Exercise Nutrition and Body Composition

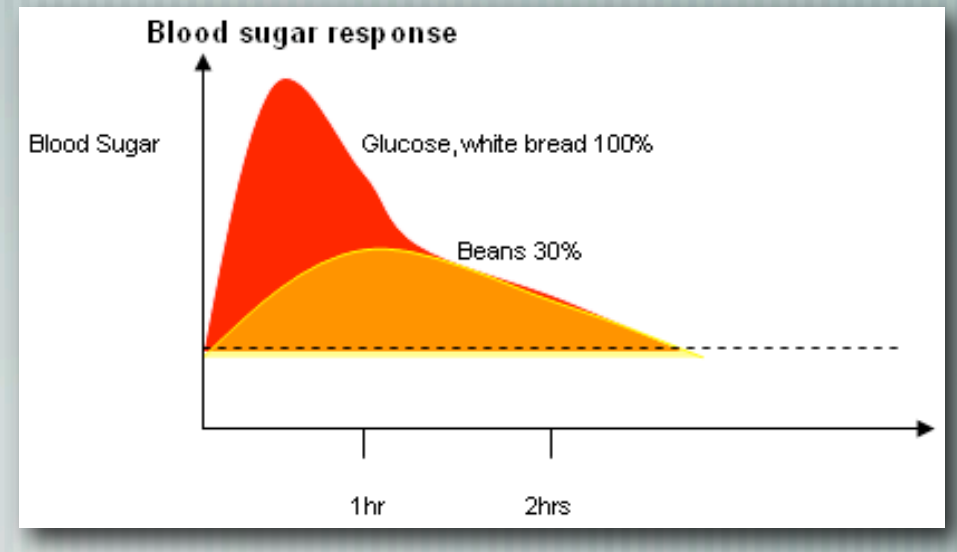
Read Chapters 18 & 23

Nutrients

- Six major nutrients
  - three are fuels

Carbohydrates

- Primary function
- Simple versus complex carbohydrates
- The glycemic index



Glycemic Index

Table 1. High Glycemic Index Foods (GI>85)*

- Angel Food Cake
- Doughnut
- Hard Candy
- Bagel, White
- Cornflakes
- TOTAL® Cereal
- Raisin Bran Cereal
- Shredded Wheat
- Raisins
- GRAPE-NUTS®
- Cornmeal
- Couscous
- Corn Chips
- Croissant
- Maltose
- Glucose
- Sucrose
- Barley Flour Bread
- CHEERIOS®
- CREAM OF WHEAT®
- Millet
- Soda Crackers
- Watermelon
- Pancakes
- Honey/Syrups
- English Muffins
- Waffles
- White Bread
- Corn Bran Cereal
- CRISPIX® Cereal
- RICE KRISPIES® Cereal
- Ice Cream
- Molasses
- Baked/Mashed Potatoes
- Pretzels
- Sport Drinks
- POP-TARTS®
- SPECIAL K® Cereal
- Rye Flour Bread
- CORN CHEX® Cereal

Table 2. Moderate Glycemic Index Foods (GI=60-85)*

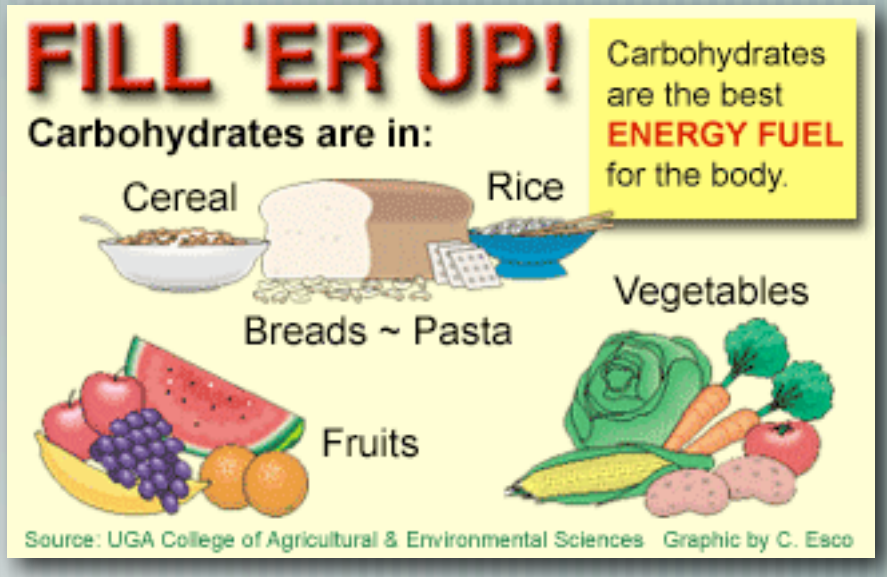
- Sponge Cake
- Corn Tortilla
- Brown Rice
- Green Peas
- Cracked Barley
- White Rice (long-grain)
- Sweet Potato
- Brown Rice
- Mango
- Pastry
- Pita Bread, White
- MULTI-BRAN CHEX® Cereal
- Buckwheat
- Orange/Grapefruit Juice
- Oatmeal, Cooked
- Basmati Rice
- Kiwifruit
- SNICKERS® Bar
- POWERBAR® Chocolate
- Oat Bran Cereal
- Bulgur
- Banana
- 7-Grain Bread
- Ice Cream, Low Fat
- Grapes
- Durum Spaghetti
- Oat Bran Bread
- Linguine
- Sweet Corn
- 100% Whole Wheat Bread

Table 3. Low Glycemic Index Foods (GI <60)*

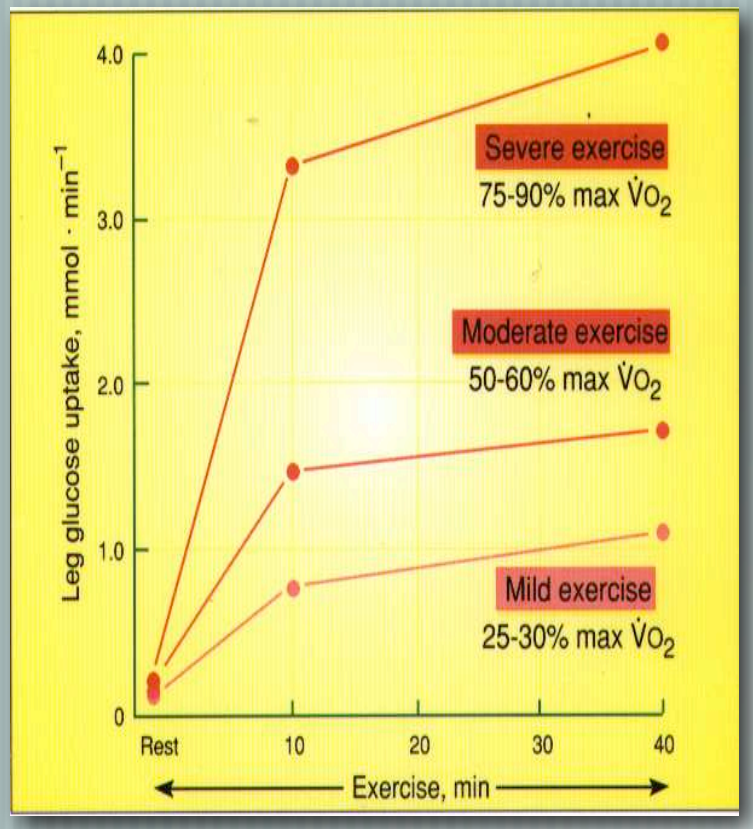
- Barley Kernel Bread
- Milk (whole/skim)
- 9-Grain Bread
- Plums
- ALL-BRAN® Cereal
- Barley, Boiled
- Yogurt (all types)
- Grapefruit/Oranges
- Beans (all types)
- Peanuts/Cashews
- Rice Bran
- Apple (whole/juice)
- Peaches (fresh)
- Lentils
- Tomato Soup/Juice
- IRONMAN™ Bar, Chocolate
- Apricots (dried)
- Pears (fresh)
- Brown Rice
- Chickpeas/ Hummus

Carbohydrates

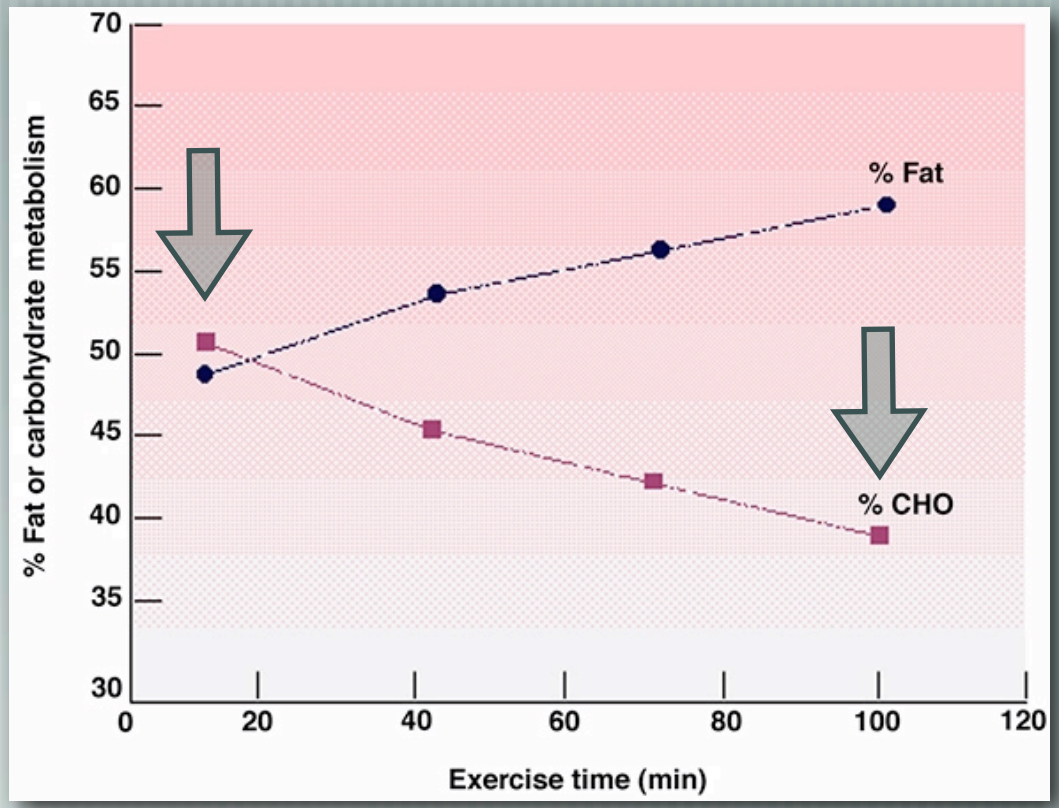
- Percentage of total calories
- Carbohydrates and health
- Carbohydrates and exercise



Carbohydrates & Exercise



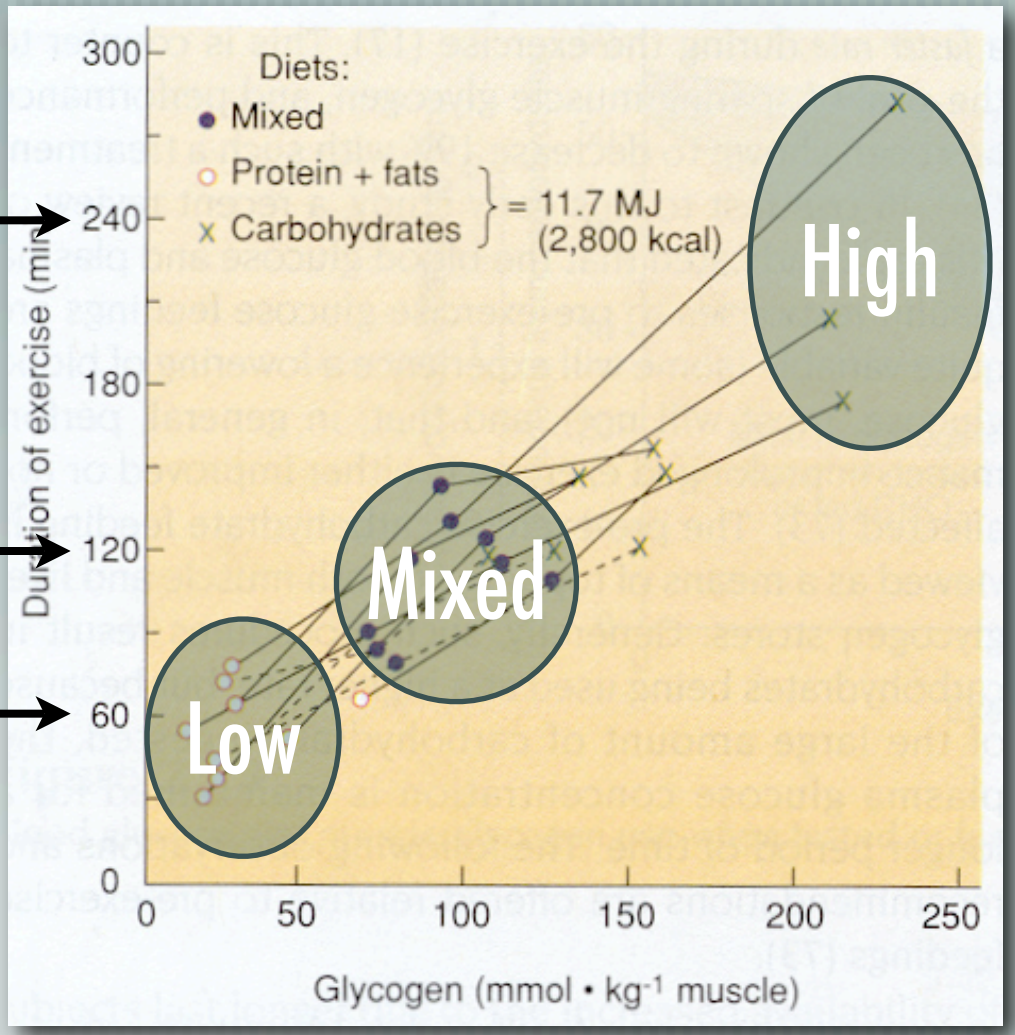
Intensity



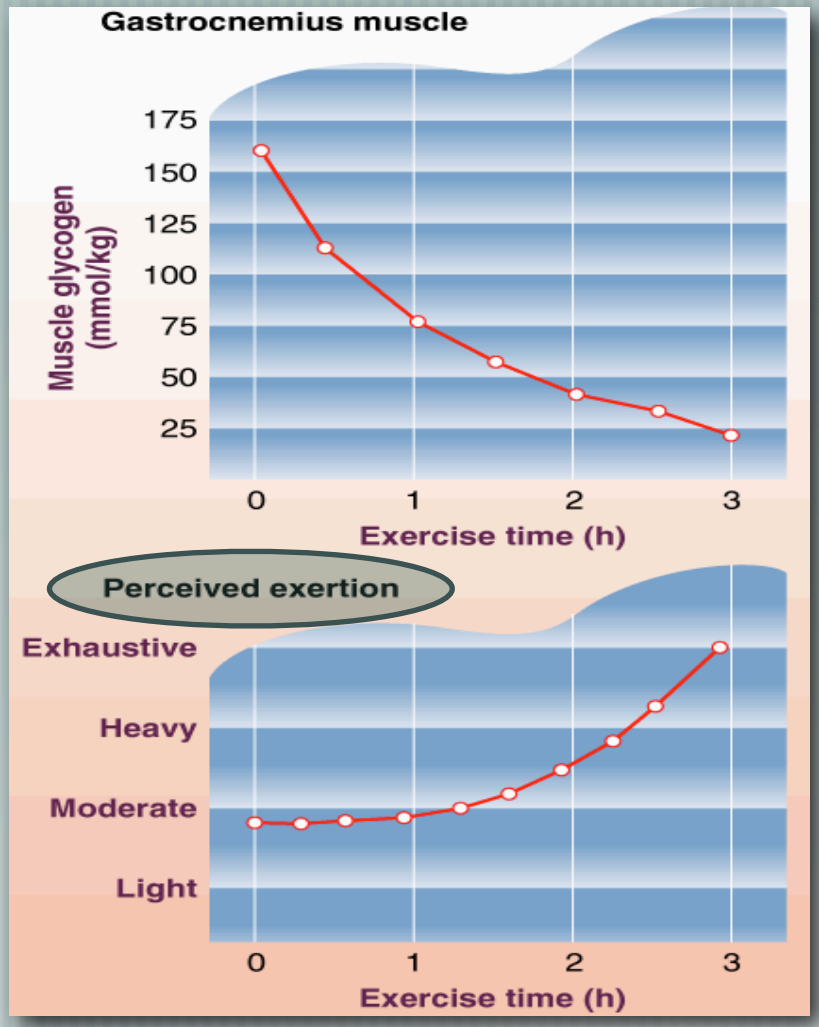
Duration

Carbohydrates and Exercise

Glycogen levels and exercise performance



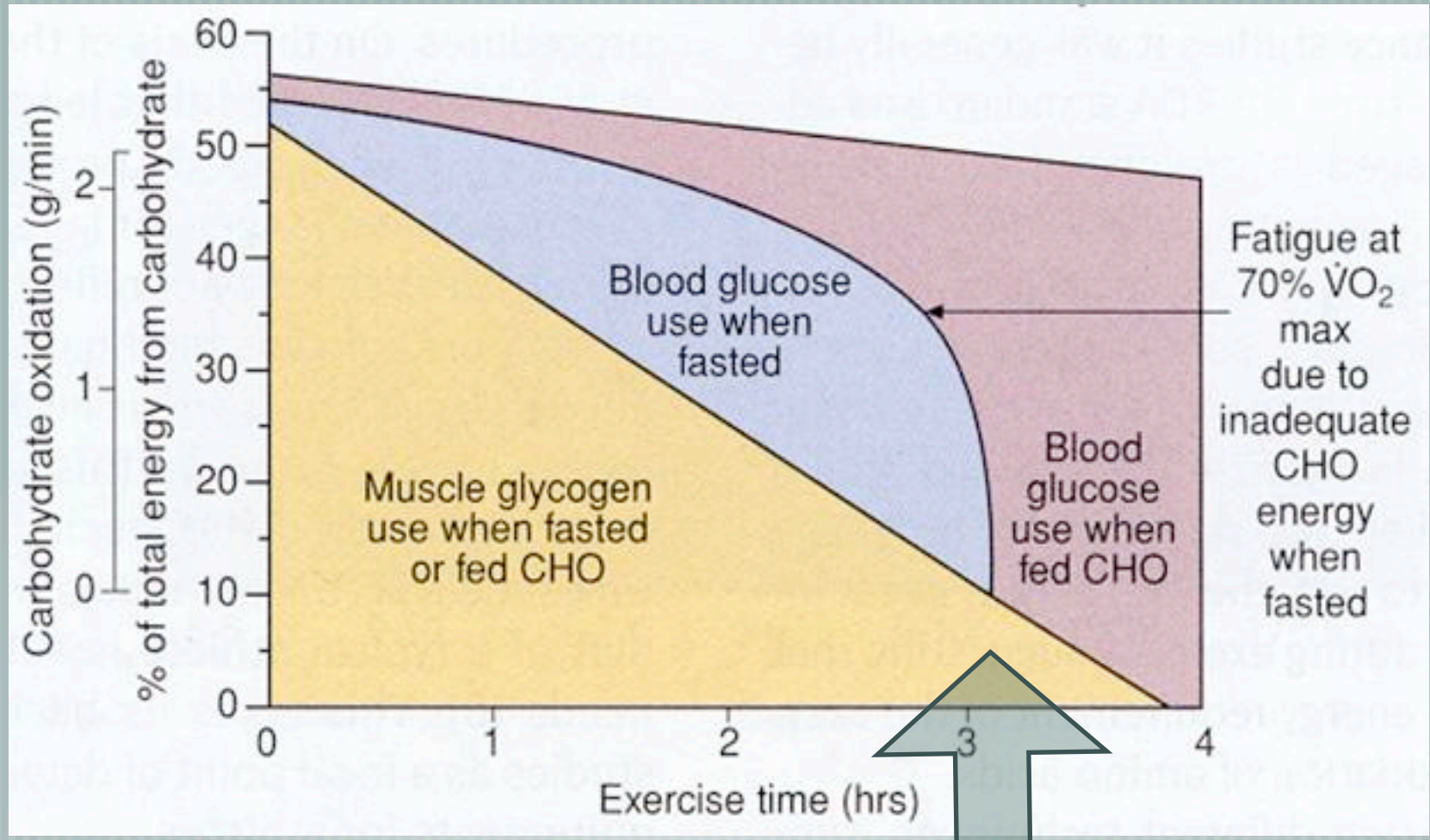
Glycogen Depletion



Glycogen

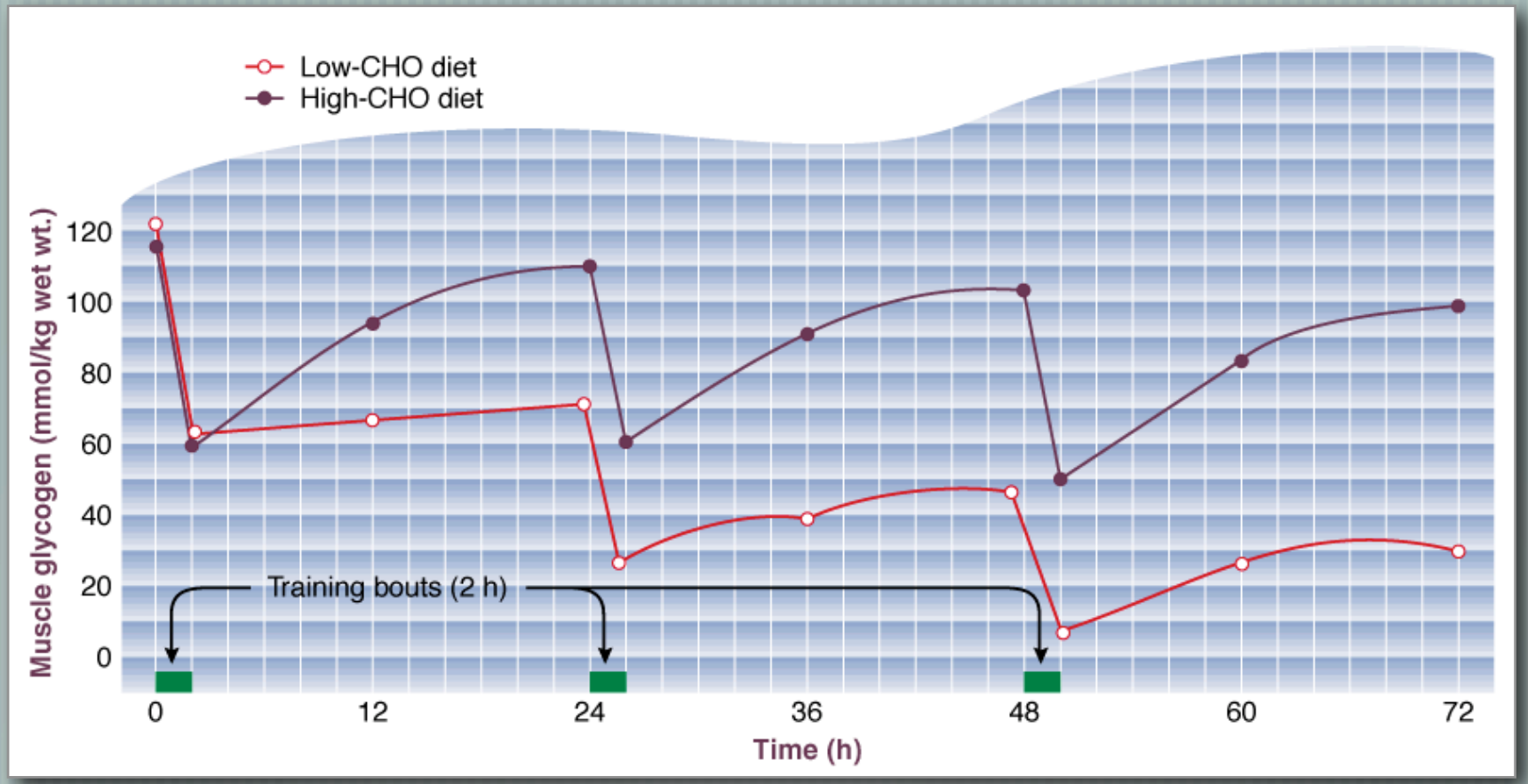
RPE

Glycogen Depletion



Glycogen Depletion

Glycogen Depletion

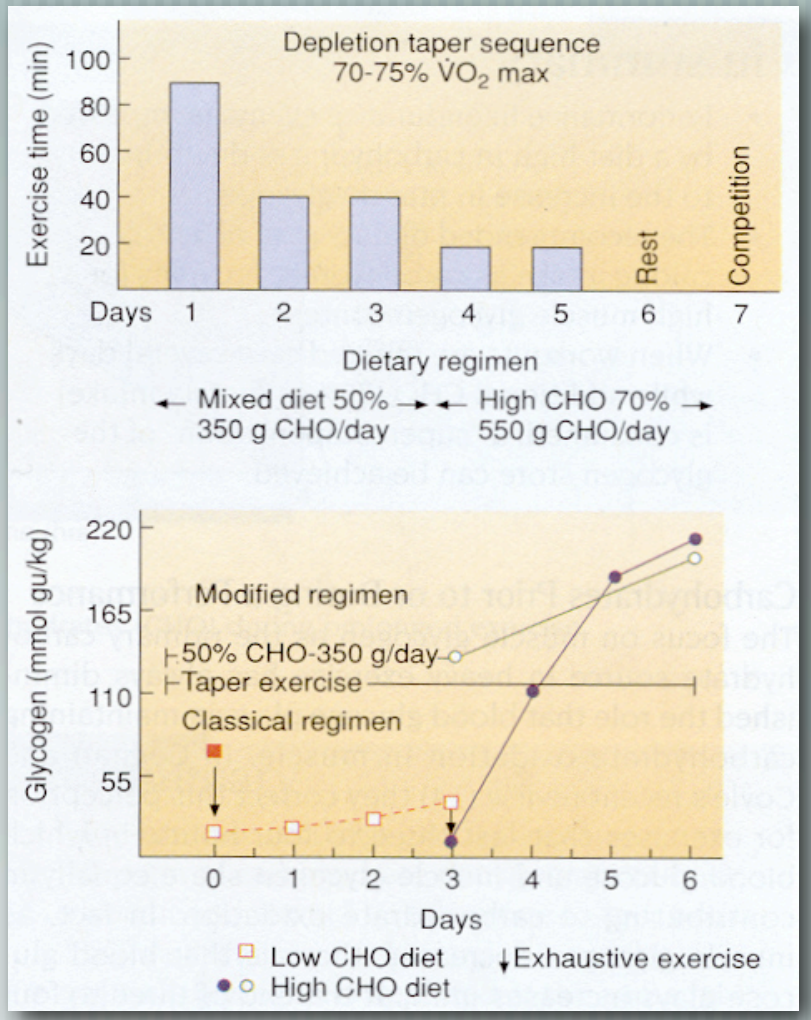


glycogen depletion can occur over time if the diet is low in carbohydrates

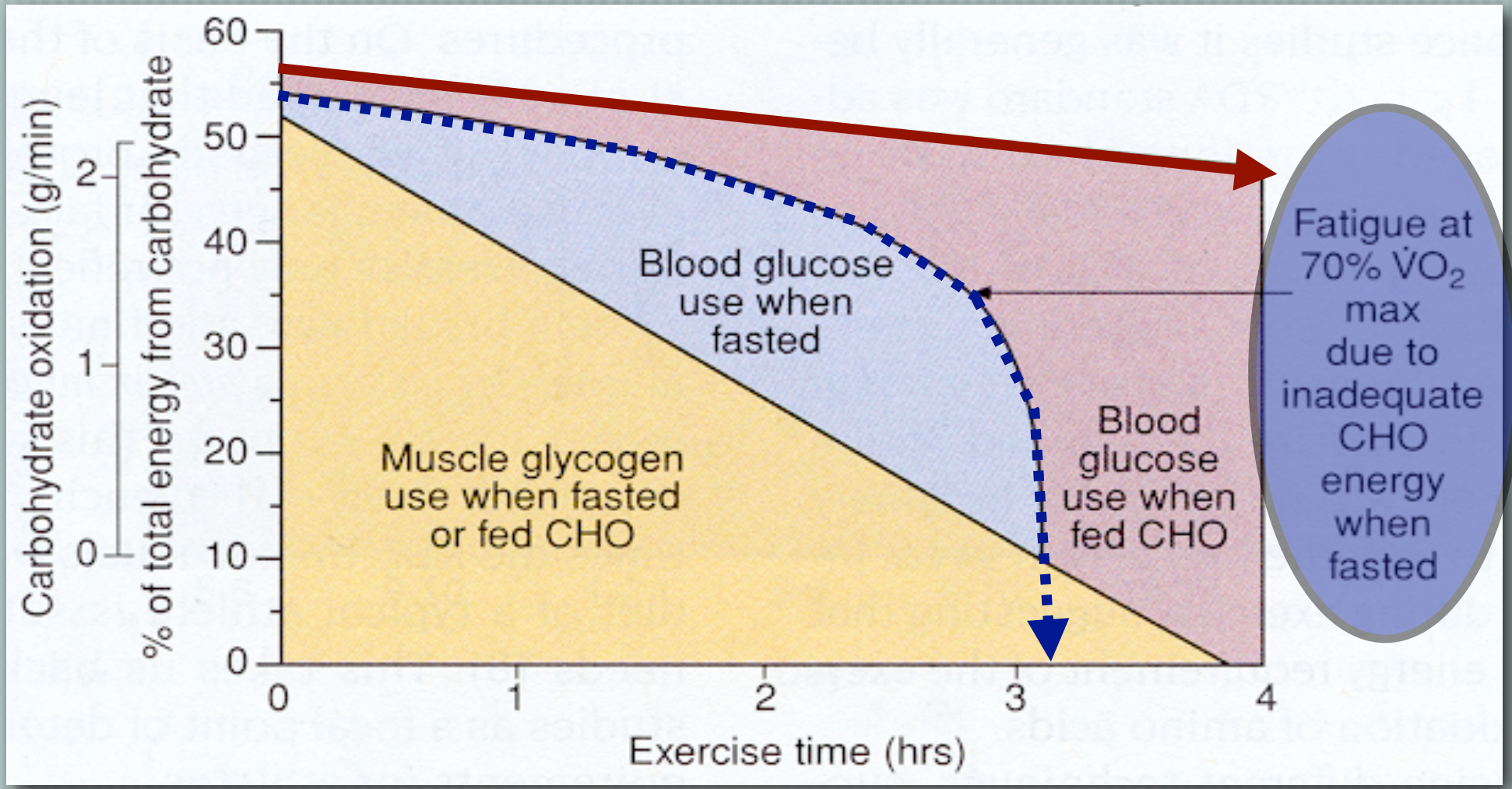
Carbohydrate Loading

Taper

70%



Carbohydrates Before Exercise

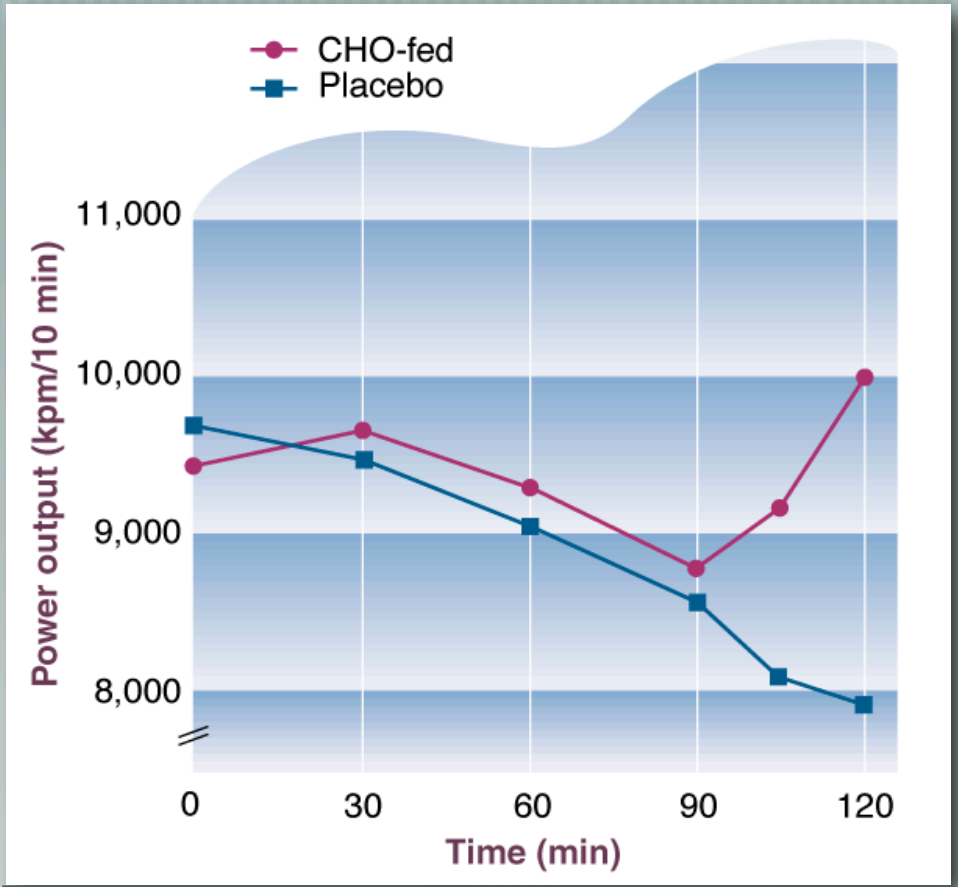


Carbohydrates Before Exercise

- Pre-exercise
  - 1-5 grams / kg of carbohydrate 1 to 4 hours before exercise
  - Easily digestible; liquid form if within one hour

Carbohydrates During Exercise

- High glycemic index
  - 30 minutes before fatigue
  - 30-60 grams every hour



Power output (intensity level) with and without carbohydrates during exercise

Gels and Energy Bars

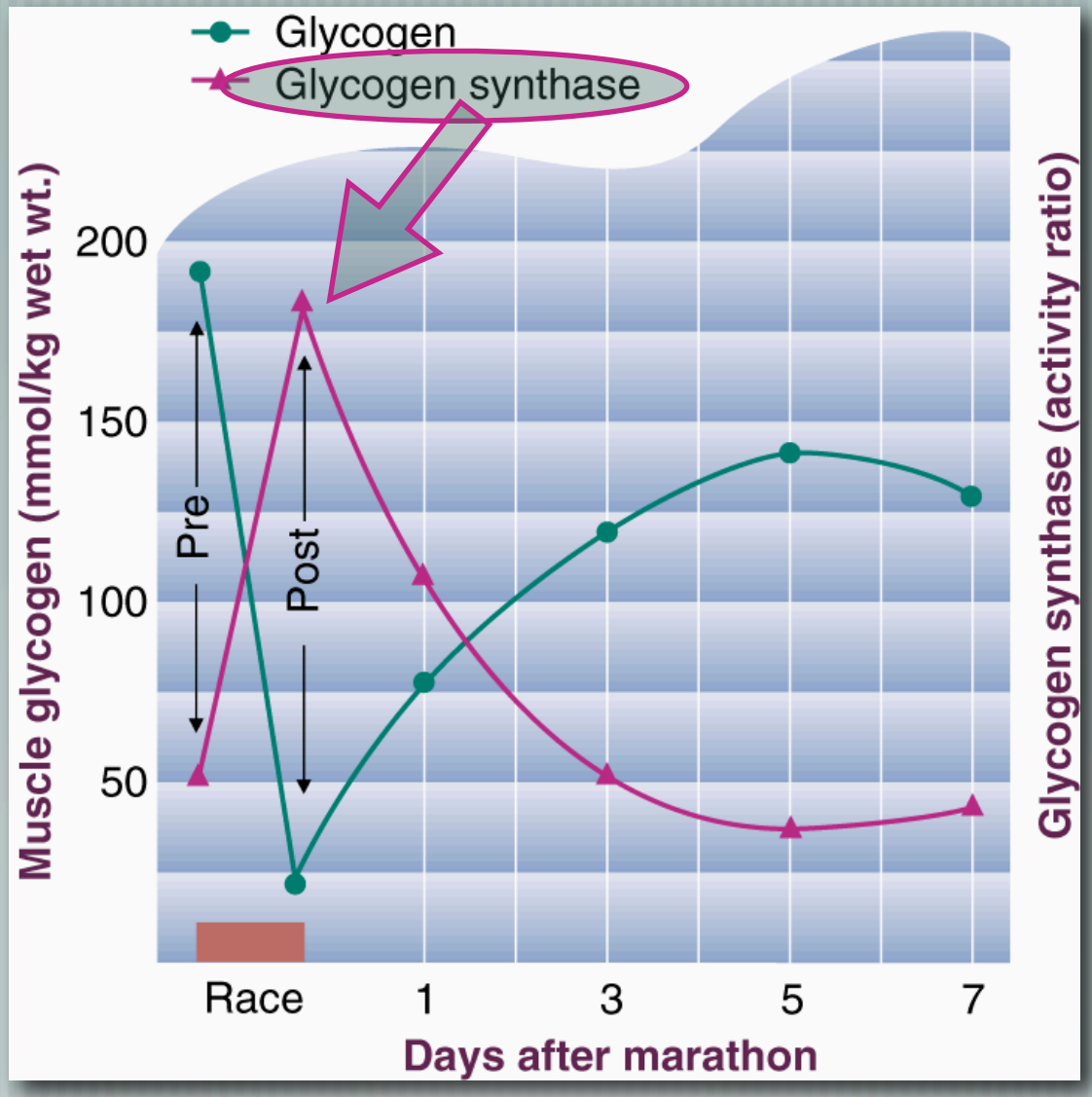
Composition of Selected Sports Gels

Name	Energy (kcal)	CHO (g)	CHO (%)	Fat (g)	Fat (%)	Protein (g)	Protein (%)	Other
Clif Shots	96	24	100	0	0	0	0	Caffeine (some flavors)
Gu	100	25	100	0	0	0	0	Caffeine
Power Gel	112	28	100	0	0	0	0	Ginseng, Kola nut, caffeine (some flavors)
Squeezy	80	20	100	0	0	0	0	

Composition of Selected Energy Bars

Name	Energy	CHO (g)	CHO (%)	Fat (g)	Fat (%)	Protein (g)	Protein (%)	Vitamins	Minerals
Balance Bar (almond brownie)	200	22	43	6	27	15	30	1	25
Clif Bar (peanut butter)	250	45	72	4	14	10	16	4	15
Clif Luna (chocolate pecan pie)	180	24	53	5	25	10	22 (soy)	1	22
EAS Myoplex Delux (chocolate)	340	43	51	7	19	24	28	2	26
Met-Rx Bar (fudge brownie)	320	48	60	2.5	7	27	43	2	22 + L-glutamine
Power Bar (chocolate)	225	42	75	2	8	10	18	3	20
Power Bar Essentials (chocolate)	180	20	62	4	20	10	22	3	21
Power Bar Protein Plus	290	15	21	8	25	32	44	1	21
PR-Bar (bavarian mint)	190	21	44	6	28	13	27	1	23
Snickers	280	35	50	14	45	4	6	1	0
Tiger Sports Bar	230	43	75	2	8	10	17	3	19

Carbohydrates After Exercise



1-2 g/kg

Fats and Exercise

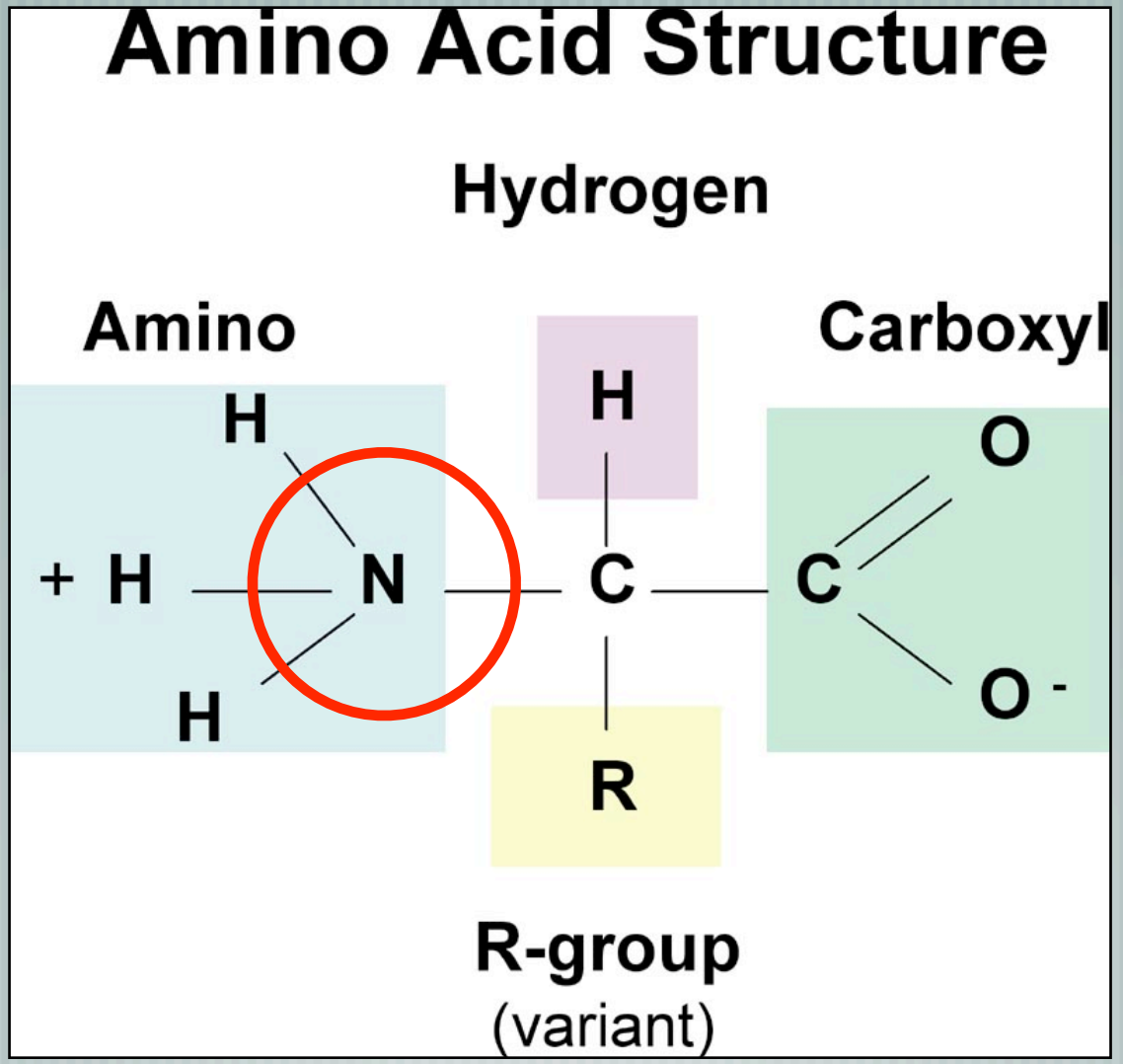
- Glycogen sparing effect
- Training
- Caffeine?

Protein

- Amino acids

Nonessential	Essential
Alanine	Histidine
Arginine	Isoleucine
Asparagine	Leucine
Aspartate	Lysine
Cysteine	Methionine
Glutamate	Phenylalanine
Glutamine	Threonine
Glycine	Tyrptophan
Proline	Valine
Serine	
Tyrosine	

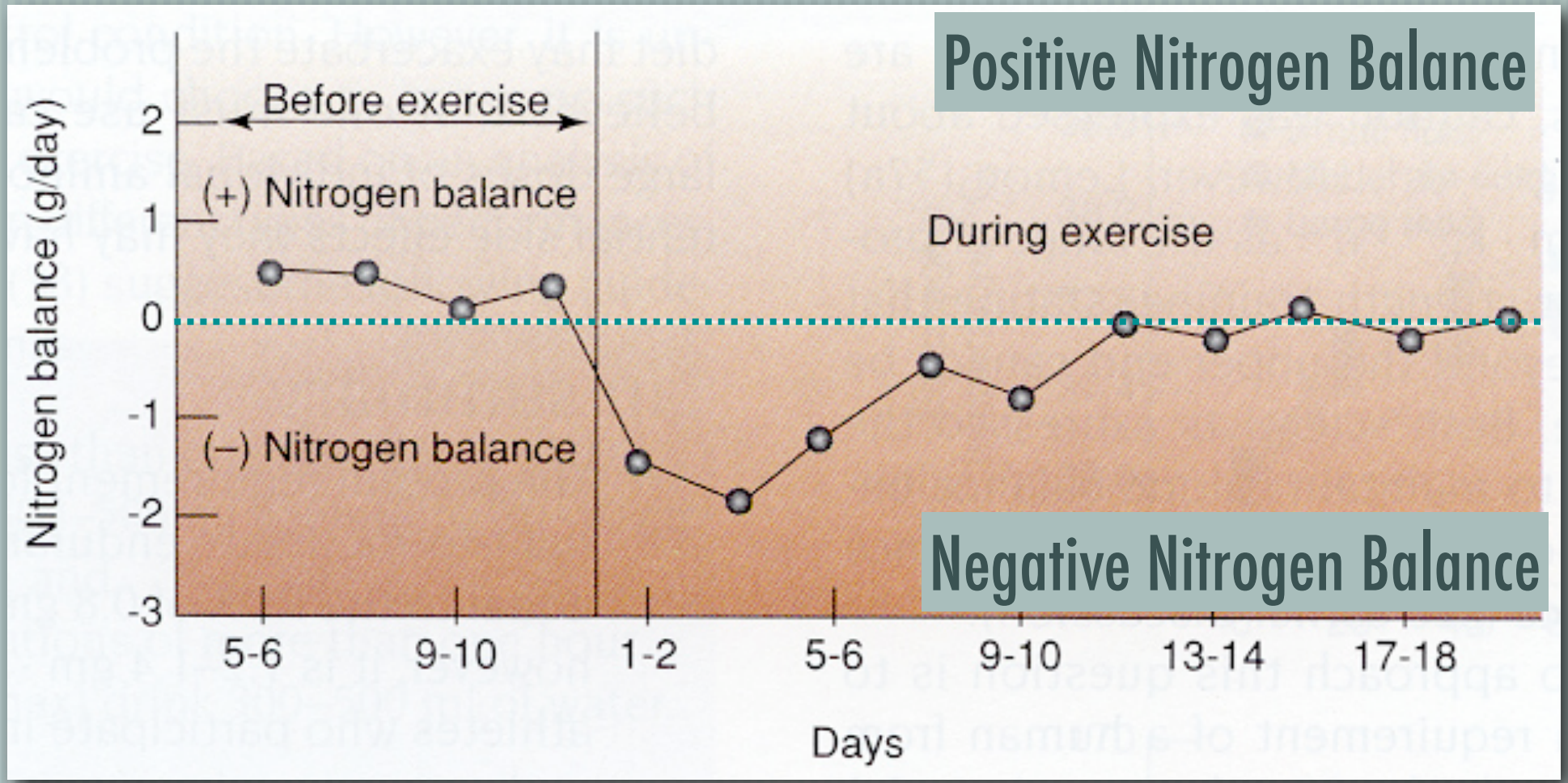
Protein


Amino Acid Structure
Hydrogen
Amino
Carboxyl
H
H
O
+ H
N
C
C
O -
H
R
R-group
(variant)

Protein

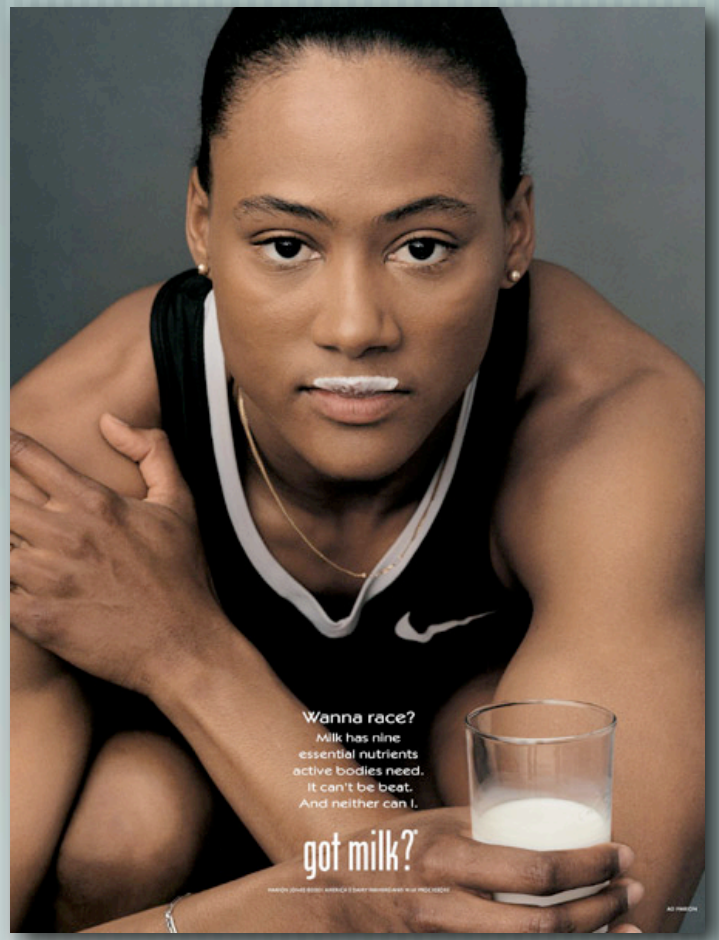
- RDA
  - 0.8 grams per kilogram
  - Average protein intake is approx. 1.5 grams/kg
- Complete v incomplete sources of protein

Nitrogen Balance



Protein & Exercise

- Do people who become physically active need to add more protein to their diet?
- Do active individuals need to consume more than the RDA for protein?



Protein & Exercise

- The RDA is sufficient for light to moderately active individuals
- **Endurance training**
  - **1.2-1.4 grams per kg per day** for high-intensity endurance exercise
- **Resistance training**
  - [0.9 grams per kg per day for maintaining strength]
  - **1.4-1.8 grams per kg per day** for increasing strength and lean body mass

Protein & Post-exercise

- Recent research shows protein AND carbohydrate eaten within 30 minutes of a workout is effective in preparing athletes for the next workout.
- 4:1 ratio or 40 grams Carbs and 10 grams Protein
- Repeated intake of small amounts for every one to two hours

Diets and Exercise

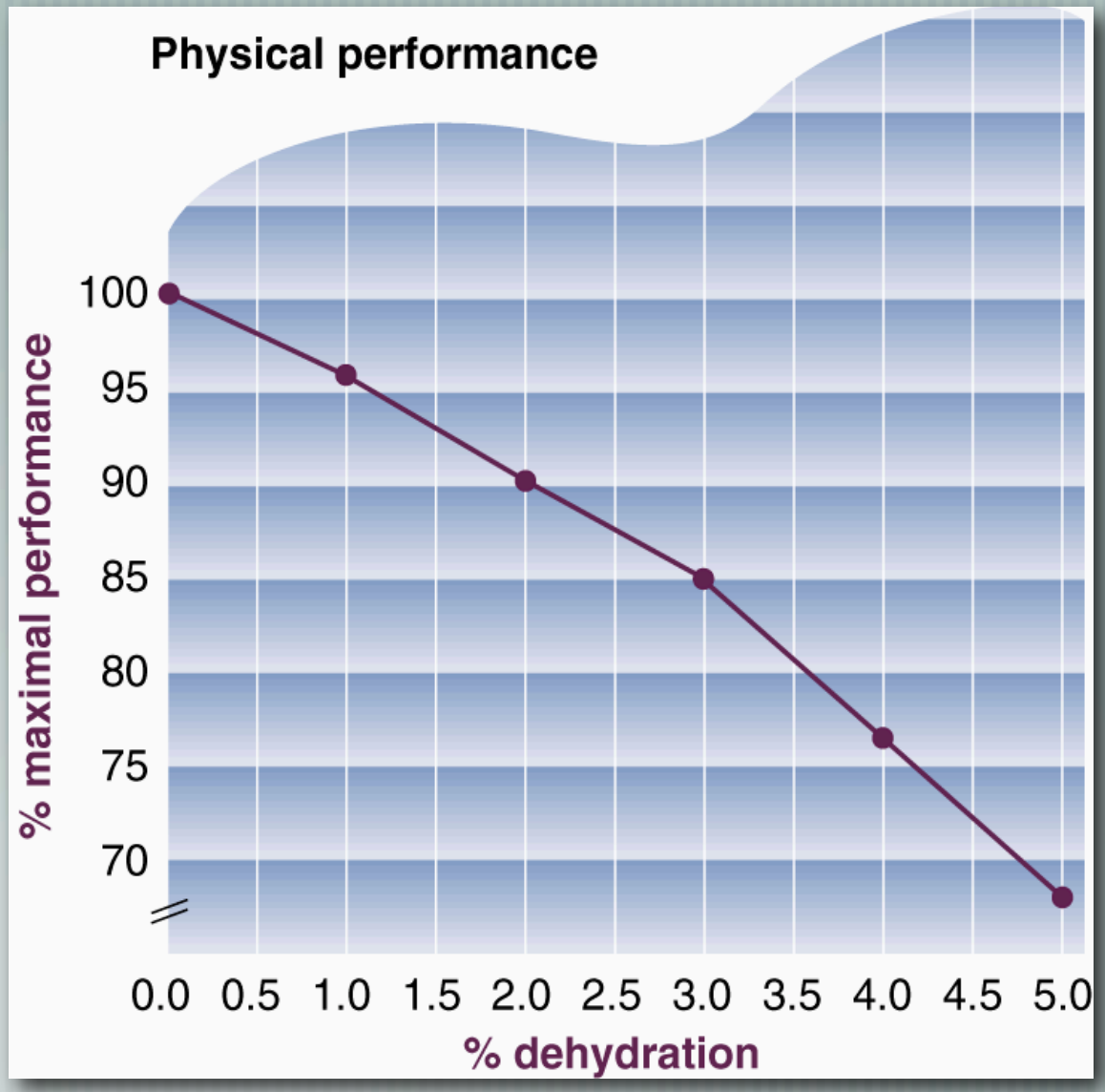
- Do low carb, high protein diets affect exercise performance?

Water

- 50-75% of the body is water
- Dehydration
  - Diets
  - Exercise

Water

- Dehydration & performance



Dehydration Hinders Basketball Performance

05 Jul 2007

Dehydration is directly linked to a decline in performance on the basketball court, according to a study published recently in *Medicine & Science in Sports & Exercise*®, the official journal of the American College of Sports Medicine (ACSM).

The study examined 17 males aged 17-28, and tested performance during basketball drills at various levels of dehydration (up to 4 percent). As dehydration increased, skill performance decreased, indicating that proper hydration is necessary for peak performance on the court.

"The study supports the notion that players should be given adequate opportunities to hydrate themselves during play and practice," said Lindsay B. Baker, Ph.D. candidate, Pennsylvania State University, and lead author of the study.

Study participants completed three hours of interval treadmill walking, either with or without hydration. After a 70-minute rest period, subjects then performed a series of continuous basketball drills designed to simulate a fast-paced game. These included basketball-specific movement exercises (e.g., sprinting, defensive slides, and jumping) and shooting drills from various spots on the court (e.g., the free throw and three-point lines). Hydrated test subjects were given either flavored water or a carbohydrate-electrolyte sports drink.

The test results showed that:

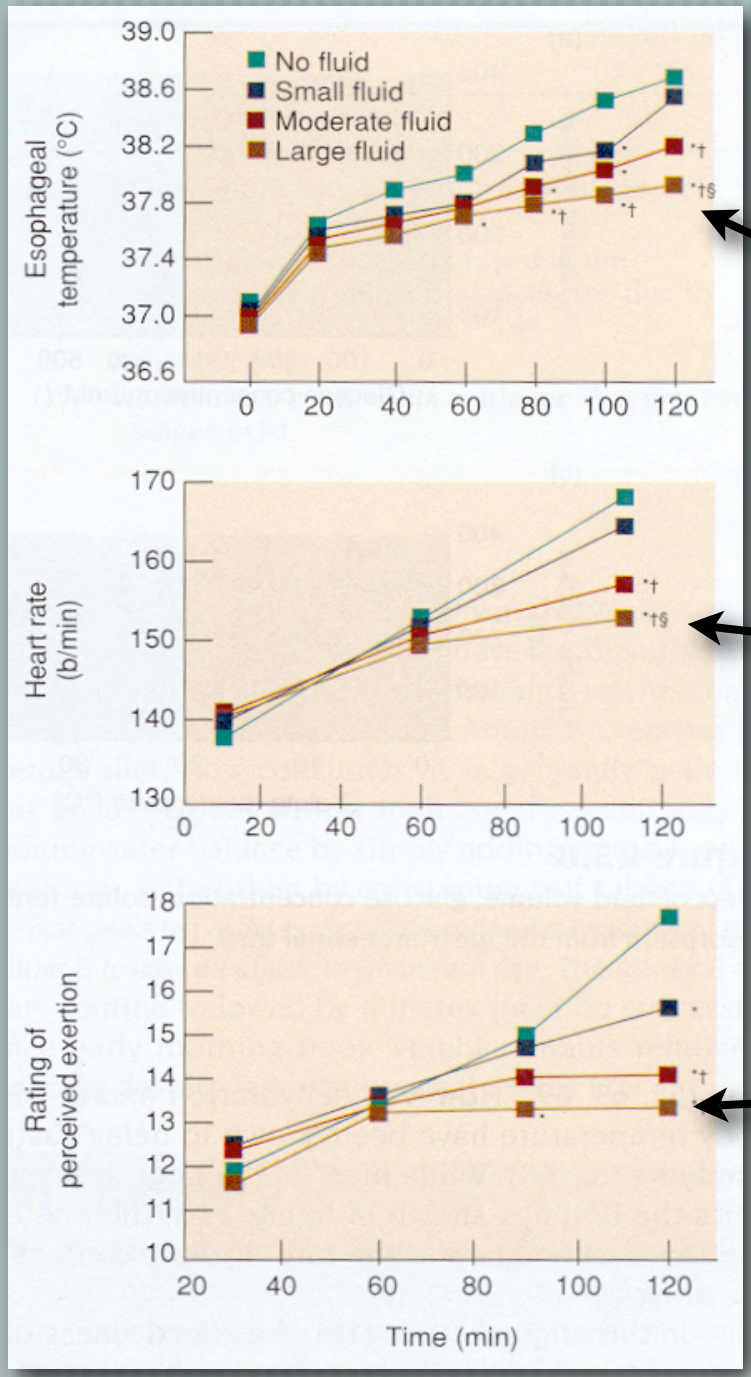
-- Subjects who were dehydrated by at least two percent consistently performed basketball movement exercises at slower rates.
-- Dehydrated subjects failed to make as many shots as hydrated players.
-- There was no difference in performance between hydrated subjects given flavored water or a carbohydrate-electrolyte drink.

Previous studies on NBA basketball players have shown significant lack of hydration, with an average of only about 40 percent of fluid losses from sweat replaced during practices or games.

"Many times the outcome of a basketball game is decided in the final minutes, when players tend to be the most dehydrated," Baker said. "It's crucial for basketball coaches at any level to be sure that their players are drinking adequate fluids during games and workouts to help prevent dehydration and attain peak performance."

In February 2007, ACSM issued the Position Stand "Exercise and Fluid Replacement," which provides insight on how to properly hydrate before, during, and after exercise. View the position stand here .

The American College of Sports Medicine is the largest sports medicine and exercise science organization in the world. More than 20,000 International, National, and Regional members are dedicated to advancing and integrating scientific research to provide educational and practical applications of exercise science and sports medicine.



Responses during exercise with different amounts of water intake

- Body temperature
- Heart rate
- Rating of Perceived Exertion

Water Intake Before Exercise

- For workouts *less than* 1 hour, drink 300-500 mL (10-17 oz) of...
  - ...water *or* sports drink? **Why?**
- For workouts *great than* 1 hour, drink 300-500 mL of...
  - ...water *or* sports drink? **Why?**

Water Intake During Exercise

- **How much?**
  - 500-1000 mL/hr (17-34 ounces/hr)
  - ...OR...
  - **8-10 ounces every 15-20 minutes**
- **What to drink?**

Sports Drinks

Name	Energy (kcal)	CHO (g)	CHO (%)	Na (mg)	K (mg)	Other
Accelerade	80	21	6.2	190	65	5 g protein, Mg, vitamins C & E
All Sport	70	20	8.3	55	50	Ca, Cl, P, vitamins C, and five B vitamins
Cytomax	47.5	10	8	50	55	Vitamins A, C and chromium
Extran Thristquencher	45	11	5	61	49.5	n/a
Hydrade	55	10	4	91	77	Glycerol, vitamin C
Gatorade Endurance	50	14	6	198	93	Chloride, calcium, magnesium
Gatorade	50	14	6	110	30	Cl, P
GU20	50	13		240	40	(Complex carbohydrates)
Powerade	70	17	7	55	35	B vitamins
Powerbar Endurance	70	17		160	10	Mg and Cl
Propel	10	3	0.4	35	40	Vitamin C, E, niacin, B6, B12, pantothenic acid

AMERICAN COLLEGE of SPORTS MEDICINE®

POSITION STAND

Exercise and Fluid Replacement

This pronouncement was written for the American College of Sports Medicine by Michael N. Sawka, FACSM (chair); Louise M. Burke, FACSM, E. Randy Eichner, FACSM, Ronald J. Maughan, FACSM, Scott J. Montain, FACSM, Nina S. Stachenfeld, FACSM.

SUMMARY

This Position Stand provides guidance on fluid replacement to sustain appropriate hydration of individuals performing physical activity. The goal of prehydrating is to start the activity euhydrated and with normal plasma electrolyte levels. Prehydrating with beverages, in addition to normal meals and fluid intake, should be initiated when needed at least several hours before the activity to enable fluid absorption and allow urine output to return to normal levels. The goal of drinking during exercise is to prevent excessive (>2% body weight loss from water deficit) dehydration and excessive changes in electrolyte balance to avert compromised performance. Because there is considerable variability in sweating rates and sweat electrolyte content between individuals, customized fluid replacement programs are recommended. Individual sweat rates can be estimated by measuring body weight before and after exercise. During exercise, consuming beverages containing electrolytes and carbohydrates can provide benefits over water alone under certain circumstances. After exercise, the goal is to replace any fluid electrolyte deficit. The speed with which rehydration is needed and the magnitude of fluid electrolyte deficits will determine if an aggressive replacement program is merited.

Hyponatremia

Background Hyponatremia has emerged as an important cause of race-related death and life-threatening illness among marathon runners. We studied a cohort of marathon runners to estimate the incidence of hyponatremia and to identify the principal risk factors.

Methods Participants in the 2002 Boston Marathon were recruited one or two days before the race. Subjects completed a survey describing demographic information and training history. After the race, runners provided a blood sample and completed a questionnaire detailing their fluid consumption and urine output during the race. Prerace and postrace weights were recorded. Multivariate regression analyses were performed to identify risk factors associated with hyponatremia.

Results Of 766 runners enrolled, 488 runners (64 percent) provided a usable blood sample at the finish line. Thirteen percent had hyponatremia (a serum sodium concentration of 135 mmol per liter or less); 0.6 percent had critical hyponatremia (120 mmol per liter or less). On univariate analyses, hyponatremia was associated with substantial weight gain, consumption of more than 3 liters of fluids during the race, consumption of fluids every mile, a racing time of >4:00 hours, female sex, and low body-mass index. On multivariate analysis, hyponatremia was associated with weight gain (odds ratio, 4.2; 95 percent confidence interval, 2.2 to 8.2), a racing time of >4:00 hours (odds ratio for the comparison with a time of <3:30 hours, 7.4; 95 percent confidence interval, 2.9 to 23.1), and body-mass-index extremes.

Conclusions Hyponatremia occurs in a substantial fraction of nonelite marathon runners and can be severe. Considerable weight gain while running, a long racing time, and body-mass-index extremes were associated with hyponatremia, whereas female sex, composition of fluids ingested, and use of nonsteroidal antiinflammatory drugs were not.

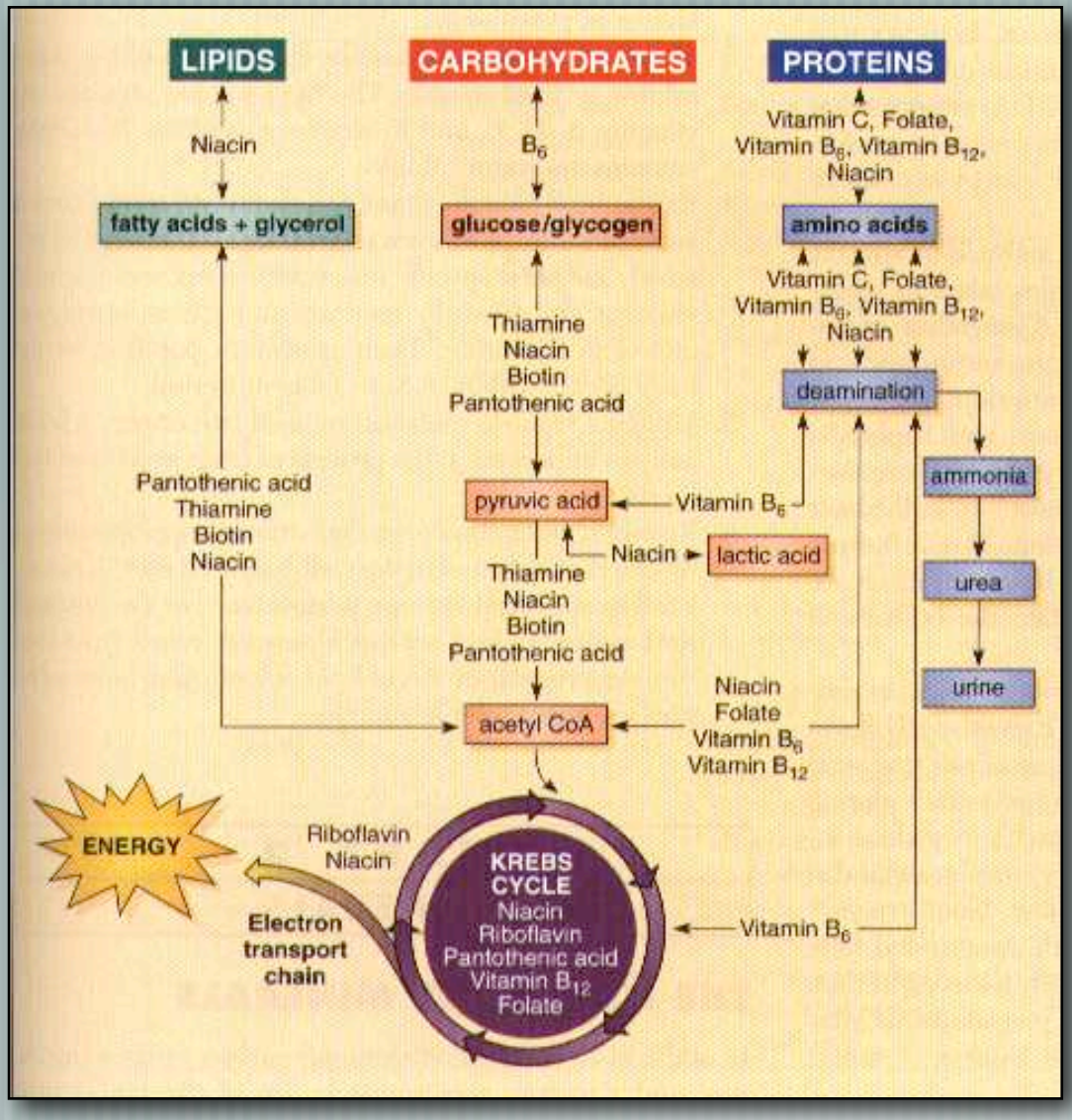
Vitamins

- Fat soluble
- Water soluble

Vitamin Chart

VITAMIN	FOOD SOURCES	HEALTH BENEFIT	DEFICIENCY
Fat Soluble			
A	Green vegetables, milk products, liver	Component of light-sensitive pigments in eye, epithelial tissue maintenance	Night blindness, permanent blindness, extremely dry skin
D	Dairy products, eggs, cod liver oil, ultraviolet light	Calcium absorption, bone formation	Rickets (bone deformities)
E	Margarine, seeds, green leafy vegetables	Protects fatty acids and cell membranes from oxidation	Possibly anemia
K	Green leafy vegetables	Blood clotting	Uncontrolled bleeding
Water Soluble			
B1 (Thiamine)	Organ meats, pork, grains, legumes	Carbohydrate metabolism, nerve and heart function	Beriberi (weakened heart, edema, nerve and muscle degeneration)
B2 (Riboflavin)	Milk products, liver, eggs, grains, legumes	Energy metabolism	Eye irritation, inflammation and breakdown of skin cells
B3 (Niacin or Nicotinic Acid)	Liver, lean meats, grains, legumes	Oxidation-reduction reactions in cellular respiration	Pellegra (skin and gastrointestinal disorders, nerve inflammation, mental disorders)
B5 (Pantothenic Acid)	Milk products, liver, eggs, grains, legumes	Energy metabolism	Fatigue, loss of coordination
B6 (Pyridoxine)	Whole-grain cereals, vegetables, meats	Amino acid metabolism	Convulsions, irritability, kidney stones
B12 (Cobalamin)	Red meats, eggs, dairy products	Nucleic acid production	Pernicious anemia, neurological disorders
Biotin	Meats, vegetables, legumes	Fat synthesis and amino acid metabolism	Depression, fatigue, nausea
C (Ascorbic Acid)	Citrus fruits, green leafy vegetables, tomatoes	Collagen formation in teeth, bone, and connective tissue of blood vessels; may help in resisting infection	Scurvy (breakdown of skin, blood vessels, and teeth)
Folic Acid	Whole-wheat foods, green vegetables, legumes	Nucleic acid metabolism	Anemia, diarrhea

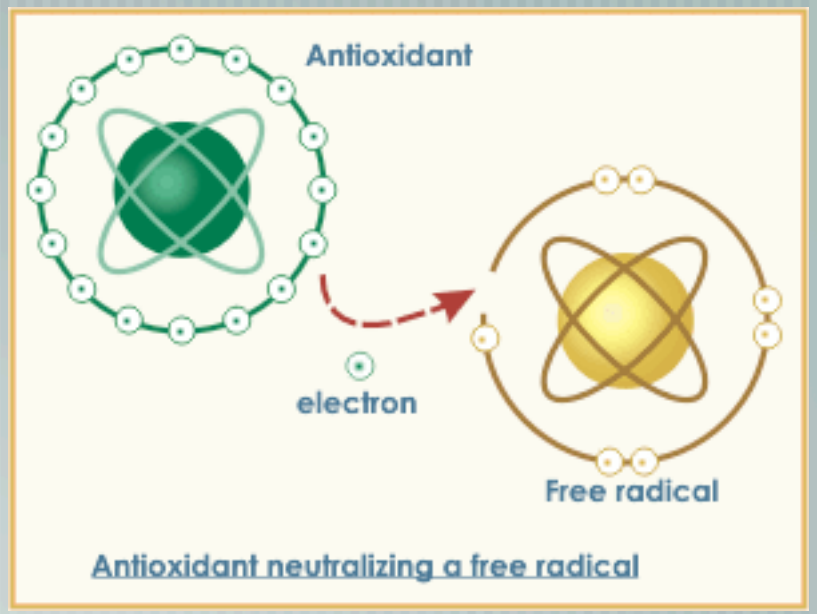
B Vitamins



Vitamins DO NOT provide energy

Anti-Oxidants

- Free radicals
  - electrons & aerobic metabolism
- Anti-Oxidants
  - Vitamins A, C and E



Vitamins

- Do active individuals need to take vitamin supplements?

Minerals

Major (Macro) minerals

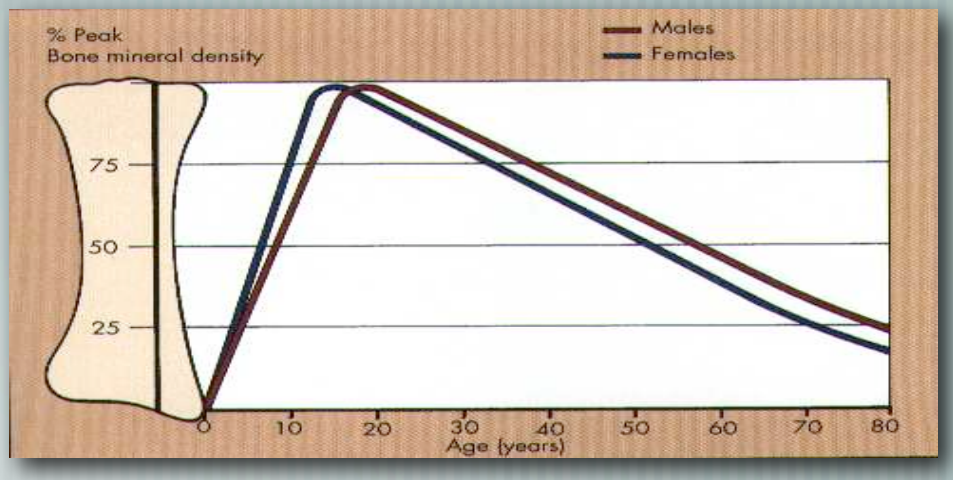
- **Calcium**
- **Sodium**
- **Potassium**
- **Chloride**
- **Phosphorus**
- Magnesium
- Sulfur

Trace (Micro) minerals

- **Iron**
- Iodine
- Fluoride
- Zinc
- Selenium
- Copper
- Cobalt
- Chromium
- Manganese
- Molybdenum
- Arsenic
- Nickel
- Vanadium

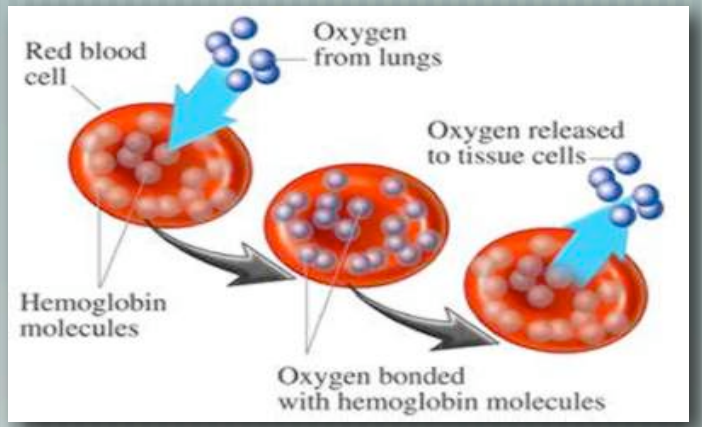
Calcium

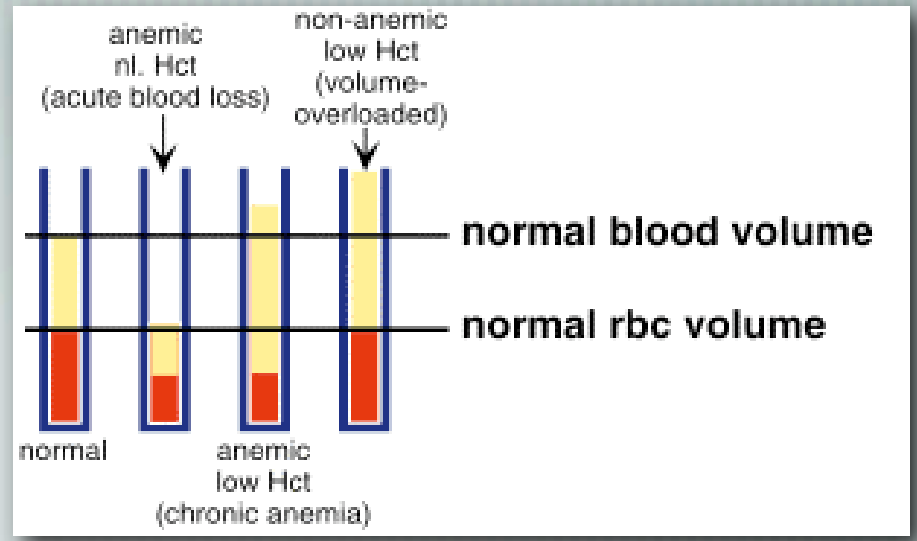
- Stored
- Low calcium diet
- Healthy bones and exercise
- Women and estrogen



Iron

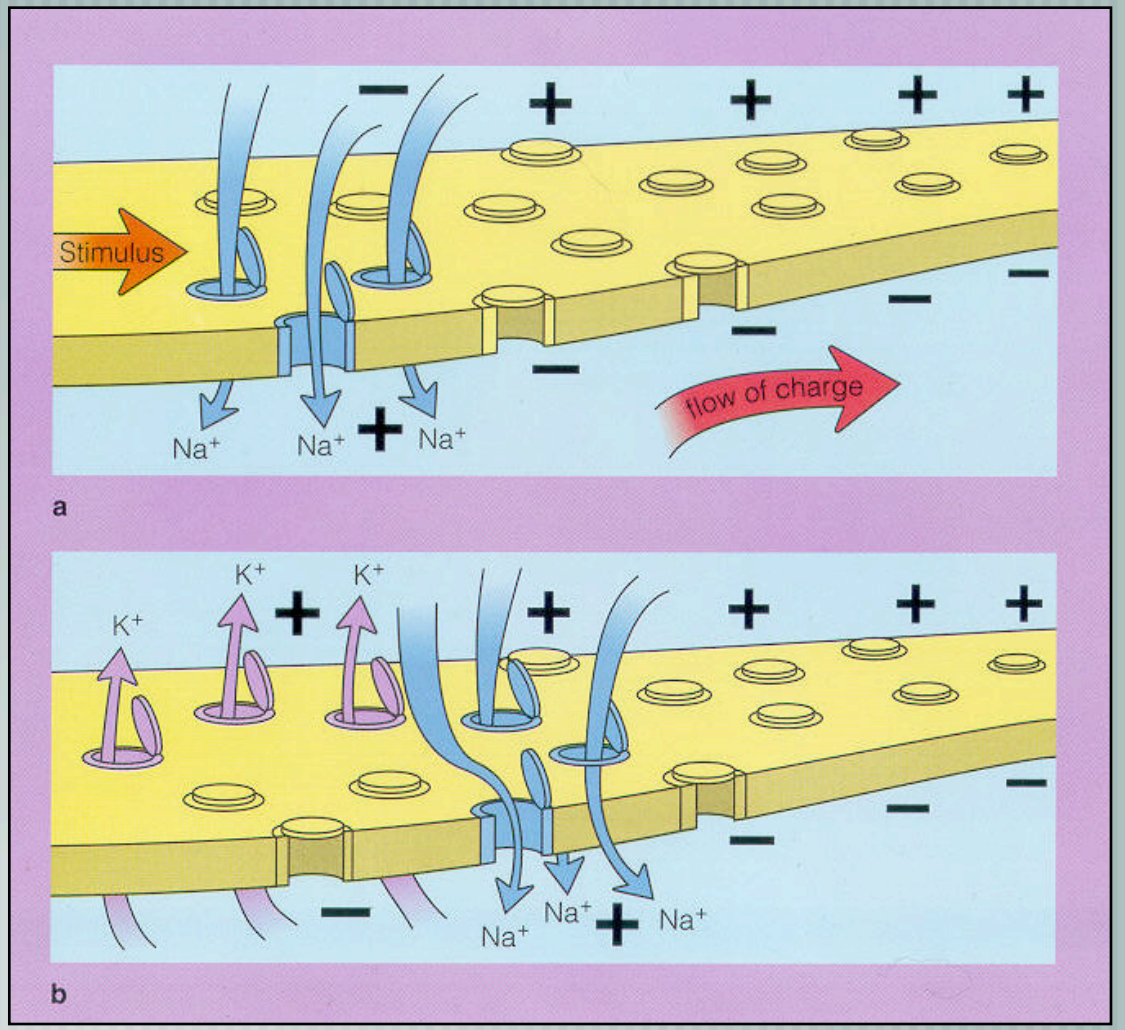
- Function?
- Diet
- Anemia



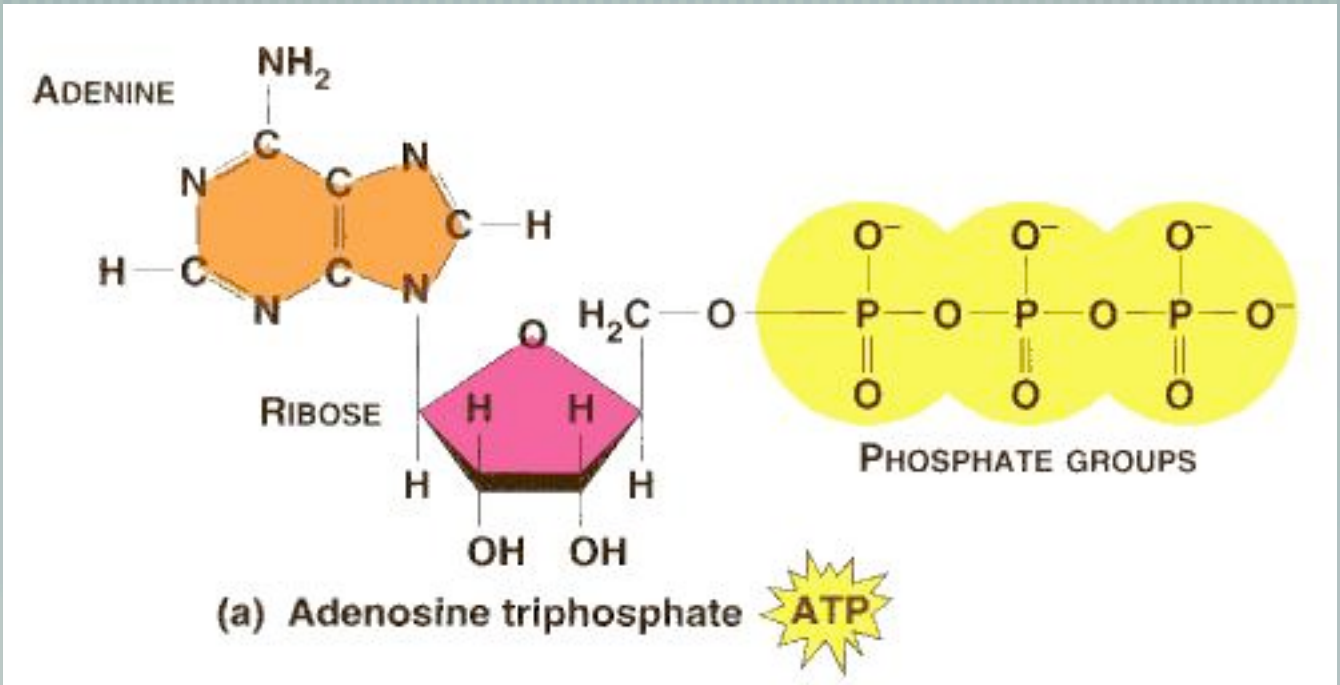


Electrolytes

- Major electrolytes
- Function



Phosphorus


ADENINE
NH2
C
N
C
N
C
H
H
C
C
N
N
O
H2C
O
RIBOSE
H
H
H
H
OH
OH
O⁻
O⁻
O⁻
P
O
P
O
P
O
O
O
O
PHOSPHATE GROUPS
(a) Adenosine triphosphate
ATP

Nutrition and Cramps

- electrolytes
- dehydration
- fatigue
- other

Minerals

- Do active individuals need to take mineral supplements?