

Sports and Nutrition

Module 11

Nov. 23

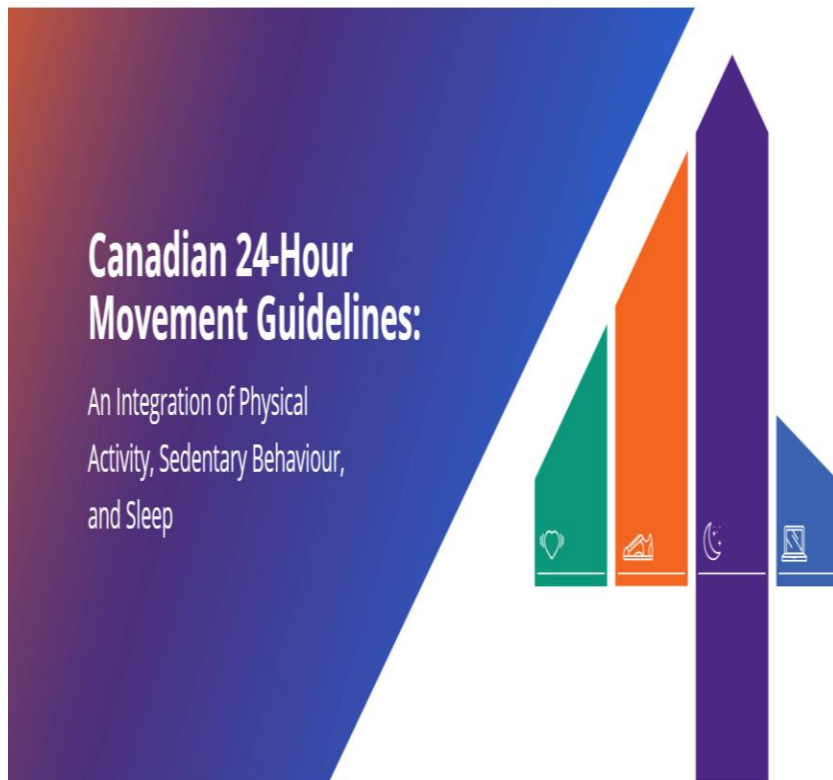
Mary Hendrickson

Book Chap 10

Fitness :

Characteristics that enable the body to perform physical activity; the ability to meet routine physical demands with enough energy to rise to a sudden challenge

Canada's 24-Hour Movement Guidelines



- New! offer clear direction on what a **healthy 24 hours looks like for ages: 0-4y, 5-17y, 18-64y and >65years.**
- Unique focus on how all movements all integrate together
- **3 Core Recommendations:**
- **Move More** – including moderate to vigorous physical activity, and light physical activity - including standing
- **Reduce Sedentary Time**
- **Sleep Well**

<https://csepguidelines.ca/>

CSEP Guidelines Adults-18-64

For health benefits, adults aged 18-64 years should be physically active each day, minimize sedentary behaviour, and achieve sufficient sleep.

A healthy 24 hours includes:

PHYSICAL ACTIVITY

Performing a variety of types and intensities of physical activity, which includes:



- **Moderate to vigorous aerobic physical activities** such that there is an accumulation of at least 150 minutes per week
- Muscle strengthening activities using major muscle groups at least twice a week



- Several hours of **light physical activities**, including standing

SLEEP



Getting 7 to 9 hours of good-quality sleep on a regular basis, with consistent bed and wake-up times

SEDENTARY BEHAVIOUR



Limiting sedentary time to 8 hours or less, which includes:

- No more than 3 hours of recreational screen time
- Breaking up long periods of sitting as often as possible



Replacing sedentary behaviour with additional physical activity and trading light physical activity for more moderate to vigorous physical activity, while preserving sufficient sleep, can provide greater health benefits.



Progressing towards any of these targets will result in some health benefits.

Benefits of Physical Activity

Restful sleep

Nutritional health

Optimal body composition and healthy body weight

Improved bone density

Resistance to colds and other infectious diseases

Strong circulation and lung function

Low risk of chronic diseases

Reduced risk of DM2

Low incidence and severity of anxiety and depression

Strong self-image

Long life and high quality of life in later years

Exercise and Chronic Disease Risk

Fitness will ultimately lead to body composition changes:

↑ LBM and ↓ fat mass

Type 2 DM

- Improves glucose tolerance
- ↓ blood pressure

CVD, Stroke

- ↓ serum lipids and cholesterol
- ↓ blood pressure

Osteoporosis

- Slows bone loss

Alzheimer's/ dementia

- May reduce risk
- Slows cognitive decline



"What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?"

FITT Principle

To Achieve and Maintain Fitness

- **Frequency**
 - 3-5 sessions per week
- **Intensity**
 - 50-90% of maximum heart rate
- **Time (duration)**
 - 30 minutes minimum
- **Type:**
 - Resistance— moderate intensity strength training
 - Endurance - cardiorespiratory
 - Flexibility— stretching the major muscle groups

ACSM Guidelines for Physical Fitness



	Cardiorespiratory	Strength	Flexibility
Type of Activity	Aerobic activity that uses large-muscle groups and can be maintained continuously	Resistance activity that is performed at a controlled speed and through a full range of motion	Stretching activity that uses the major muscle groups
Frequency	5 to 7 days per week	2 to 3 nonconsecutive d/wk	2 to 7 days per week
Intensity	Moderate (equivalent to walking at a pace of 3 to 4 miles per hour) ^a	Enough to enhance muscle strength and improve body composition	Enough to feel tightness or slight discomfort
Duration	At least 30 minutes per day	2 to 4 sets of 8 to 12 repetitions involving each major muscle group	2 to 4 repetitions of 15 to 30 seconds per muscle group
Benefits	Improve heart and lung function	Build muscle & bone mass and strength	Prevent injuries, back pain, and balance problems
Examples	Running, cycling, dancing, soccer swimming, skating, rowing, power walking, X country skiing. ... kickboxing, water aerobics	Pull-ups. push-ups. sit-ups. weightlifting, pilates	Yoga, tai chi

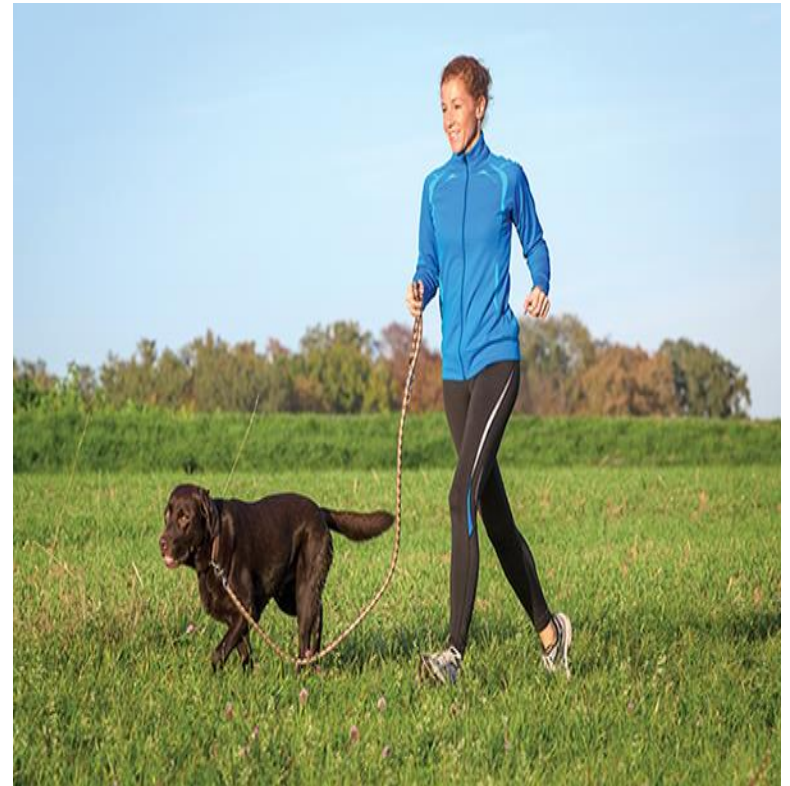
Levels of Physical Activity Intensity Compared

Level of Intensity	Breathing and/or Heart Rate	Perceived Exertion (on a Scale of 0 to 10)	Talk Test	Energy Expenditure	Walking Pace
Light	Little to no increase	<5	Able to sing	<3.5 kcal/min	<3 mph
Moderate	Some increase	5 or 6	Able to have a conversation	3.5 to 7 kcal/min	3 to 4.5 mph
Vigorous	Large increase	7 or 8	Conversation is difficult or "broken"	>7 kcal/min	>4.5 mph

SOURCE: Centers for Disease Control and Prevention, www.cdc.gov/physicalactivity/everyone; updated March 30, 2011.

Strategies To Build Fitness and Prevent Injuries

- Be active all week
- Use proper equipment and attire
- Use proper form
- Include warm-up and cool-down activities
- Challenge your strength and endurance a few times a week
- Pay attention to body signals
- Include at least one day of rest per week



True or False

Nutrition Strategies can be used to enhance athletic performance in sports.



Physique and Nutrition

Body shape, size and composition varies with

- Age
- Sex
- Heredity – and may be sport and event specific

Nutrient needs:

- Vary with athlete and type and length of event

GOAL: ‘Provide nutritional support to stay healthy and injury free while maximizing metabolic adaptations to training and improving performance’

Fuels used for Physical Activity (PA)

TABLE 14-4 Primary Fuels Used for Activities of Different Intensities and Durations

Activity Intensity	Activity Duration	Energy System	Preferred Fuel Source	Oxygen Needed?	Activity Example
Extreme	5 to 10 sec	Phosphagen system	ATP-CP (immediate availability)	No	100-meter sprint, shot put, golf or baseball bat swing, tennis or volleyball serve
Very high	20 sec to 2 min	Lactic acid system	ATP from carbohydrate (anaerobic glycolysis)	No	400-meter run, 100-meter swim, gymnastic routine
High	2 min to 20 min	Aerobic system	ATP from carbohydrate (glycolysis and TCA cycle)	Yes	Cycling, swimming, running
Moderate	> 20 min	Aerobic system	ATP from fat (fatty acid-oxidation and TCA cycle)	Yes	Hiking

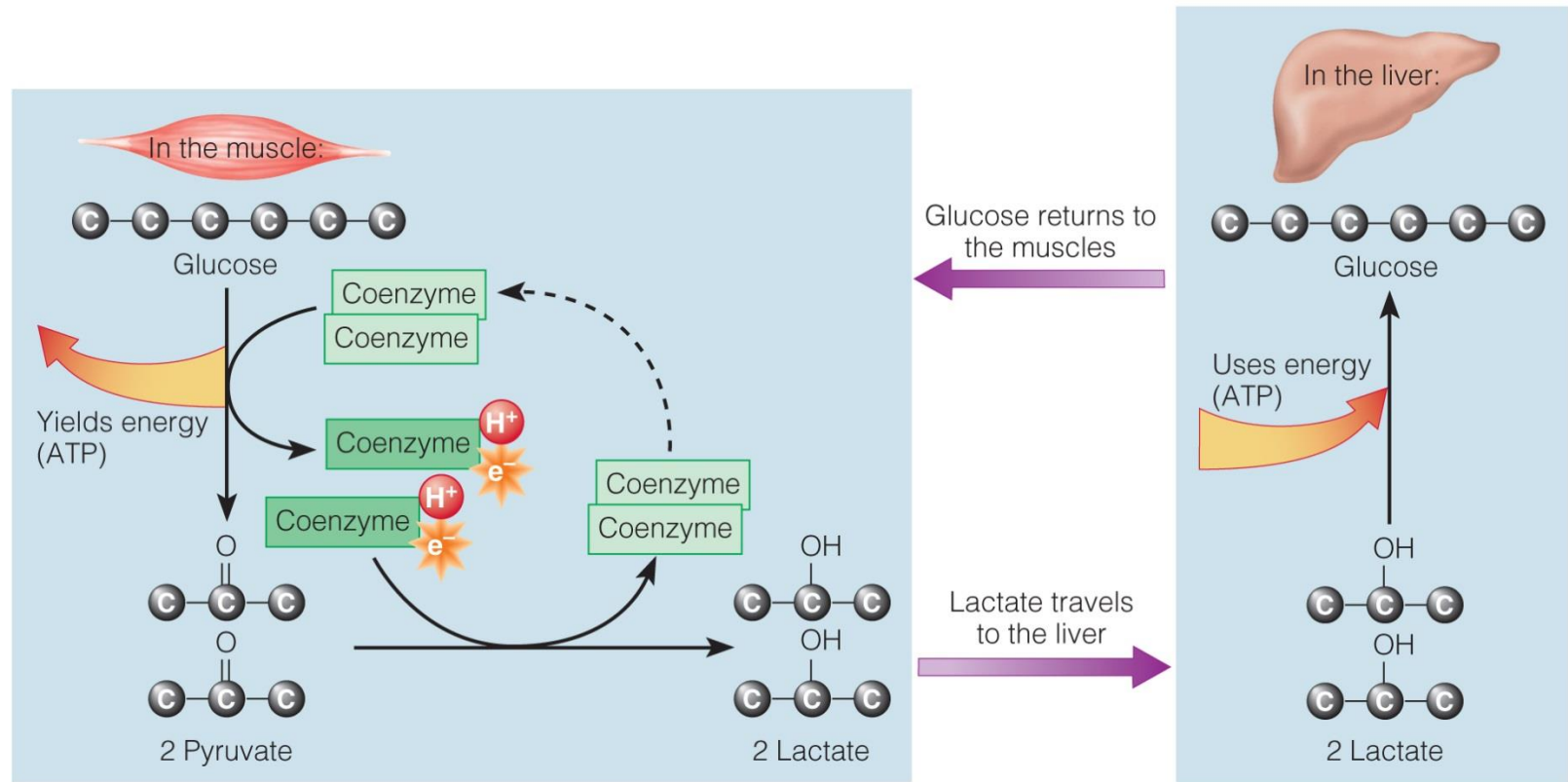
NOTE: All energy systems function at all times, but depending on the intensity of the activity and the conditioning of the athlete, one system will predominate at any given time.



Anaerobic Metabolism

- Energy provided by:
 - Circulating glucose
 - Muscle glycogen
- Rapid metabolism through glycolysis
 - Does not require oxygen
 - Lactate builds up
- Supports muscle contraction for 1-2 minutes
 - e.g. 30-second sprint, one resistance exercise set

FIGURE 7-7 Pyruvate-to-Lactate



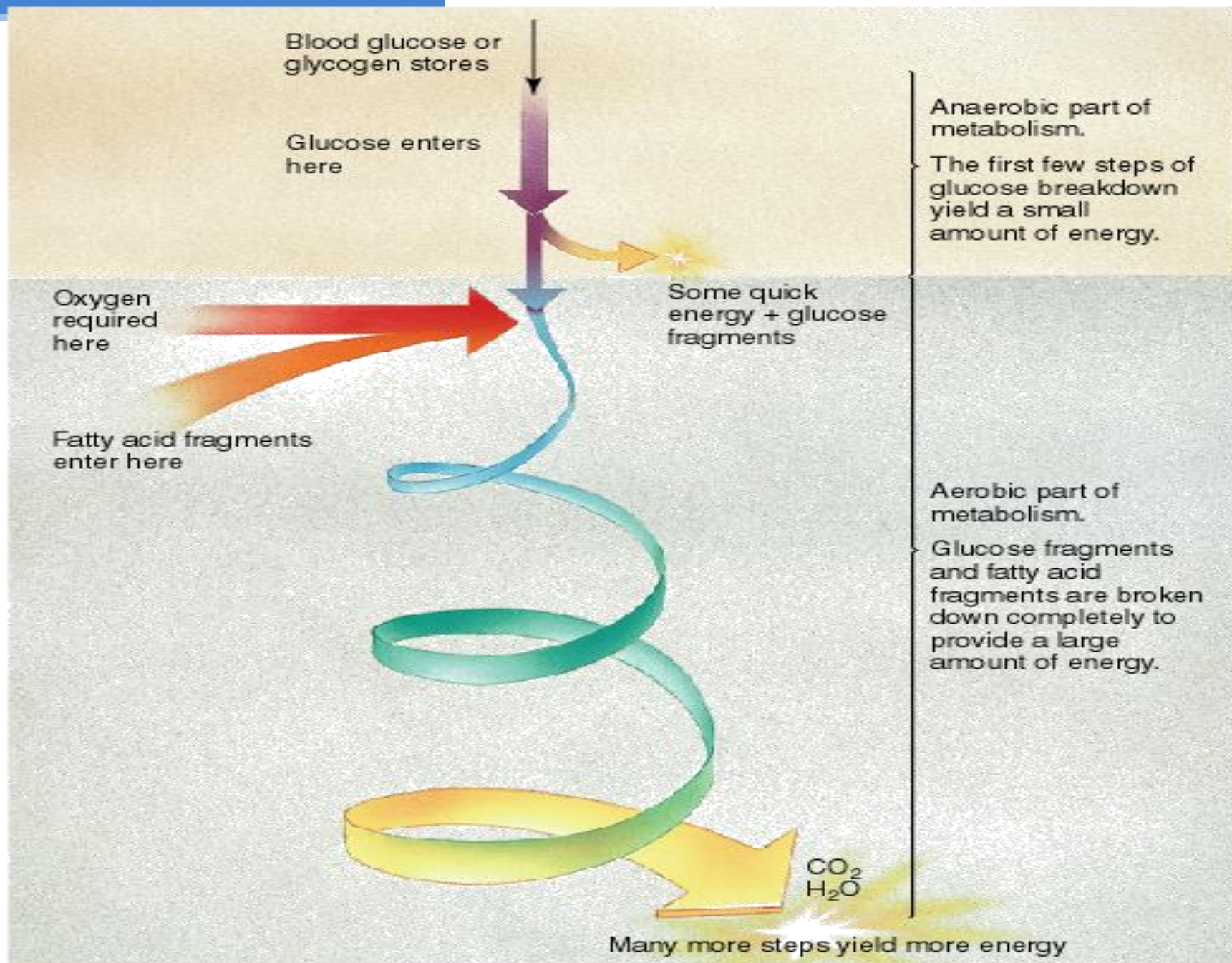
Working muscles break down most of their glucose molecules anaerobically to pyruvate. If the cells lack sufficient mitochondria or in the absence of sufficient oxygen, pyruvate can accept the hydrogens from glucose breakdown and become lactate. This conversion frees the coenzymes so that glycolysis can continue.

NOTE: Other figures in this chapter focus narrowly on the carbons of pyruvate. Its oxygen group is included in this figure to more clearly illustrate this reaction. See definitions for the chemical structures of pyruvate and lactate.

Liver enzymes can convert lactate to glucose, but this reaction requires energy. The process of converting lactate from the muscles to glucose in the liver that can be returned to the muscles is known as the **Cori cycle**.

Lactate

- Product of anaerobic glycolysis
- Accumulates during high-intensity activities
 - When accumulation rate exceeds rate of clearing, activity can only be sustained 1–3 minutes
- Lactate and fatigue
 - Lactate quickly leaves the muscles
 - Travels in the blood to the liver
 - Liver enzymes convert back into glucose



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NOTE: All energy systems function at all times, but depending on the intensity of the activity and the conditioning of the athlete, one system will predominate at any given time.



Aerobic Metabolism

- Energy provided by:
 - Circulating glucose
 - Muscle and liver glycogen
 - Adipose tissue triglycerides
- Metabolized via oxidative phosphorylation
 - Produces a large amount of ATP
 - Complete burning of oxygen to CO₂ and H₂O
- Supports muscle contraction for >3 minutes
 - e.g. 1500-meter run, marathon, etc.
- Aerobic activities **stimulate synthesis of mitochondria** to facilitate efficient aerobic metabolism

Macronutriments for exercise

Nutrient	Yields Energy?	Yields Glucose?	Yields Amino Acids and Body Proteins?	Yields Fat Stores?
Carbohydrates (glucose)	Yes	Yes	Yes—when nitrogen is available, can yield <i>dispensable/nonessential</i> amino acids	Yes
Lipids (fatty acids)	Yes	No	No	Yes
Lipids (glycerol)	Yes	Yes—when carbohydrate is unavailable	Yes—when nitrogen is available, can yield <i>dispensable/nonessential</i> amino acids	Yes
Proteins (amino acids)	Yes	Yes—when carbohydrate is unavailable	Yes	Yes

Glycogen Stored in the Body

- Glycogen stores about 2000 kcalories
 - Enough for about 32km of running
 - When glycogen depleted, muscles fatigue
- Amount of stored glycogen depends on diet
 - Higher carbohydrate diet = ↑ glycogen stores
- High-intensity activities use more glycogen



Duration of Activity Affects Glycogen Use

- Initially, body uses glycogen for fuel
 - With sustained aerobic activity, more fat and less glucose used
- Glucose depletion
 - Gluconeogenesis
 - 2 to 3 hours of strenuous activity depletes stores
 - Continued exertion becomes almost impossible
- Training affects glycogen use
 - Trained athletes use glucose and glycogen slower
 - ↑ number of mitochondria and O₂ efficiency

Strategies to Combat Glucose Depletion

- Eat a high-carbohydrate diet regularly
- Consume glucose during prolonged exercise
 - Carbohydrate-based sports drinks
- Carbohydrate-rich foods after activity
 - Increased insulin sensitivity
 - Increases glycogen stores

TABLE 14-5 Recommended Daily Carbohydrate Intakes for Athletes

Activity Intensity and Duration	Recommendations (g/kg/day)	Carbohydrate Intakes	
		Males	Females
Low-intensity	3–5	210–350 g (840–1400 kcal)	165–275 g (660–1100 kcal)
Moderate intensity, ≤ 1 hr/day	5–7	350–490 g (1400–1960 kcal)	275–385 g (1100–1540 kcal)
Moderate to high intensity, 1–3 hr/day	6–10	420–700 g (1680–2800 kcal)	330–550 g (1320–2200 kcal)
Moderate to high intensity, >4 –5 hr/day	8–12	560–840 g (2240–3360 kcal)	440–660 g (1760–2640 kcal)

NOTE: Daily carbohydrate intakes are based on a 70-kilogram (154-pound) man and 55-kilogram (121-pound) woman.

SOURCE: Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and athletic performance, *Journal of the Academy of Nutrition and Dietetics* 116 (2016): 501–528.

FIGURE 15-3 The Effect of Diet on Physical Endurance

A high-carbohydrate diet can increase an athlete's endurance. In this study, the fat and protein diet provided 94 percent of kcalories from fat and 6 percent from protein; the normal mixed diet provided 55 percent of kcalories from carbohydrate; and the high-carbohydrate diet provided 83 percent of kcalories from carbohydrate.



Hitting the wall...

- Duration of PA
 - Beyond 20 minutes
 - Use less glucose
 - More fat
 - Glycogen depleted after 2 hours of vigorous activity (75% of VO_2 max)
 - Hypoglycemia + depleted glycogen stores =
halt nervous system function

CHO Loading: Endurance events > 90 min

What it is: eating more than normal amounts of carbohydrate, while tapering the training or resting 1-2 days before the event

Goal: Glycogen super compensation pre competition to reduce fatigue

TOTAL CHO NEEDS

• 10-12 g CHO/kg BW/ 24 hour for 36-48 hours -before the event + exercise taper

TYPE OF CHO IMPORTANT

- Focus: Hi GI, compact sources of quality CHO that are tolerated, lower fiber
 - Jams, juices, fruits, refined grains (white bread, pasta, rice)
 - Dairy: Flavored yogurts/milks
 - Vegetables: peas, tomato sauce, corn..

Fat Use During Physical Activity

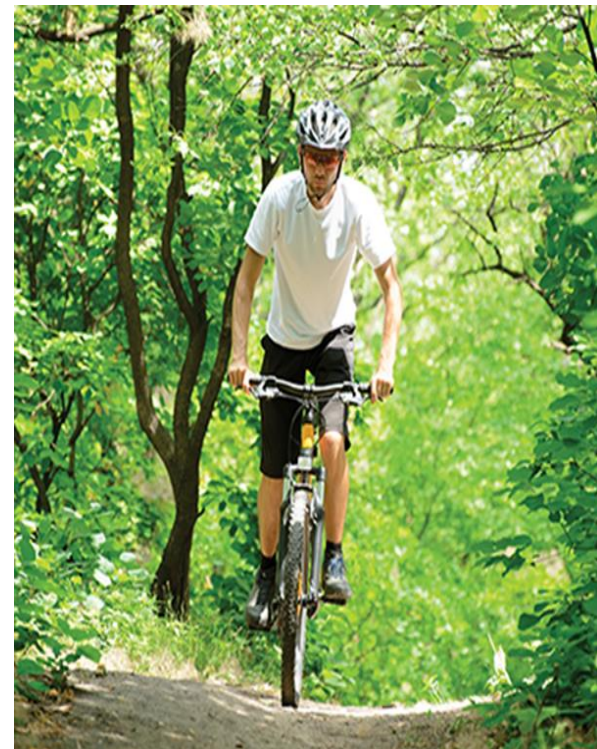
- Fat intake recommendations for athletes
 - Same as general population
 - 20 to 35 percent of energy from fat
- Fat can fuel hours of activity and not run out
- Factors affecting fat use
 - Duration and intensity of activity
 - Training

Myth: “Spot reducing”



Athletes' Protein Needs

- Protein not a major fuel
- Athletes use more protein as fuel
 - 10 percent of total fuel during activity and rest
- Diet: slightly higher needs
 - Adequate energy and CHO
Carbohydrates are protein sparing
- Intensity and duration
 - Higher protein needs & adequate CHO
 - Supplements not necessary
 - Post exercise: Pro synth accelerates
 - eating quality protein helps
 - ? 20 g protein at meals and after dinner snack



Do athletes need more protein?

	Recommendations (g/kg/day)	Protein intakes (g/day) Males	Protein intakes (g/day) Females
RDA for adults	0.8	56	44
Recommended intake for athletes	1.2–2.0	84 –140	66 –110
Canadian average intake		99	73

NOTE: Daily protein intakes are based on a 70-kilogram (154-pound) man and 55-kilogram (121-pound) woman.

SOURCES: Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports 2016

Medicine: Nutrition and athletic performance, Journal of the Academy of Nutrition and Dietetics

116 (2016): 501–528; US Department of Agriculture, Agricultural Research Service, 2014, Nutrient intakes from food and beverages: Mean amounts consumed per individual, by gender and age, What We Eat in America, NHANES, 2011–2012. <http://www.ars.usda.gov/nea/bhnrc/fsrg>; Committee on Dietary Reference Intakes, Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein and Amino Acids (Washington, D.C.: National Academies Press, 2005), pp. 660 – 661.

Cengage 2019

FLUIDS

Consider: Temperature, Humidity, Intensity, Body size, Duration, Fitness

Fluid losses:

- Endurance athletes can lose 2L/hr – digestive system can only absorb 1L/hr
 - Weigh before and after activity to determine replenishment
 - **Dehydration:**
 - Causes fatigue
 - Affects performance
 - Can lead to **heat strokes**
 - **Thirst becomes detectable only after fluid stores are depleted!**
- Not too much.... hyponatremia**



TABLE 14-9 Suggested Hydration Schedule for Physical Activity

Timing	Recommended Intakes (based on body weight)	Males	Females
≥4 hours before activity	1 oz/10 lb	16 oz	12 oz
2 hours before activity, if heavy sweating is expected	Add 0.6 oz/10 lb	+9 oz	+7 oz
Every 15 min during activity	Drink enough to minimize loss of body weight, but don't drink too much	8 oz	4 oz
After activity	Restore fluid balance by drinking volume of fluid that is equivalent to ~125-150% of remaining fluid deficit. So 1.25-1.5 L fluid per 1 Kg body weight lost		

NOTE: Intakes are based on a 70-kilogram (154-pound) man and a 55-kilogram (121-pound) woman.

^aDrinking 2 cups of fluid every 20 to 30 minutes after exercise until the total amount required is consumed is more effective for rehydration than drinking the needed amount all at once. Rapid fluid replacement after exercise stimulates urine production and results in less body water retention.

SOURCE: Position of the Academy of Nutrition and Dietetics, Dietitians of Canada, and the American College of Sports Medicine: Nutrition and athletic performance, *Journal of the Academy of Nutrition and Dietetics* 116 (2016): 501–528; C. A. Rosenbloom and E. J. Coleman, eds., *Sports Nutrition: A Practice Manual for Professionals* (Chicago: Academy of Nutrition and Dietetics, 2012), p. 115; American College of Sports Medicine, Position stand; Exercise and fluid replacement, *Medicine and Science in Sports and Exercise* 39 (2007): 377–390.

During Workout Nutrition

- **Fluids:**

~125-250 ml (1/2-1 cup)
every 15 minutes

- Needs vary between sports
- Drink more if sweating heavily or training in hot/humid conditions
- Endurance athletes: caution hyponatremia







- **Food and fluid:**

≥ 60-90 minutes:

WATER + **30-60 g** CHO/hour

Carbohydrate rich food/drink ex:

- sports drink (6-8% CHO)
- 1-2 date squares or 2-3 fig bars
- 1 sport bar – e.g. Power bar

	Transparent Possible over-hydration
	Pale straw Normal, well hydrated
	Transparent yellow Normal
	Dark yellow Normal, possible mild dehydration
	Deep amber or honey Normal, possible moderate dehydration
	Orange Possible severe dehydration

Eating tips for Physically Active People

- ✓ Consume adequate energy to support optimal function
- ✓ Portion size depends on intensity or length of training session, sex and body
- ✓ Eat breakfast
- ✓ Eat what is well tolerated- especially before race/ match

- Water
- Nutrient density
 - Vitamins, minerals, and energy
 - Real food
- Carbohydrates
 - Pregame meal
 - Intensive training
 - Recovery
- Protein
 - spread throughout the day – not too much
- Fat: 20-35%
- ..Moderation



Eat well. Live well.

Eat a variety of healthy foods each day

Have plenty
of vegetables
and fruits

CFG rec's
apply

Eat protein
foods

Make water
your drink
of choice

Choose
whole grain
foods



Discover your food guide at

Canada.ca/FoodGuide

RECOMMENDATIONS: PRE-WORKOUT

Time Before Exercise	Recommended Meals	Example of Meals
3 – 4h A snack 30-45 minutes before workout is necessary.	Regular meal made of carbohydrates, moderate protein and moderate fat	1 cup pasta with tomato sauce + 90 g chicken breast + 15 ml grated cheese + 1 fruit
2 – 3h	1 food rich in proteins + 3 – 6 foods rich in carbohydrates	1 cup cereal with 1 cup milk + 1 banana and 1 orange or 125 ml orange juice
1 – 2h	½ - 1 food rich in protein + 2 – 4 foods rich in carbohydrates	½ cup cottage cheese + 1 homemade muffin + 1 fruit or 125 ml orange juice
Under an hour	1 – 2 foods rich in carbs	1 cereal bar, yogurt , fruit bread, sports drink or gel

Game plan:

Pre-Event Meal

- High CHO
- Moderate protein
- Lower Fat
- Fluids

During Event

- Hydrate
- Long event.... Add CHO

Post-Event

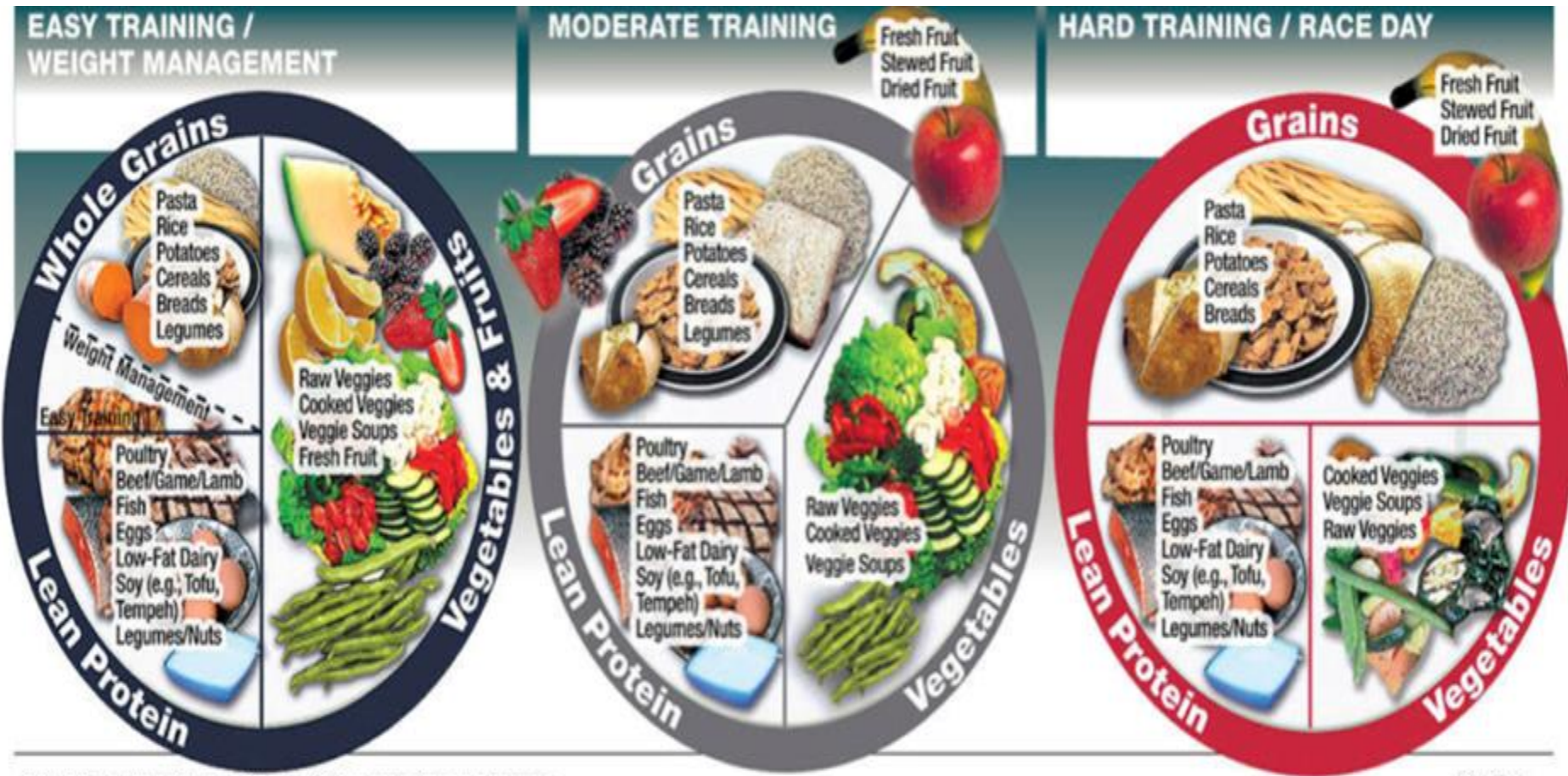
- Rehydrate
- Refuel: High CHO, Lower fiber, Moderate Pro
- Relax

<https://www.brown.edu/campus-life/health/services/promotion/nutrition-eating-concerns-sports-nutrition/sports-nutrition>

Game plan: its 1pm ..

How to eat for Practice at 5pm?

Pregame meal 3-4 hours before



SOURCE: United States Olympic Committee Sport Dietitians
University of Colorado Sport Nutrition Grad Program

JOURNAL

30-60 min before practice: Snack



Carb rich snack that is easy to digest

Sports gel, sport beans or gummies, sports bar



During the exercise

- Hydration
- Add Carbs if training/ event longer than ~ 60-90 min
 - ~30-60 g CHO per hour

FLUIDS

- **training < 60min:** Water is best
- **training > 60min:** may need a sports drink (with **6-8% CHO**)
 - Endurance sports
 - Fast sports – e.g. hockey
 - Replace fluids and electrolytes
 - Provide CHO for fuel
 - Reduces risk of hyponatremia
 - Caution: Caffeine, Energy drinks, EtOH



Post Workout Nutrition

- PURPOSE: ↓ recovery time between sessions and improve the quality of training during subsequent sessions
- High CHO taken immediately post-exercise is
 - rapidly stored in the muscle as glycogen
- Moderate Protein
 - Helps muscle recover from, and adapt to training
- Fluid and Electrolytes – replace losses



Post -exercise snack or meal

- Eat a snack or meal **within 60 min**
- Combine Carbohydrates and protein
- Fluids



Timing for Refueling

- 15-60 minutes after exercise: muscles most receptive to refueling
- "Glycogen Recovery Window"
- ≥ 2 hours, rate of muscle protein synthesis and energy storage is decreased by 50%



Pregame meal

Spaghetti, 2 cups

Marinara sauce, 1 cup

Papaya, raw, 1 cup

Broccoli, raw, 1 cup

Postgame meal

Yogurt, low-fat, 1 cup

Raisin Bran cereal, 1 cup

Pear, fresh, 1 medium

1% milk, 1 cup

How can the pregame meal plan be modified to fit the recommendations?

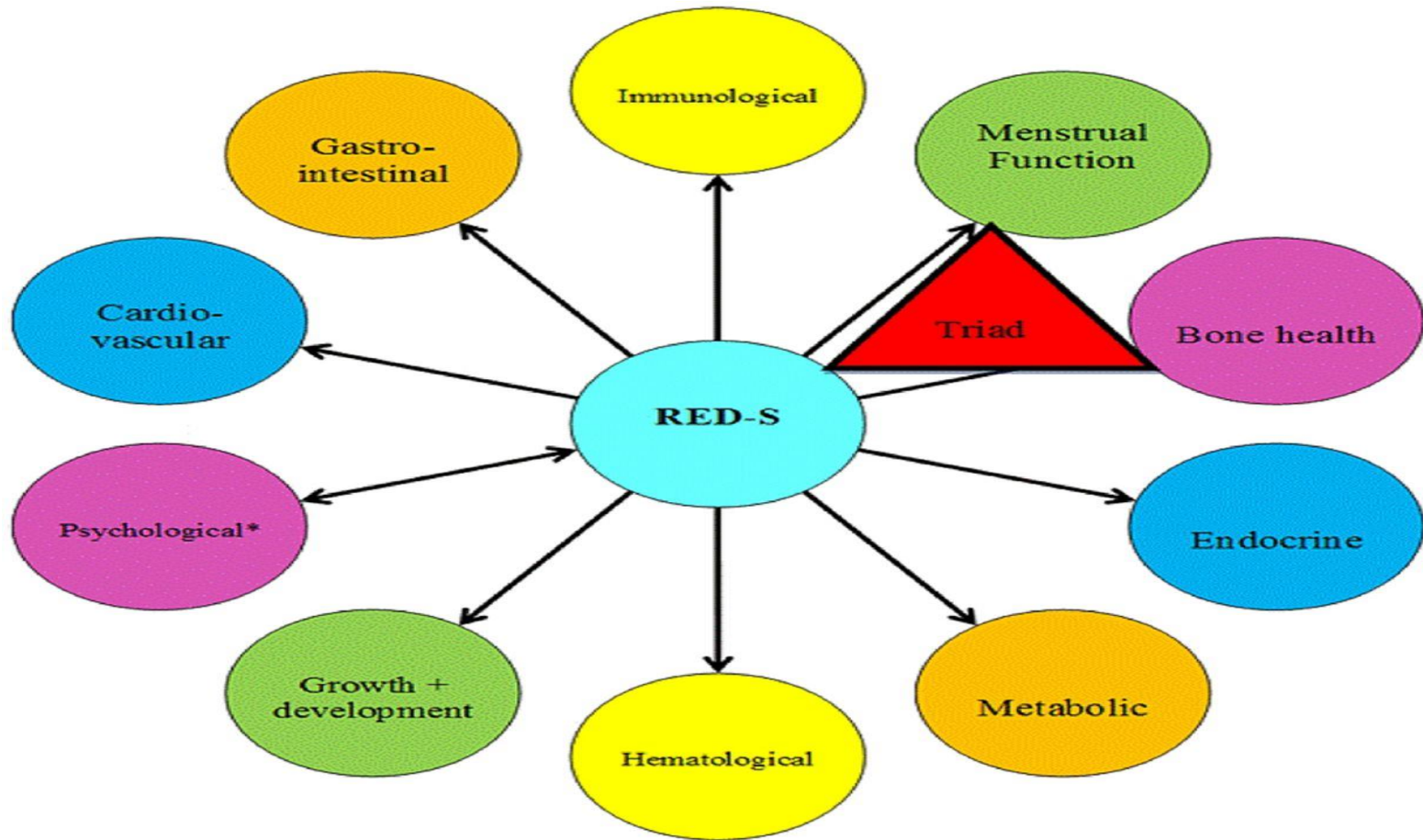
How can the postgame meal plan be modified to fit the recommendations?

Athletes

- Body image issues
 - Eating disorders 15-60%
- Caution: Intense training without dietary change: **RED-S**
 - Poor performance, physical and mental health issues and injury
- Body composition changes –RED-S
 - Women: Amenorrhea up to 40%, female athlete triad
- Bone loss
 - May be irreversible
- Anemia



Health Consequences of Relative Energy Deficiency in Sport (RED-S) showing an expanded concept of the Female Athlete Triad to acknowledge a wider range of outcomes and the application to male athletes (*Psychological consequences can either precede RED-S or be the result of RED-S).



Margo Mountjoy et al. Br J Sports Med 2014;48:491-497

Nutrition for Athletes



- Establish healthy eating habits
- Emphasize adequacy
 - Macronutrients to fuel performance
 - Micronutrients: RDA/AI: E, protein, **Fe, Ca and Vit D**
 - Vegetarian athlete: may lack: kcal, pro, n-3
 - vitamins: B12, D, E; minerals: Ca, Fe, Zn,
 - Emphasize strength, stamina, and successful performance
- De-emphasize body weight, dieting, and performance misconceptions

Nutrients of Concern

- Iron

- Deficiency

- Females, vegetarians, limited food choices

Active teens have higher iron needs

- Impairs physical performance
 - ↓ Hemoglobin to carry oxygen

- “**Sports anemia**” also known as dilutional anemia

- **Not iron-deficiency anemia**

- Adaptive, temporary response- beneficial
 - Loss of old blood cells
 - Expansion of blood volume
 - Unaltered oxygen carrying capacity
 - may not respond to nutrition intervention

Nutrition and Doping



WORLD
ANTI-DOPING
CODE



3rd party testing facilities; ISO 17025
designation

- <https://www.wada-ama.org/>

Ergogenic Aids

- Substances or treatments that may increase athletic performance beyond training
- Categories of ergogenic aids



Ergogenic Aids

- Dietary Supplements that Perform as Claimed
 - Convenient Dietary Supplements
 - Caffeine
 - Creatine
 - Sodium Bicarbonate
 - Beta-Alanine
- Dietary More Research Required: Nitrate (beet juice)
- Dietary Supplements that May Perform as Claimed
 - Beta-hydroxymethylbutyrate
- Dietary Supplements that Do Not Perform as Claimed
 - 1. Carnitine
 - 2. Chromium picolinate, boron, coenzyme Q, ginseng, and pyruvate
- Dangerous, Banned, or Illegal Supplements
 - Anabolic Steroids
 - DHEA and Androstenedione
 - Human Growth Hormone (hGH)

Scientific facts are often exaggerated and twisted to promote supplement sales \$\$\$\$\$

Weight loss Physical Activity

- Supports weight and health management
 - Physical activity recommendation
 - Combination of diet and physical activity
 - Lose more fat, reduce abdominal obesity
 - Retain more muscle
 - Regain less weight
 - Strength and balance
 - Focus on joyful movement and healthy behaviors...

Web Sites, links

- <https://csepguidelines.ca/>
- www.coach.ca
- <https://www.dietitians.ca/Downloads/Public/noap-position-paper.aspx>
- Questions?