Worksheet 6    Strength Training

• Improving Muscular strength and Endurance
Muscular Strength and Endurance in Daily Life

Benefits of Strength training:

- Reduce joint and/or muscle injuries from exercise
- Reduce low back pain
- Delay and reduce age-related decreases in strength
- Help prevent osteoporosis
- Increase resting energy expenditure (also called resting metabolic rate)
How Muscles Work

- There are about 600 skeletal muscles in the body.

- Muscles shorten or lengthen during muscle action, causing the bones and body to move.

Muscle structures: fibers, fascia, tendons

Muscle function is controlled by motor units: motor nerves and muscle fibers.
Structure of Skeletal Muscle

Figure 4.1
A Motor Unit: motor nerves & muscle fibers

Figure 4.3
Major Muscles of the Body

Figure 4.2
Muscle of the Day

_Pectoralis-_ major & minor

**Action**: Flexes and Adducts arms  
**Location**: Chest  
**Exercises to strengthen**:  
Free Weights: Bench Press, Flies  
Other Exercises: Push ups, dips

http://en.wikipedia.org/wiki/Pectoralis_major_muscle
Muscle of the Day

Trapezius

**Action**: Elevates shoulders and moves arms

**Location**: Upper back

**Exercises to strengthen**: Free Weights: Shoulder shrugs
Other Exercises: Upright rows

http://en.wikipedia.org/wiki/Trapezius
Muscle of the Day

**Bicep**

**Action:** Flexes arm

**Location:** Upper arm anterior

**Exercises to strengthen:**
Free Weights: Bicep Curl, Preacher Curl, Roman curl

**Other Exercises:** Pull Ups, Bench Press, Push Ups

http://exercise.about.com/cs/weightlifting/l/blsamplebicep.htm
Muscle of the Day

Tricep

**Action:** Extends Arm

**Location:** Upper arm posterior

**Exercises to strengthen:**
Free Weights: Tricep Extension, Tricep Kick-backs, Dips
Other Exercises: Pull Ups, Bench Press, Push Ups

http://exercise.about.com/cs/weightlifting/l/blsamplebicep.htm
Muscle of the Day

**Deltoids**

**Action:** Shoulder movement

**Location:** Shoulder abduction

**Exercises to strengthen:**

Free Weights: Lateral & Front Arms Raises

Other Exercises: Push Ups, Chest Press

Muscle of the Day

**Latissimus Dorsi**

**Action:** Extends trunk at the waist  
**Location:** Lateral mid-back region  
**Exercises to strengthen:**  
Free Weights: bent over row,  
Other Exercises: upright row, lat pull down, pull ups,

http://en.wikipedia.org/wiki/Latissimus_dorsi_muscle
Muscle of the Day

*Rectus Abdominus*

**Action:** Flexes trunk at the waist & aids with breathing  
**Location:** Ribs to pelvis  
**Exercises to strengthen:**  
Free Weights: Sit ups, crunches, leg lifts  
Other Exercises: Abdominal curl machine, Stability Ball curl ups (core workouts)

Muscle of the Day

Side Oblique

**Action**: turns trunk at the waist & aids with breathing

**Location**: Ribs to pelvis

**Exercises to strengthen**:

**Free Weights**: Abdominal Twists / crunches, leg lifts

**Other Exercises**: Abdominal curl machine, Stability Ball twist curl ups (core workouts)

Muscle of the Day

**Quadricep (4 Muscles)**

**Action:** Extends Leg at Knee joint

**Location:** Upper leg anterior

**Exercises to strengthen:**

Free Weights: Lunge, Squat, Wall Sit

Other Exercises: leg extension, leg press,

http://exercise.about.com/cs/weightlifting/l/blsamplebicep.htm
**Muscle of the Day**

**Gluteus Maximus**

**Action:** allows for power movements.. jumps, sprints, etc.

**Exercises to strengthen**

**Free Weights:** Lunge, Squat, Wall Sit

**Machine Exercises:** leg press, squat, dead lift
Muscle of the Day

**Hamstring (3 muscles)**

**Action:** Flexes Leg at Knee joint

**Location:** Upper leg posterior

**Exercises to strengthen:**

Free Weights: Lunge, Squat, Wall Sit

Machine Exercises: leg curl, leg press

http://www.floota.com/images/hamstring%20muscles.jpg
**Muscle of the Day**

**Gastrocnemius**

**Action:** Heel Raise  
**Location:** Posterior Lower leg  
**Exercises to strengthen:**  
- Free Weights: Heel Raises  
- Other Exercises: Seated Toe Press  
- Standing Toe Press

Three Major Categories of Skeletal Muscle Exercise

**Isotonic** (dynamic)
- Movement of a body part at a joint
- Most exercise and sports are isotonic

**Isometric** (static)
- Uses muscle tension but involves no movement
- Good way to develop strength after injury

**Isokinetic**
- Performed at a constant velocity
- Often done with machines that provide resistance throughout the full range of motion
Categories of Muscle Action

**Concentric action** (positive work)
- Causes movement of a body part against resistance or gravity
- Occurs when muscles shorten
- Example: upward arm movement during a bicep curl

**Eccentric action** (negative work)
- Controls movement of a body part with resistance or gravity
- Occurs when muscles lengthen
- Example: downward arm movement during a bicep curl
Concentric and Eccentric Muscle Actions

Concentric Action

Eccentric Action

Figure 4.4
Types of Skeletal Muscle Fibers

Three types:

**Slow-twitch fibers**
- Contract slowly
- Generate little force but are resistant to fatigue

**Fast-twitch fibers**
- Contract quickly
- Generate lots of force, but fatigue quickly

**Intermediate fibers**
- Combination of other two types: contract rapidly, produce great force and resist fatigue
Variations in Fiber Type

Most people have roughly equal numbers of all three types

Elite endurance runners/marathoners have more slow-twitch fibers

Elite speed runners/sprinters have more fast-twitch fibers

Some evidence exists that fibers might be able to convert from one type to another through training

**Fiber recruitment** is the process of involving more muscle fibers to increase muscle force
Muscle Fiber Recruitment and Muscular Force

Figure 4.6

Muscular Force Produced vs. Number of Muscle Fibers Recruited

Maximal Force Production
Time in Recruitment of Muscle Fiber Type

Figure 4.5

- Fast-Twitch
- Intermediate
- Slow-Twitch

Active Muscle Fibers (percent)

Exercise Intensity

Light  Moderate  High
Muscular Strength

Depends on:

Size of the muscle (primary factor)
  • The larger the muscle, the greater the force produced

Number of muscle fibers recruited during a movement
  • The more fibers that are stimulated, the greater the force generated
Principles for Designing a Strength and Endurance Program

1. Apply **overload principle** (lift greater weight than normal) use with strength and endurance exercise programs. Sometimes called Progressive Resistance Exercises

2. **Progression**: must progressively increase the amount of resistance in the training

3. Use **Specificity of Training**
   - Development of muscle strength and endurance is specific to both the muscle group being exercised and the training intensity
   - High-intensity training increases muscle size & strength
   - Low-intensity training increases endurance
How the Body Adapts to Strength Training

- **Rate of Improvement**
- Depends on initial strength level:
  - May have rapid strength gains in untrained people just starting out
  - More gradual gains in people with higher relative strength levels
How the Body Adapts to Strength Training

- **Physiological Changes**
- 1) increase in fiber recruitment (speed & number)
- 2) hypertrophy: increase in muscle size due to increase in fiber size
- Not common: Hyperplasia, the formation of new muscle fibers
How the Body Adapts to Strength Training

Gender Differences

- Women and men don’t differ in initial responses to strength-training.

- After long-term training, men show greater gains due to higher testosterone levels.
end
Evaluating Muscular Strength and Endurance

Muscular strength test:

1) One-repetition maximum (1 RM) test: determined with 10 RM
   - Measures maximum amount of weight that can be lifted one time
   - Can be substituted by the Estimated 1 RM Test, to reduce possible injury

Muscular endurance tests:

1) Push-up test
2) Sit-up or curl-up test
Safety Concerns

• Use spotters

• Don’t drop weights

• Always warm up

• Breathe during exercises

• Use slow movements, proper technique

• Start with light weights and work up gradually
Exercise Prescription for Weight Training (FITT)

**Frequency**
- Number of training days per week
- 2-3 days per week is optimal for strength gains

**Intensity**
- Measured by the Repetition Maximum (RM)
- The number of consecutive repetitions performed without resting is a Set

**Time (duration)**
- Total number of sets performed
- Programs utilizing 3 sets result in greatest strength gains

**Type (mode)**
- Choose exercises for muscle power & size, or for muscle endurance & toning
Designing a Weight Training Program - Major Muscles of the Body

Figure 4.2
Designing a Weight Training Program

• Start with large muscles and work down to small
• Alternate upper Body lifts with lower body lifts.
• Large Muscles and Lifts
  • Pectoralis: chest/bench press
  • Gluteus maximus: squats or leg press
  • Latissimus dorsi: lat pulldown
  • Quadriceps: leg extension
  • Deltoids and trapezius: Up-right row – shoulder shrugs
  • Hamstrings: leg curls
Designing a Weight Training Program

- **Small Muscles and lifts**
- Biceps: arm curls
- Rectus abdominis: ab curls & sit-ups
- Triceps: Tricep extensions
- External oblique: side ab curls
- Gastronemius: heel risers
Staying Motivated

- Make time to train regularly
- Make training fun — find a workout space or facility you like, and a program that’s challenging but enjoyable
- Develop a realistic routine: don’t make it so hard you’ll get discouraged
- Work out with friend or training partner
- Benefits of strength training: better appearance, higher self-esteem, improved metabolism, and a feeling of accomplishment
Summary

• Strength training can reduce back pain, decrease injuries, enhance bone health, and maintain age-related working capacity.

• Strength is dependent on muscle size and fiber recruitment.

• There are three major types of human skeletal muscles: slow-twitch, fast-twitch and intermediate.

• The amount of slow, fast, and intermediate muscles vary among individuals. There is a relationship between fiber type and success in some athletics.

• Fiber recruitment is the process of involving more muscle fibers to produce increased force.
Summary, continued

• Progressive resistance exercise (PRE) is the overload principle applied to resistance training

• Individualized programs can be specific for strength or endurance gains through mode, number of repetitions and sets

• Isotonic (dynamic) exercises involve movement. Isometric (static) exercises involve no movement. Isokinetic exercises are performed at a constant velocity, often using machines

• *Design a strength training program with at least 10 different lifts which work specific muscles. Know muscles scientific names, place in proper order with proper Sets and Reps.