Energy Systems
The body uses several different energy sources depending on the type/duration of activity:

ATP: Immediate and essential source for energy production

Creatine Phosphate: (synthesized in body or endogenously consumed from meats) Increases muscles’ immediate energy reserves of CP & ATP – but useful only for short term needs (e.g., sprinting or power-lifting)

- To utilize the chemical energy in foods, body cells must first convert it to ATP. A resting muscle only contains enough ATP in reserve to work at maximal capacity for 2 to 4 seconds.
- To produce more ATP for muscle contraction over extended periods, the body uses a number of sources.

High Intensity/Short duration (< 1 minute)
ATP / CP

- During periods of relaxation, muscles make creatine phosphate from ATP and creatine, which is derived from amino acids. When the muscle first contracts, and ATP is broken down into ADP, an enzyme is activated that transfers a high-energy phosphate from phosphocreatine to ADP, which reforms ATP.
- All by itself, this system could maintain maximal muscle contraction for about 10 seconds. However, energy from glucose and fatty acids also begin to contribute ATP to the muscle, so the PCr system ends up being the major energy source for about 1 minute.
- Can be activated instantly and can replenish ATP very quickly, fast enough to meet the energy demands of the fastest and most powerful sports events, including jumping, lifting, throwing, and sprinting.

High Intensity/Moderate Duration (30 seconds – 2 minutes)

- Glucose: Anaerobic
- Breakdown of glucose (CHO) without oxygen → lactic acid
- Can be activated quickly and provide high energy; however, there are several disadvantages:
  - It can’t sustain ATP production for long
  - Only about 5% of the energy available from glucose is released
  - The buildup of lactic acid in the muscles leads to fatigue

Lower Intensity/Longer Duration (2 minutes – 3+ hours)

- Requires oxygen (aerobic)
- ATP supplied more slowly, but can be sustained for hours
- Can use CHO, Fat, or Protein
  - Medium duration = CHO
  - Longer duration = Fat (more trained muscle = ↑% energy from Fat
  - Protein = very minor fuel source; when CHO stores depleted.

- Energy systems: muscles contract fast & when acted upon, don’t have time to metabolize fat & CHO – depend on quick energy compounds to power movement. Two are ATP / CP.
ATP: Present in small amounts in all body tissue all the time / Deliver energy instantaneously

CP: Activated immediately after onset of demand – before ATP stores are dwindled – replenishes ATP supplies / Last for ~10 seconds; enough to produce quick energy – without oxygen – for the 100m dash

Within first 20 mins, mostly glycogen for fuel (~1/5 of available). After 20mins, mostly fat for fuel

Food Labels
- What do we need to know on labels?
  - Serving Size, Calories, Fat, Sugar, Sodium, Ingredients List
  - Types of Claims (Un/Qualified)
    - Health Claim: Food/Supplement & reduction in risk of disease or health-related condition
      - Calcium, vitamin D & osteoporosis
      - Dietary fat & cancer
      - Sodium & hypertension
      - Dietary saturated fat, cholesterol & CHD
      - Fiber from grains, F&V and cancer / CHD
      - Fruits & vegetables and cancer
      - Folate & NTDs
      - Artificial sweeteners (that do not promote) cavities
      - Soluble fiber (from oats) and CHD
      - Soy & CHD
      - Plant Sterols & CHD
      - Whole grains & CHD/Cancer
      - Potassium & BP
      - Fluorinated water & cavities
      - Saturated fat, cholesterol & trans fat & heart disease
    - Nutrient Content
      - Gluten free
      - High, Low Fat, Fiber, Sodium, etc.
    - Structure/Function
      - Organic / Natural Foods
        - What distinguishes them?
    - Endorsements
      - AHA / Whole Grain

Dietary supplements
- FDA Regulation & Enforcement
- Commonly Deficient: Iron, Calcium, Vitamin D
  - Know/Assess Status
- Popular Supplements
  - Whey Protein/Protein Drinks
  - Daily Vitamin
  - Creatine
- Nutrient Interactions
  - Iron and: vitamin C, Zinc, Calcium, Caffeine
    - Consume within 1 hour before/after Iron-containing meal
  - Calcium and: vitamin D, Salt
- Mineral Imbalances/Over Supplementation
  - From fortified sources
Ex: Zinc can elevate cholesterol

- Appropriate Populations
  - Consuming <1500 cals/day
  - Allergies/lactose intolerance
  - Poorly balanced vegetarian diet

- NCAA approval
  - Resource Exchange Center: http://www.drugfreesport.com/rec/
  - Supplement: has <30% of calories from protein
  - Permissible for coaches to give athletes:
    - Vitamins and minerals
    - Energy bars
    - Calorie replacement drinks (for example, Ensure, Boost)
    - Electrolyte replacement drinks (for example, Gatorade, Powerade)
  - Difficulty with supplements is poor enforcement; may include banned substances

- Caffeine and energy drinks
  - Energy drinks are under-studied. Common ingredients: taurine, glucuronolactone (CHO), B-vitamins
  - Caffeine: lowered perceived exertion, diuretic, fat metabolism

- Effects before and after workouts
  - Popular Types:
    - Fitargo
    - Muscle Milk
    - Endurox
    - Whey Protein
    - Protein Shakes
    - Benefiber

Dietary Intake: Before/During/After Exercise (or competition)

- Intake Before Competition
  - Consume 1-4 grams of CHO per kg of body weight 1-4 hours prior to competition
    - 1 hour prior: choose 1 gram per kg
    - 4 hours prior: choose 4 grams per kg
  - The closer the meal is to exercise, the fewer calories that should be consumed
  - 200-800 kcals
    - 200-300 in the hour or two before
  - high in CHO & low in fat, protein & fiber
  - CHOss low - moderate in fiber & salt
  - tried & true familiar foods
    - Practice during training
  - Snack should contain 40-100g of CHO. Examples:
    - Milk, 12 crackers + 2 tbsp peanut butter (54g)
    - Banana and yogurt (56g)
    - Bagel with jelly & juice (83g)
    - 1 oz. Cereal and milk (50g)
    - Juice and pretzels (50g)
    - 16 oz. Sports drink (30g)
    - Sports/granola bar and water (20-50g)
    - Fruit: orange/banana/apple (15-25g)
    - Vegetable/chicken noodle/tomato soup & crackers (40-50g)
    - Other ideas: graham crackers, popcorn, string cheese, pita & hummus
• Intake During Competition
  o Consume 30-60g of CHO per hour of exercise
    ▪ Power Gel: 25g CHO
    ▪ 8 oz. of diluted sports drink: 7g CHO
    ▪ Cliff Bar: 52g CHO
  o Drink 4-8oz. of fluid every 15 minutes (avoid fluids that contain more than 14g of CHO per 8oz. serving)
  o Longer than 60-90 minutes, sports drinks: 40-80 cals/8oz. (homemade option: tea + honey)
  o Sports like soccer / basketball / hockey, require repeated periods of intense bursts, sugar is good – want it under 200 calories and low in fiber
  o Experiment to see what body tolerates

• Refueling/Recovery
  o Mixed meal/snack (carbohydrates and protein) after exercise
    ▪ Within 15-20 mins accelerates rate of glycogen storage by 300%.
    ▪ CHO consumption after 2 hrs post-exercise reduces glycogen synthesis by about 50% and impairs recovery
  o Drink plenty of water: 24 oz/lb of body weight lost
  o Eating foods with a high glycemic index is okay for athletes
    ▪ High intensity aerobic exercise (1 hour) depletes >50% of the liver glycogen
    ▪ 2½ hours depletes liver and muscle glycogen

Hydration and Electrolytes
• Before Exercise:
  o 1 or 2 hours before: 2-1/2 cups (20 oz.)
  o 15-30 min before: 1-1/2 cups (12 oz.)
  o Don’t trust thirst
  o Choose: Water, diluted fruit juice, sports drinks (6-8% CHO)
• During Exercise
  o 8 ounces every 15-20 minutes
  o Choose: Water, diluted fruit juice, sports drinks (6-8%), especially if exercise is > 60 minutes
• After Exercise
  o Drink 2 cups for each pound lost
  o Weigh yourself before and after exercise
  o Don’t trust thirst
  o Avoid caffeine and alcohol
  o Choose: water, fruit juice, carbo loading drinks
• Sports drinks: Concerns:
  o Dehydration
  o Gastric emptying
  o Recommendations:
    ▪ Pure H2O good, a little simple carbohydrate is probably better
    ▪ 2-4 liters per hour, if exercising longer than 30 minutes