if we don't use them, and we hardly ever isolate the muscles of our inner thigh. Isolating them is difficult because the quadriceps and hamstrings are so strong, they tend to take over. You use your inner thigh muscles in activities like horseback riding.

SUPPORTED INNER THIGH LIFT
The Setup: Use a step platform for support of your non-working leg. Lie on your left side behind the step and extend your left arm and leg straight out and rest your head on your arm. Your top hip should be aligned directly over your bottom hip. Rest your right hand on top of the step for balance. Bend your right leg and rest it on top of the step so that your knee is in the center and your toe is resting on the bottom edge. (Instead of using the step, place your top leg forward to stabilize your hips, placing the side of your forward foot on the floor for support.)
The Move: Exhale and lengthen your bottom leg by extending through your heel and lift it as high as you can. Pause briefly at the top of the movement, inhale, and slowly lower your leg back to the start position. Complete reps and switch sides.
The Focus: Try to imagine a puppet string attached to your ankle gently pulling your leg upward and lowering it down again. You'll feel a strong contraction through the inner thigh of your working leg as you move upward and hold at the top. Don't roll back away from the bench as you move. Pulling your abdominals in and keeping your spine perfectly aligned will help you remain stable.

Chapter 9
Flexibility

Flexibility is one of the major components of physical fitness (Cardiovascular Endurance, Dynamic Strength, Absolute Strength, Flexibility, and Body Composition) and is defined as range of motion. We measure flexibility by the sit and reach test and can be improved by stretching.

The purpose of stretching is to reduce muscular tension, assist in the coordination of movement, prevent injuries, develops body awareness, and relaxes the body. Stretching can be performed anytime of the day.

There are **two basic flexibility exercises**: Active and Static.

Active involves repeated, fluid, gentle, dynamic range movements. Repeat 10-20 repetitions for the normal population and longer for Special Populations. Active stretching can be used for both the warm up and cool down phase of an aerobics class. Remember this should not be exhaustive or painful which could cause reflex contraction rather than relaxation.

Static involves slow, controlled stretching with held positions. Remember to not bounce or move the joint. Hold the stretch for 10-20 seconds while breathing normally. Static stretching can also be used in the warmup and cool down portion of the class. It will thermally warm up or cool down the body.

*PNF (Proprioceptive Neuromuscular Facilitation is one type of static stretching.

1) PNF involves statically stretching a muscle immediately after isometrically contracting that muscle for 8-10 seconds.
2) Can also use this in the warm-up and cool down of a class.
3) There are two types of Hold-Relax stretching methods.
    a) Generic Hold-Relax
        1) Hold the body part to be stretched in a position of maximum extensibility.
        2) Press against a resistance.
        3) Relax.
        4) Move the limb to the new position of greater extensibility.
        5) Repeat 2 or 3 times.

    b) Hamstring Hold-Relax
        1) Lie on back.
        2) Bend one knee, placing foot flat on floor.
        3) Lift your leg with knee extended.
        4) Have partner hold extended leg(at the calf and hamstring) and lift slowly

WARM UP/COOL DOWN

Exercise classes must use a warmup and cool down as part of the class format. The body needs to be gradually warmed up or cooled down or it may go into "transitional shock"(Cooper) and injury.

Warm Up

The purpose of the warmup is to elevate the heart rate and increase circulation to the working muscles. During the warmup, the body becomes prepared for exercise.

Warm Up should last for approximately 10 minutes. During those ten minutes, spend 2 minutes performing active stretching, 5 minutes static stretching, and 3 minutes performing mild activity.

Cool Down

The purpose of the cool down is to gradually decrease the intensity/metabolic rate. By decreasing the metabolic rate, one will be more apt to relax.

The cool down should last for approximately 10 minutes too. Spend 5 minutes in the mild activity mode followed by 5 minutes of static stretching.

AQUA AEROBIC FLEXIBILITY

During the flexibility training of the class, students warm up muscle group by using it and then move into 30 to 60 second stretch of that muscle group. Participants can do knee extensions for 30 to 60 seconds followed by a 30 to 60 second stretch of the quadriceps. Remember, hamstrings should be worked next with knee flexion and then stretched.

Format

A flexibility class should have a more relaxing atmosphere than other fitness classes. The preferred music is something with slow beats and relaxing to listen to.(Instrumental or sounds of nature.) Participants should move slowly in and out of the stretches and breathe slowly to give themselves time to feel relaxed.

Water Depth

The pool depth for a flexibility class is midriff level. The participants should have joints which give them problem submersed in water during the warming and stretching segments of the class. The deep end of the pool can also be used only if the participants have buoyant equipment such as, the belts or the shoes. The temperature of the pool should be right at 86 degrees when offering flexibility programming.

Equipment

Most flexibility classes require no equipment. The edge of the pool and ladder can be used in the flexibility portion of a class.

Concerns
There are two common mistakes individuals make when flexibility training in the water: stretching cold muscles and stretching the muscle too far. Stretching cold muscles can cause injury.

Participants are sometimes led to believe no pain no gain philosophy. In order to perform flexibility training properly it is not to pain but rather to the point of mild tension. If the stretch is performed properly, it will elongate the muscle to a length greater than its resting length which creates better range of motion for that joint or joints.

CONTROVERSIAL MOVEMENTS

Now that we have discussed the dos for Flexibility, we must discuss the controversial movements. These movements can cause injury to muscles, ligaments, bones, and joints of the body. Therefore, they should not be included in exercise routines.

The Don'ts

1. Yoga Plow, Inverted Cycling, and Uncontrolled Neck Circles
   Reason: Can compress the cervical vertebra.

2. Hurdler's Stretch
   Reason: Compresses the knee.

3. Duck Walk, Deep Lung, and Bent Knee Quadriceps Stretch
   Reason: Stresses the knee and may tear knee cartilage.

4. Toe Touching
   Reason: Stresses posterior longitudinal ligament.

5. Ballistic Back Hypertension
   Reason: Can cause lower back tissue damage.

6. Straight Leg Sit Ups
   Reason: Stress is put on the lower back.

7. Straight Leg Raises
   Reason: Stresses the sciatic nerve and produces lumo-sacral strain.

FLEXIBILITY TRAINING
ONE PIECE OF THE PUZZLE
TO YOUR COMPLETE PICTURE OF PHYSICAL FITNESS

There are four basic components to an overall fitness program**—***muscular strength & endurance (muscle building), cardiovascular endurance,* ***flexibility*** *and nutrition* (body composition, lean body mass). Think of total fitness as a jigsaw puzzle; if one piece is missing, your puzzle is not complete. When you slip the missing pieces into place, you've got the complete picture of physical fitness. This publication addresses the ***flexibility training*** component of a physical fitness program.

WHY IS FLEXIBILITY IMPORTANT?

You're as old as your joints,
but it's in your power to keep them young!

Most of us take our bodies for granted. We expect them always to do what we ask of them, effortlessly and efficiently; we assume that they will always be there for us. And so we go through our lives thinking about anything and everything except how we use these
reliable vehicles, these loyal servants that unquestioningly carry out all our orders. Until, that is, something goes wrong—a knee "gives out," or a hip, a shoulder or back. We experience tension and fatigue in making the simplest movements. We tend to blame it on the "aging process." We associate aging with loss—loss of strength, of endurance, of resilience? This process has in fact two very specific causes. The first is *misalignment,* or an unbalanced relationship of the parts of the body and the body in relation to gravity. The second is loss of *flexibility,* or loss of freedom and mobility—of the full range of motion of the muscles and joints. In other words, we sit, stand and move crookedly, and we do it more and more stiffly and tightly.

What throws us out of alignment is a imbalance in the tension of muscles that are working to support or move us. Muscles work in pairs. These muscles are in a balanced relationship when they are equally strong, and when at rest each is *as long as possible.* Regular stretching of the muscles is what gives them their maximum resting length. Stretching is also essential for muscle "tone," meaning the resilience and elasticity of the muscles. The health of muscles, as well the balance of opposing pairs of muscles, depends about equally on their ability to contract (shorten) and stretch (lengthen).

WHAT IS FLEXIBILITY?

Far more than muscular strength or endurance, which get called on only sporadically,
our flexibility affects us from moment to moment in everything we do,
yet it's what we lose first.

FLEXIBILITY is joint-specific and refers to the degree of range of movement around a joint. Flexibility of the joints depends on having muscles that are both strong and elastic, that can lengthen and contract to perform any movement we want. Freedom of movement is achieved through equalizing the tension of opposing sets of muscles. If one set is too tight while the other is too slack, the range of motion of the joint upon which these muscles act together to move will be restricted. A good example is the upper back. "round shoulders," which can look like a deformation of the bones, are actually caused by muscle imbalance. The muscles of the upper chest are too contracted and tight, while the upper back muscles are too weak, too stretched out. Instead of exerting a compensating pull, the upper back muscles yield to the stronger, tenser upper chest muscles, which pull the upper body forward without resistance. The way to correct this is to stretch the muscles of the upper chest, balancing their contracting power with lengthening, and to contract the muscles of the upper back, balancing their lengthening capacity with an equal contracting length. We lengthen the short, tense muscles, and we lighten the long, slack muscles to achieve alignment.

Muscles are naturally elastic, like rubber bands, but we can greatly increase their elasticity by consciously doing stretching movements. This achieves the goal of maximum resting length for our muscles, so that when we are relaxed, our joints are completely open and free, and capable of their maximum range of motion. When your muscles are tight, our joints tend to be correspondingly stiff; the way to free and open the joints is to stretch the muscles that move them.

FACTORS THAT INFLUENCE FLEXIBILITY

The degree of flexibility a person has may be related to his or her genetics, gender, age and level of physical activity. Other factors include stress and muscular tension and whether a person has experienced injury. Some people are naturally more flexible than others, and females are typically more flexible than males.

Genetic bony structure is something we cannot alter. The shape and size of our bones and the type of connective tissue we have is mainly determined by our genetic inheritance, that is, the structure we are born with. Knowing the natural limitations of our anatomical structure allows us to stretch safely. Every joint in the body has a different range of motion dictated by shape, size and how the bones fit together. Different body types are built with varying degrees of joint range. Although generally everyone has the same basic joint design, each joint can have variations in structure that enhance or limit flexibility.

Another factor that influences an individual's potential flexibility is the quality of connective tissues. Some individuals are born with muscles, tendons and ligaments that have a higher degree of elastic properties.

THE GOAL

The human body works best. When the muscles are at their longest possible resting length, with the most distance between the joints and the greatest length in the spine

The aim of flexibility exercises is to stretch the muscles and tendons surrounding the joint, NOT the ligaments. Ligaments are responsible for the joints stability and are not as elastic as muscles and tendons. If ligaments are weakened or overstretched, they predispose the joint to injury. Ligaments attach bone to bone, providing joint stability through tensile strength. *Moving a joint beyond the limit to which it can be actively controlled is a set-up for injury.*

WHAT'S IN IT FOR ME?
BENEFITS OF FLEXIBILITY TRAINING

Stretching benefits the whole person, for not only does it tone the muscles,
Strengthen the spine and increase flexibility, it benefits the mind and emotions too,
Smoothing the nerves, relaxing the mind, and replenishing vital energy to build a foundation for total body health.

Enhanced flexibility:

- Reduces the risk of injury;
- Helps release muscle tension and soreness;
- Allows more freedom of movement and improved posture and coordination;
- Reduces joint stiffness; delays the physical deterioration associated with aging; and
- Promotes physical and mental relaxation.

STESS AND TENSION – BE GONE!

Stress and muscular tension keep muscles in a shortened, contracted state. When muscles relax, tension is released. High levels of muscular tension tend to decrease sensory awareness and can contribute to an elevation in blood pressure. Habitually tense muscles tend to cut off blood circulation. Reduced blood supply results in a lack of oxygen and essential nutrients and causes toxic waste products to accumulate in the cells, leading to fatigue and pain.

TEAMING STRETCHING WITH YOUR AEROBIC EXERCISE ROUTINE

Warm muscles are more pliable and therefore stretch better than cold ones,
and stretching both before and after your exercise activity can help improve flexibility
As well as preventing injuries.

The warm-up should include a general, low-intensity activity such as walking combined with rhythmic, limbering exercises. As your core-body temperature increases during the warm-up and tissues offer less resistance, passively stretch those muscles you will be using the most in the upcoming activity. Begin the pre-stretch after 5-10 minutes of light aerobic warm-up exercises, performing a short series of movements that takes each muscle group to the limits of its range of motion in a slow, controlled manner. *Hold the stretch for at least 8-10 seconds.* During exercise, muscles may adapt to a shortened position due to repetitive contractions. Stretching after exercise will ensure muscle relaxation, facilitating normal resting length, circulation to structures, and removal of unwanted waste products. To increase flexibility, *hold stretches for at least 20-30 seconds* and move in and out of the stretch positions slowly.

HOW TO GET STARTED…JUST DO IT!!!

When you watch cats or dogs, they seem to be stretching most of the time they're awake.
No one as to tell them that stretching is good for them; they experience a luxurious sense of release.
In the set of stretching itself, and so they do it instinctively.

All your hopes and wishes, all your good intentions, won't bring about the changes you want in your body unless you actively work to make them happen. It is an odd paradox that the more we need the relief of stretching and releasing to restore elasticity to our muscles, the less we may feel like doing what needs to be done. In most of us, the body's feedback system seems to fail us at this point . . . but it's the *acceptance* of stiffness and limitation that contributes most of the down-hill slide so many of enter in our forties or fifties, or even in our thirties!

Instead of bullying yourself into undertaking flexibility training as a way of life because you know it is supposed to be good for you, create an *appetite* for stretching. Do it simply because it feels good. Although we know eating and sleeping are *important* to our health, we eat to satisfy hunger and sigh with the pleasure of stretching out between the cool sheets and warm blankets of our comfortable beds. *Once your body truly experiences the pleasure and benefits of flexibility training, you appetite for stretching will become as urgent as the appetite for eating and sleeping . . . to your great benefit!*

WHO CAN DO IT?

If you are healthy, you can stretch. If you suffer from severe stiffness in the mornings and you are an older person, seek medical advice before starting a stretch program. Arthritis may be affecting your body.

It is not advisable to start a stretch program when you are pregnant. During pregnancy, the hormone *relaxin* is produced to facilitate the expansion of the uterine cavity. It relaxes the musculoskeletal system by softening ligaments, loosening joints and stretching muscles and tendons. The ligamentous laxity reduces joint stability, which could increase the chance of sprains, an injury resulting from the overstretching or tearing of a ligament or joint capsule.

HOW TO DO IT

Locked parts of the body are very sensitive, and releasing them needs to be approached gently, nothing abrupt or violent, so that you feel safe as you go along in the stretch, otherwise, the body/mind is likely to react by clamping down even tighter than before. As you become aware of tightness and stiffness (location, quality and extent) in your muscles, maintain this awareness as you gently and gradually move into the stretch, THINKING first of releasing the tightness before you begin to move. Don't force it. Move a little, then stop, before you feel you're pushing too far, too fast. Give yourself time to become accustomed to each new stage in the movement before you take it further, this will enable you to persist without fear of hurting yourself. Always stop at the point where you feel that the stretch has gone as far as it wants for now. Stay there for a moment. Think of breathing into the area you're working on. Then see if you can take the movement a little further. Never, never push, pull, yank or in any way force a movement. A slow, gentle but persistent release is what you want.

SOME HELPFUL TIPS

Wear loose clothing. Leotards and tights are not essential; wear whatever is comfortable.

Play some soft restful music during your flexibility training to help relax your mind and your muscles.

Never stretch to the point of pain.

Never force your body into a stretch; instead, relax your muscles. As you extend from your bones, you muscles will elongate, creating space in your joints and promoting freedom of movement.

Go into each movement on an out-breath, and then breathe normally. Do not hold your breath; this only causes tension and strain. As you come out of a stretch, breathe in, breathe out, and release.

Be conscious of the way your spine moves as you stretch and feel the movement along the back of your body as well as the front.

Perform each stretch on both sides of the body, holding the position for the same length of time on both sides to achieve balance.

Stretching is most effective when practiced slowly and with concentration. Concentrate on the muscle you're stretching while relaxing the rest of the body.

Do not make bouncing or jerking movements (ballistic stretching) which can over tense the muscles, leading to spasms and tearing.

Sustain static stretches in a supportive position which allows the muscle being stretched to relax and elongate.

Avoid stretching muscles that are cold prior to performing some preliminary rhythmic limbering exercises.

WHAT NOT TO DO
PLAY IT SAFE – SOME GUIDELINES

A safe and effective stretch begins with proper body alignment,
and proper body alignment begins at the spine.

The spine is not a solid piece of bone, but a column of small sections forming five curves, including the coccyx. This gives it great strength--ten times that of a straight rigid column—and flexibility too. The spine does not move, but in segments, the vertebrae turning on and gliding over each other. This flexibility enables us to bend, twist, and hold ourselves upright, and for optimum health and mobility all the curves must be in balance. Unfortunately, this flexible column is inserted in a more rigid pelvis, and imbalances here, or weak abdominal muscles and a tight lower back, make the lower spine prone to injury. Although regularly stretching the spine correctly will help protect it retain flexibility, stretching incorrectly can place excessive stress on the spine and cause permanent damage. Her are some guidelines to help you play it safe:

AVOID THESE EXERCISES….

AVOID *UNSUPPORTED FORWARD FLEXION.* Although the spine was meant to flex forward, hanging the torso in an unsupported position with gravity pulling downward on the back can place stress on the vertebrae, discs and ligaments in the lumbar region as well as increase potential for overstretching lower back muscles and ligaments of the spine. Remember, ligaments have little elasticity. Once overstretched, they remain elongated, decreasing the stability and support in the lumbar region. Always support the torso by flexing from the hip joint, placing hands on the upper leg above the knee joint, or directly on the floor if sitting. Avoid arching the back—keep abdominals contracted to stabilize the spine and protect the lower back.

DON'T DO TRADITIONAL *TOE TOUCHES* to stretch the hamstrings as this place a strain on the lower back muscles and ligaments. The hamstrings are in an extreme stretch and are pulling the knees into a hyperextended position that places them under extreme stress. The position also compresses the intervertebral discs of the spine. Low-back pain may result as well as posterior knee pain. The rotation of the trunk in this position can be even more dangerous because it creates increased pressure on the discs.

Chapter 10
Special Populations

There are five categories of Special Population: Pregnancy, Hypertension, Obesity, Asthma, and Elderly. It is prudent that you obtain written clearance from a physician prior to beginning an exercise program with any individual who fits into any of these categories.

Pregnancy

At one time it was thought that a woman could not exercise when she was pregnant but no longer is that train of thought valid. Most women can safely exercise throughout the entire pregnancy. The American College of Obstetricians and Gynecologists (ACOG) states “any exercise prescription should be bases on the individuals medical and exercise history and any complications in pregnancy.”

Some of the complications are: cardiovascular disease, hypertension, anemia, history of premature labor, and history of low birth weight.

The benefits of exercising provided there are no complications are: controlling weight gain, increasing energy levels, reducing tension, and easier delivery.

ACOG Guidelines

1) Regular exercise at least 3 times per week
2) Avoid vigorous exercise in hot/humid weather
3) Avoid ballistic/explosive movements
4) Avoid hyperextension and hyperflexion movements
5) Adequate warm up and cool down is important
6) Heart rate should not exceed 140 beats per minute
7) Liberal ingestion of fluids should be encouraged
8) Low intensity is recommended for low fit individuals
9) STOP activity and consult physician immediately if unusual symptoms appear
10) The Aerobic portion of the class should not exceed 15 minutes
11) Individuals should have intensity level 50% to 60% of maximal functional capacity should be set.

Signs and Symptoms of Exercise Intolerance:

1) Pain of any kind
2) Uterine Contractions
3) Vaginal Bleeding
4) Dizziness or faintness
5) Shortness of Breathe
6) Palpitations
7) Persistent Nausea and Vomiting
8) Back Pain
9) Pubic or groin pain
10) Difficulty walking
11) Generalized edema

12) Decrease fetal activity.

Special Considerations
Low Blood Sugar increased Cardiovascular Response, Musculoskeletal injury, Basal Temperature, Respiratory System and Diastasis Recti.

Water Depth
Midriff to the armpit in the shallow water class. Buoyancy allows in the deep water classes, which reduces stress on the body.

Water Temperature
80-83 Degrees Fahrenheit. Water temperatures over 86 Degrees should not be used for prenatal programs unless they are simple toning classes.

Benefits
General relaxation, Improved Circulation, Improved balance reactions, increased cardiovascular endurance, Increasing maintaining muscle strength, and Increased socialization and Self-esteem.

Hypertension

Hypertension is also referred to as high blood pressure(140/90 mmHg). Both numbers of the 140/90 are important. Hypertension is a Primary Risk Factor for cardiovascular disease and is a risk factor for kidney disease.

Factors associated with Hypertension are:
1) Genetics
2) Excessive sodium intake
3) Excessive alcohol consumption
4) Inadequate potassium, calcium, and magnesium in the diet.
5) Upper body obesity
6) Sedentary lifestyle
7) Cigarette smoking
8) Chronic Stress

When a person cannot control hypertension, they are put on medications to reduce their blood pressure. Some of these medications are: Diuretics, Beta Blockers, Calcium Channel Blockers, ACE Inhibitors, and Peripheral Vasodilators. Many of these medications have side effects.

Should hypertensive individuals exercise? They can participate in low to moderate intensity aerobics performed 3-5 times per week for 15-60 minutes each session. It used to be said that hypertensive individuals could not participate in strength training. Research now indicates otherwise. Hypertensive individuals can strength train as long as they avoid the Valsalva Maneuver (holding one's breath) and use moderate resistance. Remember Borgs Perceived Exertion Scale should be used to monitor intensity. Also, individuals with a blood pressure of 160/110 mmHg should NOT exercise.

Water Depth
Midriff to the armpit in the shallow water class. Buoyancy allows in the deep water classes, which reduces stress on the body.

Water Temperature
80-83 Degrees Fahrenheit.

Obesity

Obesity is excessive body fat. There are three categories of obesity: mild, moderate, and extreme.

Mild obesity = >120% of idea body weight
Moderate Obesity = >130% of idea body weight
Extreme Obesity = >150% of idea body weight

There are other ways to define obesity: Body Mass Index > 27.3 in females or > 27.8 in males; or Percent of Body fat > 30% in females or males > 25%; or Waist Hip Ratio of > .9 inches in females or > 1.0 in males.

Health Problems Related to Obesity
Cardiovascular disease
Hypertension
Non Insulin Dependent Diabetes (Type 2)
Low Back Pain
Elevated Blood Cholesterol
Labor in breathing known as Dyspnea
Less tolerance to environmental stress

Prescription for Exercise
Identify ways a person can become more active in everyday life. Some examples: short walks and walking up and down stairs.
Identify enjoyable activities and get them involved in those activities.
Work on low intensities where a person can carry on a comfortable conversation. This is approximately 60% of target heart rate.
Gradually increase the number of minutes a day that the individual works outs.
Strength training should gradually be incorporated into the client's routine.

Water Depth
Deep water exercises are ideal for the obese. Less impact on the joints.

Water Temperature
78-82 Degrees Fahrenheit. Water temperatures of 86 Degrees and higher can trigger heat stress.

Benefits
Changes in body composition improve cardiorespiratory fitness, and increase self-esteem.

Exercise Induced Asthma

The American Thoracic Society defines asthma as, ”a disease characterized by an increased responsiveness of the trachea and bronchi to a variety of stimuli, resulting in a widespread narrowing of these airways, that changes in severity either spontaneously or result of therapy”. Asthma affects about 7% of the population. Of the 7%, 50-80% will experience exercise -induced asthma. There are many factors that trigger asthma: cold/dry air, exercise, upper respiratory tract infections, smoke/pollution, allergies, and emotional stress. Symptoms of an asthma attack include coughing, shortness of breath, and wheezing to name a few.

Exercise induced asthma is triggered when: there is a lack of a proper warm up, during short duration/high intensity exercise, and if there is pollen/pollution in location where exercising.

Physicians usually give their asthmatic patients the “green light” to exercise if they adhere to certain guidelines.

Exercise Induced Asthma Guidelines

1) Medicate at least 15-30 minutes to exercising(if medication is required)
2) Never exercise with an upper respiratory infection
3) Avoid exercising in cold/dry or smoggy air
4) Take frequent fluid breaks
5) Short duration high intensity workouts should be avoided

Elderly

Dr. Roy Shepard defined aging as, “the diminished capacity to regulate the internal environment, resulting in a decreased probability of survival.” When dealing with the elderly population, NAFTA recommends further education in the field of Senior Fitness.

Two concerns when dealing with this population are: Arthritis and Osteoporosis.

Arthritis

Arthritis is an inflammatory disease of the joints. There are two types of arthritis: Osteoarthritis and rheumatoid arthritis. Osteoarthritis is the most common type, and the pain is joint specific. Individuals with osteoarthritis have reduced range of motion with a wide range of pain. Rheumatoid arthritis is the most severe form of arthritis. It is thought to be an autoimmune disease. The attacks lead to swelling, pain and reduced mobility in the joints.

Osteoporosis

Osteoporosis is a disease that is characterized by severe bone loss. How does this affect exercise programming? If a person has severe bone loss, it will limit what they can do. For example, they cannot do high impact workouts because their bones are so fragile, they could break.

Water Depth

New participants in the class should stay at the shallow end of the pool but generally speaking, they can go to whatever level best suits them. Arthritic individuals should

exercise at chest to shoulder level in the water. The affected areas should be submerged.

Water Temperature
86-88 Degrees Fahrenheit is recommended. Arthritis for individuals it is recommended at 88-92 degrees. Many can exercise at temperatures of 82 degrees but must wear a full unitard, wet suit or windsurf suit.

Benefits
The older adult will be able to live a more healthy and enjoyable life. Exercise will also strengthen the heart muscle. Design programs to include stretching to improve or maintain range of motion and flexibility. Exercises to improve postural alignment should also be included. Also, you may need to spend more time warming up in order to release synovial fluid in the joints and deliver oxygen to the muscles.

Exercise Prescription for the Elderly

1) A treadmill stress test should be performed whenever possible.
2) Low impact modality should be performed.
3) Warm up and cool downs should be extended.
4) Use the Borg Perceived Exertion Scale to measure exercise intensity.

Individuals With Low Back Pain
Approximately 90% of the American population will at some time in their lives suffer from low back pain. This is the reason why a lot of these same individuals frequent Aquatic Aerobic Classes. It is basically a impact free workout.

Goals
The goals are to increase overall fitness and to eliminate low-back, hamstring inflexibility, to decrease body fat, to improve posture alignment and to strengthen the abdominal.

Special Considerations
Any exercise that causes low-back pain should be stopped immediately and modified move should be done instead. The ‘two-hour pain rule” applies to low back pain participants. If they hurt two hours after the exercise was performed, they probably did too much during that exercise session.

These individuals should also not perform full extensions or flexion of the arms or legs. The knees and elbows should always be slightly flexed.

Should eliminate straight leg lifts or high kick even from a stable base. Kicks should be limited to a 45-degree angle and forward flexion in the water is okay as long as not in the position for extended periods of time.

The instructor should always stress proper spinal alignment during exercise. Many people with the low-back pain have excessive lordotic curve in the lumbar. Participants should be instructed to perform pelvic tilts to reduce this curve.

Water Depth
These participants should move to the deepest end of the pool to give them more buoyancy and less stress of impact.

Water Temperature
Should be 76-83 degrees. Those with excessive back pain may need warmer water to keep the body core temperature up during low-intensity and low-impact pain.

Individuals with Physical Limitations
Some individuals with physical limitations feel uncomfortable exercising in public and would much rather do nothing.
*decreased range of motion
*decreased muscular strength
*decreased flexibility
*pain during any movement resisting gravity
*lack of coordination or proprioception

Goals
Generally, to provide a means for a full fitness potential, recreation and social outlet.

Special Considerations
Exercise should never be executed to the point of fatigue.
The setting is relaxed and informal.

Doctor's approval and a complete health history should be required of all participants.

Water Depth
Work through varying depths of water.

Water Temperature
Water temperatures vary from 82-98 degrees, somewhat warmer than usual because this is actually Aquatic Therapy. Remember, that the water temperatures do affect the heart rates.

Some of the therapeutic effect of warmer water are:
*increases the extensibility of collagen
*decreases joint stiffness
*relieves pain and muscle spasm
*produces a sedative effect
*increases localized blood flow
*assists in reducing inflammatory filtrates, edema and exudates

Benefits
There are an abundance of benefits from increasing physical fitness level to increase socialization.

Multiple Sclerosis (MS)
People with MS are usually able to participate in cooler pool temperatures then persons with other progressive diseases. The optimal pool temperature for MS patients is 78-82 degrees. The cooler water prevents increasing the body core temperature, which could exacerbate the disease process.

Chapter 11
Exercise and Safety

Safety is the most important component to any exercise program. **If the class is not safe, how can it be effective or fun?** This Section deals with several issues of safety: weather and temperature, overtraining, and exercise related injuries.

Heat and Safety

Where is the body's temperature regulatory center? **The brain is the body's regulation center (hypothalamus**). The body dissipates heat by: conduction, radiation, convection, and evaporation.

Evaporation is sweating. The body dissipates heat through sweating. The hypothalamus controls the sweating mechanism.

Conduction is where the body transfers heat from one solid object to another.

Convection is where the heat from the body transfers to the surrounding air.

Radiation is the loss of heat in the form of infrared rays.

The hypothalamus is the body's thermostat making adjustments whenever core body temperature deviates from normal temperature either higher or lower.

Monitoring the Heat

It has already been discussed how the body deals with heat but how is the heat monitored? There are two ways to monitor the heat. First, the military monitors the heat through the Flag System/Wet Bulb Globe Temperature Index. Second, through the Heat Stress Index.

Wet Bulb Globe Temperature Index

1) Green Flag-Physical activity is unrestricted (WBGT - less than 85).

2) Yellow Flag-Physical activity should be limited to those individuals who have already exercised for at least 10 days (WBGT - 85-87).

3) Red Flag-Physical activity is restricted to only those individuals who have exercised in the same temperature for a minimum of 30 days(WBGT - 88-90).

4) Black Flag-Physical activity outdoors and indoors where facilities are not air conditioned is not advisable (WBGT - more than 90).

Heat Stress Index

The temperature and the humidity added together equal the Heat Stress Index. This index is only valid for temperatures below 90 degrees and exercise should be reduced in intensity and duration.

Example: 78 degrees + 85% humidity = 163 Danger

HEAT STRESS INDEX

< 130	SAFE (Same as the Green Flag)
130-149	CAUTION (Same as the Yellow Flag)
150-170	DANGER (Same as the Red Flag)
> 170	CANCEL (Same as the Black Flag)

Guidelines for Hot Weather

1. Allow approximately 30 days for acclimatization.
2. Will not perform at peak performance.
3. Drink plenty of water.
4. Drink electrolyte replacement drinks during long-term exercise when profuse sweating occurs. Dilute the electrolytes 50/50 with water.
5. Beware of the sun.
6. Do not warm any type of oil-based sunscreen because it will block the pores, hence trapping sweat/moisture in.
7. Never wear rubber suits
8. Clothing should be loose fitting and light in color.

Heat Injuries

There are three types of heat injuries: Heat Cramps, Heat Exhaustion, and Heat Stroke.

Heat Cramps are painful spasms in skeletal muscles. It is recommended that a warm wet towel be applied firmly to the cramped area and rehydrate with cold sports drinks.

Heat Exhaustion symptoms are profuse sweating, weakness, dizziness with possible nausea, headaches, and vomiting. It is recommended that the individual be moved to a cooler environment and rehydrated with sports drinks. In serious cases, get immediate medical attention.

Heat Stroke symptoms are Central Nervous System impairment including: confusion, amnesia, incoherent speech, dizziness, sweating profusely, etc. Obtain medical attention immediately. A person can die from Heat Stroke. Monitor the pulse and respiration and apply CPR when necessary.

Cold and Safety

When exercising in the cold you are trying to conserve energy and reserve heat. The body needs to acclimate to the cold just like in hot weather. The resting metabolic rate increases, blood flow increases to the feet and hands, shivering occurs at a later time, and an increase in brown adipose tissue occurs when acclimating to cold weather.

Guidelines for Cold Weather

1) It is very important that a person dresses appropriately for the weather.
2) It is recommended that a person uses layers of clothing: cotton as the first layer and the outer layer needs to be wind resistance.
3) Keep moving.
4) Cover all exposed skin.
5) Drink plenty of fluids but avoid alcohol.
6) Be aware of the wind chill factor.
7) Know where the nearest shelter is.

Cold Injuries

There are two types of cold weather-related injuries: Frostbite and Hypothermia.

Frostbite is the freezing of the skin which can occur superficially or deep within the body tissues. Usually, the common areas for frostbite are the nose, ears, fingers and toes. It is recommended that the affected areas are covered and warmed or if it is severe get medical attention immediately.

Hypothermia is where the temperature of the body drops below the normal body temperature. It is recommended that you wrap the individual in blankets from head to toe and you remove all wet frozen clothing and place the individual in warm water and get medical attention as quickly as possible.

The Wind Chill Index

Wind Speed	40	30	20	10	0	-10	-20	-30
Calm	40	30	20	10	0	-10	-20	-30
10	28	16	4	-9	-21	-33	-46	-58
20	18	3	-10	-25	-39	-53	-67	-81
30	13	-2	-18	-33	-48	-63	-79	-94
40	10	-6	-21	-37	-53	-69	-85	-101

OVERTRAINING

Overtraining is most commonly apparent in fitness professionals. As fitness professionals we tend to overtrain without realizing it. Some of the symptoms of overtraining are: unexplained soreness, lowered resistance, colds, headaches, chronic fatigue, and cold sores.

VOICE BOX INJURY

This is one of the most overlooked over used muscles in an aerobics instructors body.

Symptoms of Vocal Injury:

-tired voice
-a feeling like you have a lump in your throat
-dry throat
-sore throat
-tightness or increased tension in the throat

Symptoms You Might Hear:

-hoarseness
-loss of voice
-squeaky, breathy or rough voice
-frequent coughing or clearing throat
-Voice worsens at night

Tips on Teaching

-Relaxation-keep the head, jaw, neck and shoulders tension free.
-Posture-Demonstrate rather than verbally explain movement.
-Projection-Speak out, not down and up.
-Pitch-use the natural pitch of your voice.
-Cueing-use gestures and visual cueing
-Environment-music at a moderate volume,
-Microphones-use whenever possible.

EXERCISE RELATED INJURIES

1) **Strain**-overstretching, overexertion or overuse of soft-tissue; less severe than a sprain.
2) **Sprain**-severe stress, stretch or tear of soft tissues such as joints capsules, ligaments, or tendons.
3) **Dislocation**-displacement of a bony part of a joint which leads to soft-tissue damage, inflammation, pain and muscle.
4) **Muscle/tendon rupture or tear**-partial tear, pain is felt when the muscle is stretched or contracted against resistance. With a complete tear, stretching and contracting the muscle causes little pain.
5) **Tendonitis**-inflammation of a tendon leading to scarring or calcium deposits.
6) **Bursitis**-inflammation of a bursa.
7) **Chondromalacia (Runner's Knee)-**pain in the kneecap.
8) **Plantar Fascists**-point tenderness on the bottom of the heel.
9) **Torn Meniscus**-very common injury in the knee. This can occur if there is a bouncing movement from the heel not making complete contact to the floor.

STAGES OF INFLAMMATION AND REPAIR

1) **Acute(inflammatory) stage** usually lasts for about four to six days. Swelling, redness, heat, pain and loss of function are evident.

2) **Subacute(healing) stage** is when repair of the injured site begins. Immature connective tissue is produced that is very fragile and easily injured.

3) **Chronic(maturation and remodeling) stage** describes a long-standing condition with recurring pain episodes often accompanied by dysfunction resulting from the healing process.

First Aid Guidelines

The main first aid principle that fitness professionals need to know is **RICE**. Rest, Ice, Compression, and Elevation. The new definition is **P.R.I.C.E**.-Protection, Rest, Ice, Compression and Elevation.

NAFTA'S REQUIREMENTS

CPR and Basic First Aid.

AQUA COMMON INJURIES

Swimmers Ear-is caused by a bacterial infection from the failure to dry the ear adequately following swimming or taking a shower.

Symptoms-itching, greenish colored discharge, pain with chewing, a constant feeling that the ears are blocked.

High Risk Moves as a general rule there are very few contraindicated moves for aquatic fitness. There are several high-risk moves that should be carefully evaluated before incorporating them into a fitness class. Almost every movement can be beneficial in the appropriate setting with the appropriate population. However, there are many moves that are specialized in their benefits that they should be considered high risk inclusion in general population fitness programs. "Hurdles' Stretch" for the Land Aerobics would be considered a high -risk move because of the potential for injury and the availability for a safer option.

Example of High Risk Moves:
Very High Impact Exercises
Very Fast Movements
Extended Use of Arms Overhead
Muscle Imbalance Moves
Prone Flutter Kicks
Wall Hanging Exercises
Hip Flexion Versus Abdominal Conditioning
Hyper-Flexion of the knee
Spinal Integrity

Chapter 12
Pool Safety

Prior knowledge about the area in which an instructor is to instruct the class will ensure a safe program for the participants. The instructor will be better able to compensate for inadequacies. There are seven sub-categories under pool safety: Pool bottom, pool walls, pool deck, water temperature, air and humidity temperatures. Water depth, sun exposure and usable space.

THE POOL AND SURROUNDINGS

Pool Bottom

The pool bottom can affect the likelihood of injury for the participant and instructor. The slippery bottoms are usually painted. Or completely done in tile, or fiberglass. One safety measure would be to wear aqua shoes when either taking a class or conducting a class.

The pool bottom should be smooth yet not slippery. The pool depths should be clearly painted for all to see. Recently, there has been drowning due to the pool grates not fitting properly over the drains. Before conducting a class, be sure to check that the pool drain grates are properly fitted.

Rough pool bottoms can scratch the feet and cause cuts. Participants whose feet have open sores or cuts from the pool bottoms, should not be allowed to participate again until the feet have healed. Safety measure, wear protective aqua shoes to prevent the sores and cuts from occurring.

Sloped pool bottoms can create an imbalance when exercising which could lead to poor postural alignment. Pools with extreme slopes should not be used or only used for deep-water exercise.

Pool Walls

Instructors should examine the pool walls before an aqua aerobics class. Look for smooth surfaces with no obstructions or protruding areas.

Pool Deck

The pool deck, as the pool bottom, should be non-slip with a slight slope to allow for drainage. When the deck is slippery, instructors should escort participants to and from the pool to ensure their safety. Also, ask your participants to wear aqua footwear.

Instructors, when teaching on deck, have a non-slip mat in the area in which you are teaching. Most pool decks are made of concrete and the mat will help to reduce your risk in injuries.

Water Temperature

Indoor pool temperature ranges from the 70s to the 90s (degrees Fahrenheit). Outdoor pool temperature can range from the 40s and 100 degrees.

Idea pool temperatures should be 80 to 83 degrees Fahrenheit. Even in this ideal temperature range, the pool water is cooler than the body's temperature, it can cause.

certain physiological reactions: blood vessels near the surface of the skin will become smaller, blood will circulate more in the deep vessels of the body in an attempt to converse body heat; the muscles will contract automatically, and the participant will begin to shiver immediately. It is essential to have the participants begin moving immediately upon entering the water. If the temperature is below 80 degrees, participants must increase the time spent in the warm-up before moving on to the full-range-of-motion movements.

The body in the water cools four times faster than in air. That is why it essential to begin thermal warming immediately upon entering the water. Thermal warming usually includes having the participants bouncing, jogging, and jazzkicking.

Water temperatures in the low 70's and below is not advised and quite frankly is unsafe to perform aqua aerobics. Temperatures above 85 degrees present another potential risk of overheating and caution is needed when exercising. Remember, therapeutic pools are heated above 90 degrees but aerobic activity is not and should not be performed in these temperatures.

Air Temperature and Humidity
A general rule offered by Dr. Kenneth Cooper of the Institute for Aerobics Research is that if the air temperature is over 90 degrees and humidity is over 60%, aerobic exercise should not be attempted(Institute for Aerobics Research 1981).

Sun Exposure
Outdoor pool instructors need to be aware of the sun and the risks that they take when teaching their classes. They have unusually high risk of developing skin cancer because of the compounded effect by the exposure of direct sun rays and the potent UV reflections off the water surface(American Cancer Society, 1988).

OTHER DANGERS

The pool safety checklist will help the instructor to identify other and potential hazards. This checklist will also help the instructor decide whether or not to cancel the class due to these potential dangers. The other dangers or concerns range from water to mechanical.

Water
The instructor should look for turbidity, turnover, quality, temperature and depth of the water before instructing a class.

Water turbidity is cloudiness. The instructor should be able to see the main drain gate from anywhere around the pool. They should also know how to shut down the power breakers for circulation in case anyone gets trapped at the drain area. If the water is too cloudy, the instructor should cancel the class.

Water turnover is the amount of time it takes for the water to re-circulate. The standard is approximately 6 hours.

Water quality should be tested every two hours and is usually done by the lifeguard who has a Pool Operators License.

Depth
The depth should be within the appropriate guidelines for the programs being offered. It is advised for the non-swimmers to stay closer to the shallow end of the pool.

Ladders/Steps
The instructor should make sure they are securely attached before a participant is allowed to use either. The instructor should caution participants to use the ladder and or step when accessing or exiting the pool.

Electrical Devices
Electrical devices should be grounded and created for the pool area.

Ventilation
The ventilation should eliminate unpleasant odors or fumes and dissipated chemicals. Low humidity should be maintained in the indoor pools at approximately 50-60%.

Chapter 13
Presentation Skills

There are three categories of concern when dealing with presentation skills: **Factors of Control, Emotional/Physical Concepts, and Delivery Sequence.**

FACTORS of CONTROL

-are those factors that can be controlled: Material & Substance, Environmental, Audience,
and Support System.

Material & Substance

-sequence
-delivery style
-content

Environmental Control

-area in which class is to be taught
-P.A. system
-room temperature
-distance from participants

Audience Control

-ice breakers
-motivate the participants to get involved
-point someone out in the class to get involved
-movement through the class period

Support System

-always be on time
-all students know what to expect

EMOTIONAL/PHYSICAL CONCEPTS

-are: Commanding Attention, Expert, Physical Dimensions, and Magic.

Commanding Attention

-command the attention of your audience through eye contact, voice, and/or expressions.

Expert

-you are the expert when teaching a class
-always express confidence
-deliver the class in a clear manner

Physical Dimensions

-dress appropriately
-be clean, fresh, high energy, and alive before, during and after your class
-body language needs to be positive
-eye contact is very important

Magic
-have compassion for the beginners
-be patient
-you are an example

DELIVERY SEQUENCE
-is the content of your class: Introduction, Main Body, Close and Elements of Fear

Introduction
-Introduce yourself and your credentials
-Let the participants know what type of class is being taught
-arrive early so you are prepared for the start of the class
-help beginners before, during and after class

Main Body
-Class Sequence
*Stretching**(What type of stretching: Dynamic, Static and Mild Activity)(Importance of stretching the back)**
*Warm Up
*Aerobic Period

Close
-Calisthenics Phase
-Cool Down
-Class ends on time

Chapter 14
Teacher Effectiveness

There are two categories for the teacher: **Ineffective and Effective**. **Anyone can be an effective teacher with practice.**

Teacher	Attributes	Perception	Views of Others	Behavior
Ineffective	authoritarian insensitive lacks humor impatient sarcastic rigid	less self confident feels inadequate direct authoritarian	unfavorable opinion of others	inflexible uses criticism and sarcasm
Effective	democratic helpful open spontaneous	confident competent worthy dependable	favorable opinions of others	flexible praises encourages

CHARACTERISTICS OF AN EFFECTIVE INSTRUCTOR

An effective instructor has many characteristics which manifest themselves in a variety of different ways. **The instructor's personality and familiarity with the material are only part of the equation for an effective instructor. The characteristics for effective teaching are**:

Good Communication Skills
-The ability to enhance the learning process through motivation, association, repetition, and
the use of the senses.

Subject Knowledge
-Know your "stuff".

Positive Attitude
-Help to motivate your students by being friendly and enthusiastic. Show genuine concern and listen to their ideas and suggestions.

Role Model
-Be one.
-If the guidelines state that you teach in a specific "beat per minute" do it! This can only assist your students in getting an effective and safe workout.
-Remember, you are the "boss" in the class not the students.
-Wear appropriate attire and have a professional appearance,

Practice Patience and Flexibility
-Incorporate modifications and challenges whenever possible.

Always Maintain Professional Behavior
-Be on time and prepared for class.
-Do not bring in your "problems" to the class.
-Do not make negative remarks about a particular student getting on your nerves.

COMMUNICATION

The process of transferring a message from one person to another is what we refer to as communication. Communication can occur verbally or nonverbally.

Verbal
Verbal communication occurs through the process of speaking, writing or singing. When working on your verbal communication or "cues" consider the following aspects:

Volume-do not scream

Do not talk to fast or too slowly. Make sure your cues can be understood.

Pronunciation-practice cueing with a tape recorder

Use clear simple language.

Enthusiasm, enjoy your class

Non-Verbal
Non -Verbal communication also plays an important part as an effective instructor. Positive nonverbal communication we should utilize in our program include:

Smiling
Use of hand signals
Eye contact
Uncrossed arms.

Non-Verbal Negative Communication should be avoided include:

Frowning
Yawning
Rolling of the Eyes
Pointing Directly at Someone
Becoming Fidgety
Clenching Fist

TEACHING TECHNIQUES

There are several practices and principles to keep in mind when teaching aqua aerobic classes.

First, remember you are the role model. Therefore, you must teach and demonstrate proper techniques including correct breathing, proper body alignment, proper body positions and good posture.

Second, the participant's balance and feeling in the water are crucial in allowing an effective workout.

Third, always stress the importance of beginning with a strong stable starting position for the body.

Fourth, teach the participants about the principles of water and how to feel the water. Your goal as an instructor is to get the participants to understand how they can vary the workout by working with and against the water. For example, have your participants modify the different hand positions (open and close) while working in the water and feeling the difference.

Fifth, build on what your participants already know. It is best to always start with the basic movements and then modify or increase the intensity by changing the body's positions. Move from the simple to the more complex movements. Remember to gradually change in a non-threatening manner.

Finally, always have a positive attitude. Reinforce participant's progress at every level and allowing for variations in age, learning rate and physical/emotional ability.

DECK VS. POOL

There are advantages and disadvantages to both teaching on the deck and in the pool. If the class is large and funding is available, it is recommended that there are two instructors. One can demonstrate on the deck and the other in the pool. Some instructors prefer to teach both on the deck and in the pool. For first time instructors, it is recommended that teaching begins on the deck for the first classes. This will allow the instructor the opportunity to improve on their teaching skills. At the same time, the participants will become more comfortable with the cues and the aqua environment.

There is no right or wrong answer but as the instructor, you must weigh the pros and cons of each technique. Consider the pool environment, as well as the your participants' preference.

Finally, other things to consider are: deck surface (wear proper footwear), acoustics (should you use music) eyesight (participants can not wear glasses in the pool) and bathing caps (impairs the ability to hear).

ADVANTAGES AND DISADVANTAGES
POOL VS. DECK TEACHING

POSITION	ADVANTAGES	DISADVANTAGES
In The Pool	Instructor can have contact with the participants.	It is more difficult to see all the participants.
	Instructor can adjust the intensity.	It is difficult for participants to see.
	The participants do not have to strain their necks by looking upwards.	
On The Deck	Participants can see the movements and proper techniques.	It may be difficult to perform the exercises at the speed at which participants will do them in the water.
	Adjust the music more easily.	The deck could be slippery. Risk for injury increases.
	Easier monitoring.	

Chapter 15
Choreography & Music

Aerobic choreography is the coordination of music and movement.

BASICS

Movement
-patterns have a simple theme
-patterns are consistent
-established pattern is repeated
-designed in “bite-size” step by step method
-elements are: design, dynamics, rhythm, and motivation

Low Impact Aerobic(LIA)
-keeping one foot on the floor or as close to floor as possible.

Moderate Impact Aerobics(MIA)
-both feet staying on the floor but the feet roll through toe-ball-heel action every time

High Impact Aerobics(HIA)
-both feet leaving the floor alternately or at the same time.

Effectiveness of Teaching Basic Movements
-know participants’ ages
-know participants’ level of coordination
-know participants’ level of experience
-know risks of the participants’
-know your comfort level
-know your ability to teach basic movements
-remember frame of reference(F.O.R)

TRANSITIONING

Ensures:
-smoothness of class flow
-effectiveness
-safety
-ability to follow
-control of movements

ELEMENTS OF VARIATION
-are tools to use to change, design, or develop movements.

Rhythm
-is executed to every beat or in between beat of the music.

Intensity
-is the degree of physical, emotional, and psychological energy exerted

Direction
-the floor pattern which the whole-body travels

Symmetry
-bilateral movement

Spatial
-refers to planes of space in which the body moves

Style
-is the amount of individuality a person applies to a class i.e., Funk, Step, Latin, etc..

Building Block Method
-whole movement is added on one at a time

California Style
-directional variations as well as floor patterning.

MUSIC

Know the 32-count music phrasing. It is not advice that you mix your own music because you will not be able to hear the 32 counts on a regular basis.

The 32 count is 4 sets of 8 count beats. Design your routine to begin on the top of the 32 count and end at the bottom of the 32 counts. For example: Right foot lead step up step back twice then grapevine to the left and grapevine back, left foot lead step up step back twice then grapevine to the right and then grapevine back. This is a full 32 count move.

Royalties

To use an artist's music, you must pay royalties if you mix your own music. There are companies who produce aerobic music that you can purchase from and not have to be responsible for the royalties.

MUSIC

Music can energize and help to motivate the participants. Most people enjoy moving to music. Therefore, adding music to the aerobics class has become increasingly popular over the past decades. There are special considerations that need to be addressed when using music in your classes. These considerations are: participant's preference, acoustics, pool environment, and type of class.
It is important that you listen to your music before you use it in your class. Remember the exercises with the music you utilize on the land cannot be always used when working in the water. Movement in the water is slower due to the properties of the water. Movements too should be practiced in the water before demonstrating them on deck. It is important that you try to demonstrate the movements on the deck as if you were in the water. There are other factors that will affect the timing and use of music and they include: body type, body dimension, water depth, participant's fitness level, and effort.

exerted by the participant. Also, remember that changing the direction in the pool is difficult in any depth of water.

The following chart will assist you in defining the beats per minute (BPM) that are appropriate for a variety of aquatic classes.

CLASS	BEATS PER MINUTE(BPM)
Water Walking	110-130 BPM
-Shallow	130-160 BPM
-Waist Deep	120-130 BPM
Water Jogging	120-130 BPM
-Shallow	130-160 BPM
-Waist Deep	120-130 BPM
Water Aerobics	120-160 BPM
-Shallow	140-160 BPM
-Waist Deep	140-150 BPM
Toning	120-130 BPM
Stretching	Less than 120 BPM

Note: Music preference is personal. You will not be able to please every participant in your class. It is best to try to incorporate music that your participants can identify. Ask your participants what music they like to hear during their workouts. Remember, it is the participants workout not yours.

32 COUNTS

The 32-count phrasing is an important element to choreography. It is relatively easy to use on land aerobics and has to be modified for water aerobics. In the beginning, it is difficult to learn but once it is learned, it will make the classes an instructor conducts easier. Also, the 32 count flows with the movements of the brain waves and body movements.

MOVEMENT PROGRESSIONS

Movement ideas are virtually unlimited if the basic rules for choreography are utilized. Choreography movement includes add-ons, series of movements and variations of movements.

The following is an example of Add-On Choreography.

1) Start with a march for 8 counts.
2) Add 8 walks forward.
3) Repeat 1 and 2.
4) Add 8 alternating knee lifts.
5) Repeat 1, 2, and 4.
6) Add 8 heel digs.
7) Repeat 1, 2, 4, and 6.

The following is an example of how to use Series Choreography.

1) 8 Marches, 8 Walks, 8 Knee Lifts and 8 Heel Digs.
2) Break the movements down to 4 instead of the 8 counts.
3) Break the movements down to 2 instead of the 4 or 8 counts.

ELEMENTS OF MOVEMENT

There are 8 elements that affect choreography, intensity, creativity and sequencing of your movements. The 8 elements are: Space, Direction, Speed, Form, Levels, Quality, Effort, and Relationship. When dealing with these elements, ask these questions:

SPACE-"Have you effectively utilized the space available?" and/or "Have you considered the participants personal space?'

DIRECTION-"Have you traveled in a variety of directions including diagonally, turned, snaked across, up and down?' "Have you utilized specific areas within the pool environment?"

SPEED-"Have you changed the tempo or speed of the workout/movements?"

FORM-"What forms has the class used and created during the movement?" "Have you experimented with changing the form of the body by adapting different shapes and forms?"

LEVELS-"Have you incorporated different levels of intensity or impact into your choreography?"

QUALITY-"Have you explained changed the quality of your participants movements?" "Have you swished, punched, flowed, floated or hung?"

EFFORT-"Have you explained and experimented with the properties of the water so that your participants know the difference between a push and PUSH?"

RELATIONSHIP-"Does your class offer opportunities for the participants to develop relationships between each other, the environment, and/or you?" "Do you work on the relationship and awareness of the participants body parts, and the environment?"

Choreography Terms

Component-the smallest part in the choreography.

Combination-two or more moves linked together to form a repeatable sequence in choreography.

Styles-ways of linking together moves either by sequencing, numbering of rep or both.

Beats-regular pulsation's having an even rhythm.

Tempo-the rate of speed at which the beats occur.

Water tempo-an appropriate rate of speed used in the aquatic environment to allow for slower reaction time and full range of motion in water choreography.

Transition-occurs when there is a change from one move to another.

Alignment-proper posture.

Chapter 16
Cueing

Implementation

Cueing

Types

1. **Footwork**-refers to which foot you want them to move.
2. **Directional**-refers to the direction you want the participant to move.
3. **Rhythmic**-refers to the rhythm of the movement
4. **Numerical**-refers to the number of repetitions you want the participants to execute.
5. **Step**-refers to the name of a step.
6. **Alignment**-refers to body posture and placement throughout the entire class.
7. **Verbal and Nonverbal**- refers to the "7-38-55" rule.
   7%-communication verbally
   38%-communication in which words are said
   55%-communication is body language
8. **Visual**-refers to cueing that is communicated through hand gestures and sign language

When

1. Prior to any pattern and/or step change
2. If using an 8 count, cue on 7 and 8, and change on one

Practice

When cueing you count down and leave the number off. For example, 4, 3, 2, and next move. 4, 3, 2, and left lead.

Chapter 17
Designing an Aquatic Aerobic Class

FORMATTING

There are five segments to an Aquatic Aerobic Class: Warm up, Cardiovascular Endurance/Training, cool down, Toning and Flexibility.

Warm Up
The warmup has three segments: Thermal Warming, Pre stretch and Cardiovascular Warm Up.

Thermal Warming
Thermal Warming is aimed at the warming of the skeletal muscles and the bones that support them and should last approximately 3 to 5 minutes. The movements are gentle, controlled, and small ranges of movement. Thermal warming is used to warm-up the internal body temperature by increasing the temperature by one to two degrees. One achieves this by releasing more oxygen to the muscles as the body prepares for the cardiovascular workout.

Pre stretch
This segment is designed to prevent injury during the cardiovascular segment of the class. The stretching and holding of the stretch of the muscles should last for about 5 to 10 seconds per muscle.

Cardiovascular Warm Up
This segment includes movements with an increased range of motion and moderate intensity. The goal is the warming of the cardiovascular system and prepare it for exercise.

Cardiovascular Endurance
This is considered the calorie-burning portion of the class. The goal is to improve the cardiorespiratory system. As discussed in SECTION F the same guidelines apply as to the FITT Principle.

Cooldown
This portion of the class usually lasts about 5 minutes. The purpose is to return the blood to the heart at a low intensity to allow the heart to move toward a resting level. The cooldown is especially important because of the pressure of the water. If a participant leaves the pool before they cooldown, they may become dizzy and feel lightheaded.

Toning
Toning is also referred to Muscular Endurance and Muscle Strength. Muscular Endurance is repetitive contractions on a muscle(15 repetitions). Muscular Strength is defined as a 1 Maximal Repetition. Usually, participants will use the pool edge or buoyant devices holding the participant off the bottom of the pool.

Flexibility/Post stretch
This portion should last about 5 minutes and all the muscles used during the workout should be stretched. The purpose is to provide flexibility, help prevent muscle soreness, lower the oxygen demands, and reestablish the body's equilibrium.

TYPES OF AQUA CLASSES

There are several types of Aqua Classes that can be offered. This manual will only discuss fifteen different types: Water Walking, Shallow Water Jogging, Aerobic, Toning, Strength Training, Flexibility Training, Aqua Power Aerobics, Sport Specific Workouts, Step Aerobics, Interval Training, Deep Water Exercise, Plyometric Training, Aquatic Therapy, and Relaxation.

Water Walking
This is simply water striding in waist to chest deep water fast enough to create the Principle of Overload on the cardiovascular system. The format should still include thermal warming, pre stretch, and cardiovascular warming followed by the cooldown, toning, strength training and flexibility training.

Shallow Water Jogging
This is much like water walking but is done with bounding or leaping steps. Jogging is pushing up and partially out of the water. The format should still include thermal warming, pre stretch, and cardiovascular warming followed by the cooldown, toning, strength training and flexibility training.

Water Aerobics
This includes a wide variety of dance and calisthenics moves done in the water. The format should still include thermal warming, pre stretch, and cardiovascular warming followed by the cooldown, toning, strength training and flexibility training.

Water Toning
This class is used to improve muscular endurance. In this class, participants work a specific muscle group with one move for 15 to 60 repetitions. And then move on to the another muscle group. The format should still include thermal warming, pre stretch, and cardiovascular warming followed by the cooldown, toning, strength training and flexibility training.

Aqua-Power Aerobics
This combines aerobic conditioning, strength training and muscle toning in the cardiovascular portion of the workout.

Sport Specific Conditioning Workouts
These workouts are designed to assist sports enthusiasts in developing the muscle strength and flexibility needed in their sport.

Step Aerobics
This is similar to Step Training on the Ground. Participants step up and down on a bench for the aerobic portion of the class.

Interval Training
Interval training is an exertive exercise program usually reserved for well-conditioned athletes. Interval training means a workout that combines high intensity portions with moderate or low intensity segments.

Deep Water Exercise
This usually falls into two categories: running or exercises. Deep water running is simply running, using different strides, in deep water. Deep-water exercises follow the same format for an aerobic workout, including deep water running.

Plyometric Training
Plyometrics is training to improve power, speed, and jumping for the athletes. This class involves a series of jumping, bounding and hopping moves. Plyometric moves work well in sport-specific-training and interval-training programs.

Aquatic Therapy
This type of class includes athletic rehabilitation, medical rehabilitation and ongoing therapy. Therapeutic work should only be provided by licensed caregivers.

Relaxation Therapy
There are two basic types of relaxation techniques: Muscle-to-mind and Mind to Muscle. Muscle-to-mind approaches use muscular contraction and release to make entire body including the mind to relax. Mind-to-muscle techniques use the mind its abilities to relax the entire body, including the muscles.

There is a standard of care that a fitness instructor is liable for. The question that must be asked when determining whether an instructor is liable is: "What would a reasonable and prudent exercise professional do in a similar situation? Basically, you are asking whether the instructor was negligent. There are four elements that must be present before an injured party can recover damages. The four elements are: duty, failure to perform that duty, proximate cause, and damage.

Duty

The courts place duty upon the instructor as "to respond as a reasonable and prudent exercise professional in a similar situation." Duty has two elements, and they are:

The first element of this duty is that the instructor must act reasonably and prudently.

The second element is that it requires the instructor to act reasonably and prudently in a similar situation. A similar situation means that if a student is injured in one of your classes years before because they were repeatedly performing uncontrolled neck circles, the instructor may not be liable. If, at the time, the student was performing these uncontrolled neck circles and they were industry standard, the instructor would not be liable.

All states have statues of limitations. These statues require that an injured party sue within a certain time frame. For example, Illinois civil procedure requires that a person must sue within a two-year time period for certain types of personal injuries.

Failure to Perform That Duty

The second element of negligence would be failure to respond as a reasonable and prudent exercise professional in a similar situation. To prove an instructor or club failed in some way to respond reasonably, the court would look towards industry-wide standards.

Proximate Cause

The third element of negligence is proximate cause. This requires that the injury actually be caused by the fitness professional. This means that the instructor can "do" something to encourage an injury.

Damage

Remember that there has to be damage before an instructor can be sued. Damages are calculated by adding up the expenses relating to the injury.

Necessary Forms

Health History Forms

Health History Forms are the norms in the fitness industry. These forms are used to determine whether an individual should exercise or not. Remember that these forms can act as a double-edged sword because the more you know, the more you are liable.

Waivers of Liability
May 1987, the State of Illinois Supreme Court decided a landmark case for the fitness industry that supported Waivers of Liabilities. The case, Larsen v. Vic Tanny International, confirmed that an individual who knew of the dangers which may cause and injury and who realized the possibility of injury and who entered into a contract not to sue a health club voluntarily, can waive the right to sue if they become injured. In other words, if you require your clients to sign a waiver of liability and/or an informed consent prior to beginning an exercise program, they may not be able to sue you if they become injured.

Legal Music

The 1976 Copyright law states that " the copyright owner has the right to charge a fee for the use of his/her music in public performance." Public performance is a general term which includes health clubs, aerobic studios and church basements. In the United States licensing fees must be paid to each of the two major performing rights organizations: American Society for Composers, Authors, and Publishers (ASCAP) and Broadcast Music Inc. (BMI). You legally are responsible to pay for the rights to use the event if he legally produced the music.

LEGAL MUSIC SOURCES

Dynamix	1-800-843-6499
Music Mixes	1-800-526-4937
Power Productions	1-800-975-7771
Reggaerobics	1-619-793-2493

Marketing

Marketing is very important to any organization or individual. For example, Tami Lee Webb markets herself as a fitness professional and has sold numerous exercise videos. Her name is recognized by most fitness people.

How do you market yourself?

First, have business cards printed and pass them out at the Conventions/Conferences.

Second, find a niche in the industry. Maybe you would prefer to work with Seniors. It is recommended that you become an expert in that area.

Third, polish up that resume.

Fourth, make contacts in the industry.

Fifth, treat others as you would want to be treated yourself. The ideas can go on and on.

Chapter 19
Nutrition

Basic Nutrition

There are six essential nutrients, and they are: Carbohydrates, proteins, Fats, Vitamins, Minerals and Water.

Carbohydrates
One gram of carbohydrates is equal to 4 calories. There are Simple and Complex Carbohydrates.

Simple are the sugars and fruits.

Complex are the pastas, rice and breads.

Daily requirement 50-60% of daily calories.

Proteins
One gram of protein is equal to 4 calories. There are Complete and Incomplete proteins.

Complete are animal sources.

Incomplete are plant sources.

Daily requirement 12-15% of daily calories.

Fats
One gram of fat is equal to 9 calories. They are Saturated, Monounsaturated and Polyunsaturated.

Saturated is solid at room temperature and comes mostly from animal sources. LDL cholesterol increases and decreases the HDL cholesterol.

Monounsaturated is more liquid and comes from vegetable sources. Examples are olive oil or nuts. The LDL cholesterol decreases, and the HDL cholesterol increases.

Polyunsaturated is liquid and comes from vegetable sources. Examples are Safflower oil and Corn Oil. The LDL and HDL cholesterol both decreases.

Fat should comprise 20-30% of daily calories.

Vitamins
Vitamins are defined as a class of organic substances containing substances that act primarily as regulators of numerous physiological processes in the body. There are fat soluble and water-soluble classifications.

Fat Soluble include A, D, E, and K. They are absorbed at the small intestines in the presence of bile.

Water Soluble includes the B complex and C. Excess water soluble vitamins are generally excreted in the urine.

Minerals

Minerals are defined as inorganic elements found in nature that are essential to life processes. They are classified as Major and Trace.

Major Minerals are those that are needed in levels greater than 100 mg/day. They include: calcium, phosphorus, magnesium, sodium, potassium, and chloride.

Trace Minerals are those that are needed in much lower amounts. They include: fluorine, chromium, manganese, cobalt, copper, iron, zinc, selenium, molybdenum, and iodine.

Water

Is needed for bodily functions.

Chapter 20
Equipment

There is a variety of equipment created especially for aquatic fitness classes, but you can also utilize objects that may be found be found around the pool or in your "kid fit" children's program closet. The equipment includes but is not limited to the following:

Competitive Swim Equipment
*Flutter boards-use for pushing, pulling or kicking
*Pull buoys-use as a buoyancy aid or for arm work
*Hand Paddles-used for pushing, pulling upper body work
*Webbed Gloves-used to improve the push pull motion, upper body work

Toys
*Hula Hoops-use for stretching, aerobics, hand work and games
*Balls-use for coordination work, balance and fun

Aquatic Equipment
*Belts-use for deep water work
*Arm cuffs-use for deep water and abdominal work
*Vests-use for deep water work
*Water dumbbells-use for upper body and waist work
*Steps-use for aerobic work, toning and balance
*Logs/Noodles-use for deep water, abdominal, upper body work and stretch work.
*Tubing/Bands-can be used for upper body and stretching work.

Other
*Sponges-use for strength and hand work
*Plastic chairs-use for aerobic toning and balance work

Be creative and have fun using the various types of equipment during your classes. Remember, to practice first and to utilize the following set of safety guidelines.

Guidelines for Using Equipment

Using equipment in an aqua class can increase the intensity of a movement as well as create a fun atmosphere. It is very important to educate the participants about the usage of the equipment.

Remember the following when using equipment in your class:
*An increase in the rate of movement will cause an increase in intensity.
*Pay attention to the body's position, equipment does affect body alignment.
*Pay attention to buoyancy equipment, can cause injuries when not used properly.
*Hold equipment with a relaxed grip.
*Do not exceed normal range of motion.
*Avoid full extension.
*Always check to ensure that the equipment fits properly and adjusts.
*When working with buoyancy equipment, take your time.
*Consider pool temperature. Make sure participants stay warm at all times.

Glossary

Abduction is a movement away from the midline of the body

Acceleration is the reaction of a body as measures by its acceleration is proportional to the force applied.

Action/Reaction is for every action there is an equal and opposite reaction.

Acute injury is an injury which is sudden onset and short duration.

Adaptation is the ability of a system or organ to adjust additional stress or overload over time, by increasing in strength or function.

Adduction is moving a limb toward the midline of the body.

Adenosine Triphosphate is a chemical compound that is the most immediate chemical source of energy for a cell.

Aerobic is a source of energy production for fueling prolonged exercise.

Agility is the ability to rapidly and fluently change body positioning during movement.

Agonist is the muscle of a pair that is actively contracting at any given time. Also called the prime mover.

Alignment is proper posture.

Amenorrhea is the absence of menstruation.

Anorexia Nervosa is a psychological condition manifested by a refusal to eat to achieve an abnormally thin appearance.

Antagonist is the muscle of a pair that is relaxed or stretched when the other muscle of the pair is contracting.

Anatomical Position is the body in an upright, erect position with the forearms supinated and all joints in neutral position.

Aorta is the large artery stemming from the left ventricle of the heart which blood goes through on its way to the body.

Appendicular Skeleton refers to the bones associated with the “appendages” and includes the bones in the arms, shoulders, legs and hips.

Anaerobic is a source of energy for fueling short term exercise.

Arteries carry oxygenated blood from the heart muscle to all parts of the body.

Arthritis is the inflammation of a joint.

Asthma is the constriction of the airway passages.

ATP-PC is a source of energy providing immediate fuel.

Atrophy is the loss or wasting of muscle tissue or function through lack of use or disease.

Axial Skeleton consists of the bones found around the “axis” or imaginary midline of the body including the skull, vertebral column, sternum and the ribs.

Balance is the controlling the position of the body’s center of gravity, or maintenance of equilibrium while stationary (static balance) or moving (dynamic balance).

Ballistic Stretching is bouncing, tugging or overstretching a muscle which can actually cause the muscle to tighten instead of relax. Elicits the stretch reflex arc.

Beats are regular pulsation’s having an even rhythm.

Body Composition is the body’s relative percentage of fat as compared to lean tissue (bones, muscles and organs).

Bronchial Tubes are smaller branches of the bronchi in the lungs.

Bulimia is a condition characterized by an abnormal increase in hunger along with a binge-purge syndrome.

Buoyancy is the force that is exerted on an object by the fluid in which it is submerged; mathematically, this force equals the volume of the fluid displaced times its density.

Bursitis is the inflammation of the bursa, which is a synovial lined sac of fluid that helps reduce friction between tendon and bone or tendon and ligament.

California Style is a type of choreography used in teaching a class.

Carbohydrates are compounds composed of simple sugars or multiples of them.

Calories are a measurement of energy or units of heat.

Capillaries are where the arteries and veins meet. Very thin membranes which readily allow the exchange of oxygen and nutrients for carbon dioxide and waste products through their walls.

Cardiac Output is the amount of blood circulated per minute.

Cardiovascular Disease is a disease of the heart and blood vessels.

Cardiovascular System is comprised of he heart, blood vessels and blood. It distributes oxygen and nutrients to the cells. Removes carbon dioxide and waste from the cells. Maintains the acid-base balance of the body.

Central Nervous System is the brain and spinal cord.

Cervical is the part of the vertebral column found in the neck and contains 7 smaller vertebrae.

Choreography is the arrangement or written notation of a series of movements.

Chronic Injury is an injury with a long onset and long duration.

Circumduction is the movement at a joint is a circular direction (arm circles).

Circuit Training is a station formatted workout. Stations can train an individual aerobically or in muscular strength and endurance, or a mixture of the two. Usually, equipment is utilized.

Component is the smallest part or segment in choreography. A knee lift, kick or jumping jack would be considered a "move" or basic component of choreography.

Concentric Contraction is the contraction where the muscle is creating tension while shortening or contracting.

Contractility is the ability of muscle tissue to shorten and thicken, or to contract when it is stimulated to do so.

Coordination is the integration of many separate motor skills or movements into one efficient movement pattern.

Coronary Arteries are the blood vessels in the heart.

Coronary Heart Disease (CDH) is also known as coronary artery disease (CAD) in which arteriosclerosis develops in the arteries of the heart.

Diabetes is a blood sugar disorder, characterized by chronically elevated blood glucose levels in the body.

Diastasi Recti is the separation of the abdominal muscle which may occur during pregnancy.

Drag is the fluid-dynamic resistance that acts upon an object which is moving through a particular fluid.

Eccentric Contraction is retaining tension in a muscle as it lengthens.

Elasticity is a property which allows a muscle to return to its original shape after it is contracted or extended.

Evaporation is the loss of body heat through the sweating mechanism. The evaporation of sweat from the skin cools the body.

Excitability is a property of muscle which allows the muscle to receive and respond to stimuli.

Exercise Behavior are the behaviors that motivate an individual to initiate and maintain regular exercise. It also dictates how a person chooses to exercise.

Extensibility is a property in muscle which allows the muscle to stretch.

Extension is the returning to anatomical position.

Fast Twitch Muscle Fibers is a “white” muscle fiber characterized by its fast speed of contraction and a high capacity for anaerobic glycolysis.

Fats are lipids as a whole are referred to as fats.

Flexibility is the ability of limbs to move at the joints through a normal range of motion.

Flexion is moving out of anatomical position.

Frontal Plane is an imaginary longitudinal section that divides the body into anterior and posterior halves.

Frontal Resistance results from the horizontal forces of the water.

Heat Cramps is the overexposure to heat combined with inadequate rehydration causing muscle cramping (calf cramping is common).

Heat Exhaustion is the overexposure to heat combined with inadequate rehydration can cause heat exhaustion. The symptoms are pale, clammy skin; profuse sweating; dizziness; weak, rapid pulse; shallow breathing; nausea; headache and loss of consciousness.

Heat Stroke is the overexposure to heat combined with inadequate rehydration can cause heat stroke which is a medical emergency. The symptoms are hot, dry, very red skin; generally, no perspiration; rapid and strong pulse; labored breathing; loss of consciousness.

Hydrostatic Pressure is the pressure exerted by molecules of a fluid upon an immersed body.

Hyperextension is going beyond neutral extension.

Hypertrophy is a term used to describe an increase in the size, girth or function of muscle tissue.

Independent Contractor is a person responsible for carrying his or her own insurance policy, responsible for all liability and taxes paid to the government.

Inertia is an object that remains at rest or in a state of uniform motion unless acted on by force.

Informed Consent Form is a signed form documenting that the client has been fully informed of the risks and possible discomforts involved in a physical fitness program.

Insertion is at the distal end of the bone (the end further forms the body) and tends to more mobile.

Isokinetic is a type of muscular contraction where movement occurs at the joint as in an isotonic contraction, however the tension remains constant as in an isometric contraction.

Isotonic are muscle contractions where the muscles shorten and lengthen, and movement occurs at the joint.

Karvonen's Formula is a mathematical equation which figures in heart rate reserve for determining a target heart rate range. Personalizes heart rate measurement by factoring in a person's resting heart rate.

Kyphosis is an abnormal curvature of the spine. Kyphosis (humped back) refers to an exaggerated curve in the thoracic region. The head is often too far forward with round shoulders and sunken chest.

Lateral is a term used in exercise to describe one body part's position in relation to another. Lateral means "away from the midline".

Left Atrium is the receiving chamber of the heart where the oxygenated blood arrives from the alveoli in the lungs.

Left Ventricle is the sending chamber of the heart that pumps the oxygenated blood out of the heart.

Level I is standing in an upright position and rebounding, or pushing off from the pool bottom.

Level II is flexing at the hips and knees to lower the body to a position where the shoulders are at the water's surface. The feet will still contact the pool bottom but without the rebounding or jumping forces.

Level III is flexing at the hips and knees to the lower body position where the shoulders are at the water's surface while keeping the feet elevated from the pool bottom for several counts.

Lever are the rigid bars that turn an axis. The axis or fulcrum can be visualized as a pivot point. In the body the bones represent the rigid bars, and the joints are the axis (fulcrum).

Linear Progression is a style of choreography where a series of moves are performed without a predictable pattern.

Lordosis is an abnormal curvature of the spine. Lordosis (bent backward) is an increased concave curve in the lumbar region of the spine. Lordosis is often accompanied by an increased anterior pelvic tilt. The abdomen and the buttocks will protrude and the arms hang farther back.

Lumbar is the low back area of the vertebral column and consists of 5 large vertebrae.

Max VO2 is the maximum oxygen the body can use.

Medial is a term used in exercise to describe one body part's position in relation to another. Medial means "toward the midline".

Metabolic Respiration is the conversion of chemical energy to mechanical energy needed for muscular contractions.

Metabolism is the sum of all chemical processes occurring within a living cell or organism.

Monounsaturated are when there is only one point of unsaturation in the chain of fatty acids.

Motor Unit consists of one motor neutron and all of the myofibril it stimulates.

Muscular Conditioning is a segment of class designed to isolated specific muscle groups in order to promote strength and/or endurance through resistance training.

Muscular Endurance is the capacity of a muscle to exert force repeatedly, or to hold a fixed or static contraction over time.

Muscular Strength is the maximum force that can be exerted by a muscle or muscle group against resistance.

Myofibrils are protein filaments that bundled together make the fibers that bundled together which make muscles.

Neutral Buoyancy is the gravity-versus-buoyancy relationship that results from the force of weight being equal to the force of buoyancy (causing the object to remain suspended at some intermediate point within the fluid).

Nutrients are components of food that help to nourish the body by performing any of the following functions: provide every, serve as building material, help maintain or repair body parts, promote or sustain growth, and regulate or assist body processes.

Overload is a greater than normal stress or demand placed upon a physiological system or organ typically resulting in an increase in strength or function.

Overtraining is excessive exercise.

Plantar refers to the bottom surface of the sole of the foot.

Plantar Fasciitis is a condition that most commonly affects the heel of the foot. May factors, such as leg length discrepancies, foot mechanics, lack of gastronomies and soleus flexibility, training shoes (fit, type or lack of), stride length and running surfaces have been studied in relation to the cause of plantar fasciitis.

Polyunsaturated refers to the triglyceride in which two or more carbons have double bonds.

Posterior means “behind” and is a term used in exercise to describe one body part’s position in relation to another.

P.R.I.C.E. is the First Aid response to injury. Protection, Rest, Ice, Compression and Elevation.

Progressive Overload is a gradual and systematic increase in the stress or demand placed upon a physiological system or organ to avoid the risk of chronic fatigue or injury.

Pronation is rotating or turning the forearm inward, so the palm of the hand is facing behind in anatomical position.

Prone refers to the body lying in a “face down” position.

Proteins are compounds composed of carbon, hydrogen, oxygen and nitrogen.

Proximate means to physically hold the separated abdominal muscle together while performing an exercise.

Proximate Cause is an element of negligence that requires that the injury be caused by the fitness professional.

Pulmonary Disease limits the body’s ability to provide oxygen to the body’s tissues.

Radiation is the loss of body heat through vasodilation of surface blood vessels. Heat radiates from the body into the surrounding environment.

Reaction Time is the amount of time elapsed between stimulation and acting upon the stimulus.

Relative Velocity is the speed of one object as measured in respect to the speed of another object.

Respiratory System is made up of the lungs and a series of passageways leading in to and out of the lungs.

Reversibility is the principle that states that the body will gradually revert to the pre-training status when it does not exercise.

R.I.C.E. is the Basic First Aid response for injuries. Rest, Ice, Compression and Elevation.

Right Atrium is the receiving chamber of the heart where the blood first arrives from the body.

Right Ventricle is the pumping chamber of the heart which sends the blood to the pulmonary artery to the lungs.

Rotation refers to the movement around the long axis of the limb.

The Sagittal Axis is a line from the front of the body to the back at about the waist height.

Sagittal Plane is an imaginary plane that divides the body from the right side to the left side. It is also referred to as the median plane.

Saturated is a triglyceride which has hydrogen attached to every available bond on the carbons. It is a type of fat that is solid at room temperature.

Scoliosis is an abnormal shaped curvature of the spine.

Shin Splints are medial tibial syndrome.

The Skeletal System is all the bones of the body.

Slow Twitch Muscle Fibers are the red muscle fibers characterized by its slow speed of contraction.

Specificity is a principle which states that only one part of the system or body is overloaded.

Speed is the rate at which movement or activity is performed.

Static Stretching is when there is no joint movement. It is a stretch and hold.

Stroke is an obstruction of the artery leading to the brain.

Stroke Volume is the amount of blood pumped from each ventricle each time the heart contracts/beats.

Superior is a term used in exercise to describe one body's part position in relation to the other. Usually means toward to head.

Supination is rotating the palms outward, so it faces forward.

Supine refers to the body lying in a face up position. Spine on the floor.

Swimmer's Ear is caused by a bacterial infection resulting from not drying out the ear adequately.

Tempo is the rate of speed at which the beats of the music occur.

Tendonitis is inflammation of the tendon.

Tendons are very strong fibrous connective tissue which connects muscle to bone.

Thermal Warm Up is the process to increase the core body temperature.

Thoracic is the part of the vertebral column found between the rib cage and consists of 12 mid-sized vertebras.

Transition occurs when there is a change from one move to another.

Transverse Plane is an imaginary plane which divides the top half of the body from the bottom. Also referred to as the Horizontal Plane.

Turbulence disturbs or disrupted water flow.

Variability is the varying of intensity, duration or mode of the exercises.

Veins are the small pipes that carry blood back to the heart.

Vitamins are essential nutrients needed in tiny amounts to the diet.

Vocal Cords are a pair of membranes covering muscles and ligaments located in the mid throat.

Vocal Injury is the abuse of the vocal cords.

Waiver of Liability is an agreement between the club and the client that the client blankly agrees not to sue should the client become injured.

Water is an essential nutrient.

Water Tempo is an appropriate rate of speed used in the aquatic environment to allow for slower reaction time and full range of motion in water choreography.