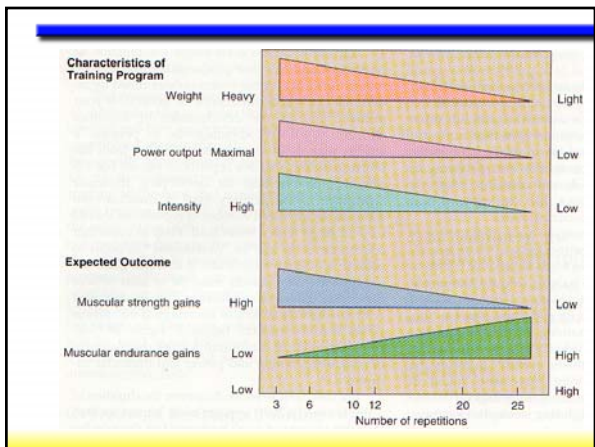
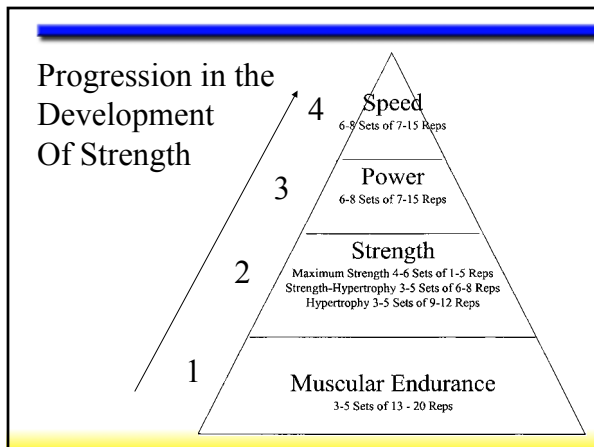
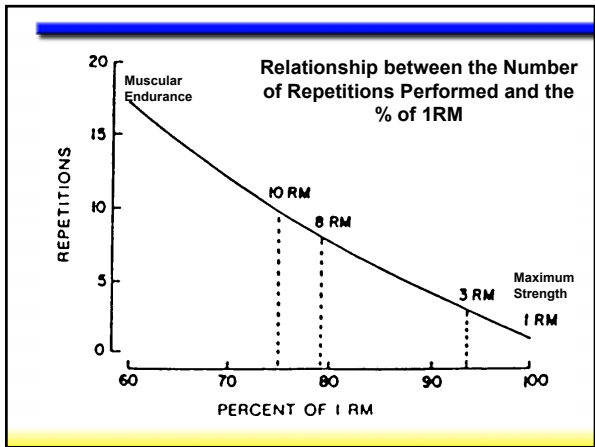
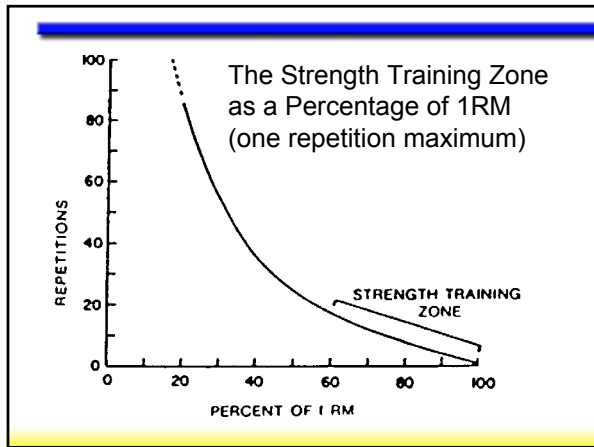
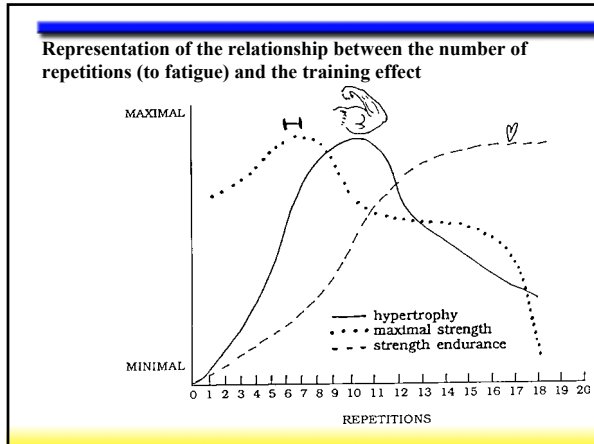




### Basic Training Principles

- Individuality**—Consider the specific needs and abilities of the individual.
- Specificity**—Stress the physiological systems critical for the specific sport.
- Disuse**—Include a program to maintain fitness.
- Progressive overload**—Increase the training stimulus as the body adapts.
- Hard/easy**—Alternate high-intensity with low-intensity workouts.
- Periodization**—Cycle specificity, intensity, and volume of training.





### RESISTANCE TRAINING PROGRAM DESIGN CONSIDERATIONS

1. Sport requirements - desired outcome(s)
2. Athletes characteristics - maturity (developmental age), previous sport/resistance training experience
3. Exercise selection - balance and sequence
4. Training method -
 

Method/Effect	Reps	Load (% 1 RM)
Maximum Strength	1-5	85.6 - 100.0
Strength-Hypertrophy	6-8	78.6 - 83.1
Hypertrophy	9-12	70.3 - 76.5
Strength-Endurance	13-20	60.6 - 68.8

 (4-6 Sets)  
 (3-5 Sets)
5. Variety (a change every 2 weeks) Load (intensity), Volume (sets x reps), Exercise, Tempo/rate, Contraction type (conc., ecc., isom.), System (circuit, super sets, pyramiding).

### RESISTANCE TRAINING GUIDELINES FOR HEALTHY ADULTS

1 Set of  
 8 to 12 Repetitions for each of  
 8 to 10 Exercises  
 done 2 days per week

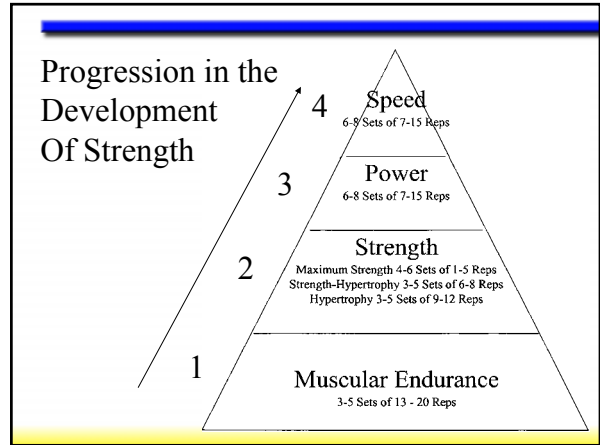
Stage	Sets	Reps	Intensity	RPE	Frequency
Beg.	1	8-12	30-40% 1-RM (upper) 50-60% 1-RM (legs/hips)	"light" Borg* 12-13	2 days / week
Int.	1	8-12	35-45% 1-RM (upper) 55-65% 1-RM (legs/hips)	"hard" Borg* 15-16	2 days / week
Adv.	1	8-12	50-55% 1-RM (upper) 70-75% 1-RM (legs/hips)	"max effort" Borg* 19-20	2 days / week

\*original 7-20 Borg Scale Rating of Perceived Exertion

"Good Form" is critical with each Exercise

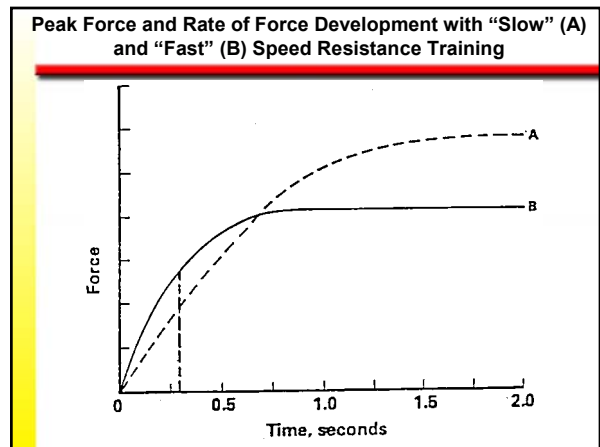
Advanced persons must go to "fatigue" or maximum effort

Adapted from Frigoletto, M.S. and Pollock, M.L. Prescription of resistance training for health and disease. Med. Sci. Sports Exerc. 1984; 16: 334-339.



### DEVELOPMENT OF POWER (SPEED AND STRENGTH)

1. Slow Speed + high force = Maximal Tension = **MAXIMAL STRENGTH GAINS**
2. High Speed + low force = Minimal Tension = **MAXIMAL SPEED GAINS**
3. Speed/strength = SPEED X STRENGTH (power)  
 both need to be trained by athlete



## DEVELOPMENT OF POWER (SPEED AND STRENGTH)

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**POWER** = **SPEED** X **STRENGTH**  
 (SPEED/STRENGTH)

ATHLETES CAN  
INCREASE  
BY 10-20%

ATHLETES CAN  
INCREASE  
BY 300-500%

Power = (force x distance)/time

## ALACTIC (SPEED) STRENGTH TRAINING

(Alactic Strength Training - SPORTS Vol.12#7/92)

1. **EXPLOSIVE MOVEMENT**  
 Mind Set - prepare for maximal effort/high arousal for every repetition  
 Pre-Load - quickly reverse the bar movement at the point of maximal stretch  
 Acceleration - accelerate the bar as rapidly as possible at the start of the movement  
 Momentum - although the bar has momentum, maintain effort through the movement
2. **Set the Load at 70-75% of 1 RM**
3. **Exercise Guidelines**

	Multi Joint	Single / Double	Circuit Style
Work Time	12-15s	10-12s	10-12s
Repetitions	6-8	6-8	6-8
Rest Interval (sec)	150-180	150-180	150-180
Number of Sets	7-15	7-15	7-15

## ALACTIC (SPEED) STRENGTH TRAINING

(Alactic Strength Training - SPORTS Vol.12#7/92)

4. **Comments and Precautions**  
 Stop the exercise when the #number of repetitions/set falls by 25%  
 End the set when there is a breakdown in technique or compensatory movements are added towards the end of a set  
 Failure to complete a set may signal the need to stop training for that session  
 Avoid 'bouncing/bottoming out' and letting bars strike the body  
 Athletes may experience some muscle stiffness/sorness for 2-3 days following 'heavy' alactic strenght training (due to eccentric loading)

## SUMMARY OF RESISTANCE TRAINING PROGRAM FORMATS

RESISTANCE TRAINING METHOD	LOAD (% 1 RM)	# REPS	#SETS	REST	TEMPO
Strength-Endurance	60.6 - 68.8	13 - 20	3 - 5	2.5 - 3.0	Mod
Hypertrophy	70.3 - 76.5	9 - 12	3 - 5	2.5 - 3.0	Slow
Strength-Hypertrophy	78.6 - 83.1	6 - 8	3 - 5	2.5 - 3.0	Slow
Maximum Strength	85.6 - 100	1 - 5	4 - 6	2.5 - 3.0	Slow
Alactic Strength multi-joint exercise	70.0 - 75.0	6 - 8	7 - 15	2.5 - 3.0	Explosive
Alactic Strength single/dbl joint ex.	70.0 - 75.0	6 - 8	7 - 15	2.5 - 3.0	Explosive

## MACHINES AND FREE WEIGHTS

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<i>Machines</i>	
ADVANTAGES	DISADVANTAGES
1. Can efficiently isolate certain muscles.	Resistance usually moves through a predetermined path (difficult to strengthen synergistic or stabilizer muscles).
2. Safety: spotter not necessary.	Expensive
3. Easy to use: simply choosing a resistance with dial or pin.	Specific: need a variety of machines for all the muscle groups.
4. Faster workouts possible.	Difficult to train for speed due to construction of machine.
5. Can perform some exercises that cannot be duplicated with barbells or dumbbells e.g., lat pulldown.	Built for average-sized individual. Short or extremely tall individuals have difficulty with some machines.

## MACHINES AND FREE WEIGHTS

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<i>Free Weights</i>	
ADVANTAGES	DISADVANTAGES
1. Inexpensive	Training alone is possibly dangerous.
2. Mobile and versatile	Plates and collars must be manually adjusted to increase or decrease resistance.
3. Effective in developing smaller synergistic muscles from balancing the weights.	Difficult to isolate certain muscles.
4. Movement closely matches biomechanical action associated with sports skills.	Ballistic movements, i.e., throwing up the weight, are possible IF PROPER FORM NOT FOLLOWED.

## CONCURRENT STRENGTH AND AEROBIC TRAINING

Martin, A. and Johnson, M. (1996) Concurrent strength and aerobic training: a review. Coaches Report, Vol. 3, No. 2, pp. 12-15.

A concurrent strength and aerobic training program is one in which, for a specified period of time, the subject performs some activities that develop and/or maintain endurance or  $\dot{V}O_2^{\max}$  and others that improve strength.

Concurrent Training...

- can result in a significant improvement of both qualities
- does not appear to interfere with the development of endurance or  $\dot{V}O_2^{\max}$
- can result in strength gains similar to those observed when strength alone is trained

## CONCURRENT STRENGTH AND AEROBIC TRAINING

Martin, A. and Johnson, M. (1996) Concurrent strength and aerobic training: a review. Coaches Report, Vol. 3, No. 2, pp. 12-15.

Strength gains can significantly improve performance in aerobic-type efforts

Compared to a program where strength is trained alone, strength gains can be compromised as a result of concurrent training

**Effects of Aerobic Endurance Training and Strength Training on Health and Fitness Variables**

Variable	Aerobic Exercise	Resistance Exercise
Bone Mineral Density		
Body Composition		
• % Fat		
• Lean Body Mass	**	
Strength		
Glucose Metabolism		
• Insulin response to glucose		
• Basal insulin levels		
• Insulin sensitivity		
Serum Lipids		
• HDL		→
• LDL		→
Resting Heart Rate		**
Stroke Volume		**
Resting Blood Pressure		
• Systolic		**
• Diastolic		→
$\dot{V}O_{2\max}$		
Endurance Time		
Physical Function		
Basal Metabolism		

Patel, H.J. and Singh, V.A. Aerobic response to strength and fitness variables. Med. Sci. Sports Exerc. 1997; 29(1): 1-10.

## Resistance Training Principles

1. Individualization
2. Specificity
3. Overload
4. Adaptation
5. Progression
6. Development/Maintenance/Retrogression

## Acute Muscle Soreness

- ◆ Results from an accumulation of the end products of exercise in the muscles
- ◆ Usually disappears within minutes or hours after exercise



## Delayed-Onset Muscle Soreness (DOMS)

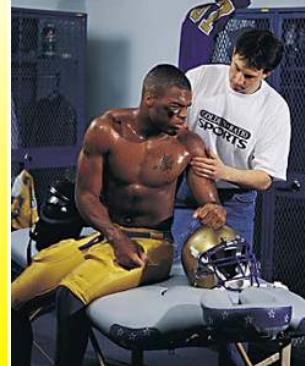
- ◆ Results primarily from eccentric action
- ◆ Is associated with damage or injury within muscle
- ◆ May be caused by inflammatory reaction inside damaged muscles
- ◆ May be due to edema (accumulation of fluid) inside muscle compartment
- ◆ Is felt 12 to 48 hours after a strenuous bout of exercise

## DOMS and Performance

- DOMS causes a reduction in the force-generating capacity of muscles.
- Maximal force-generating capacity returns after days or weeks
- Muscle glycogen synthesis is impaired with DOMS



## Delayed Onset Muscle Soreness



Unaccustomed exercise using eccentric muscle actions (downhill running, slowly lowering weights)

High muscle forces damage sarcolemma causing release of cytosolic enzymes and myoglobin

Damage to muscle contractile myofibrils and noncontractile structures

Metabolites (e.g., calcium) accumulate to abnormal levels in the muscle cell. This produces more cell damage and reduced force capacity

Delayed-onset muscle soreness (DOMS), considered to result from inflammation, tenderness, pain. The inflammation process begins. The muscle cell heals; the adaptive process is complete, and the muscle is more resistant to damage from subsequent exercise.

## Reducing Muscle Soreness

- Reduce eccentric component of muscle action during early training
- Start training at a low intensity, increasing gradually
- Begin with a high-intensity, exhaustive bout of eccentric-action exercise to cause much soreness initially, but decrease future pain

## Key Points

### Muscle Soreness

- Acute muscle soreness occurs late during or immediately after an exercise bout.
- Delayed-muscle soreness (DOMS) occurs 12 to 48 hours after exercise (especially eccentric exercise).
- DOMS may include structural damage to muscle cells or inflammatory reactions within the muscles.
- Muscle soreness may be an important part of maximizing the resistance training response.