

# Performance Fueling & Hydration to Maximize Training



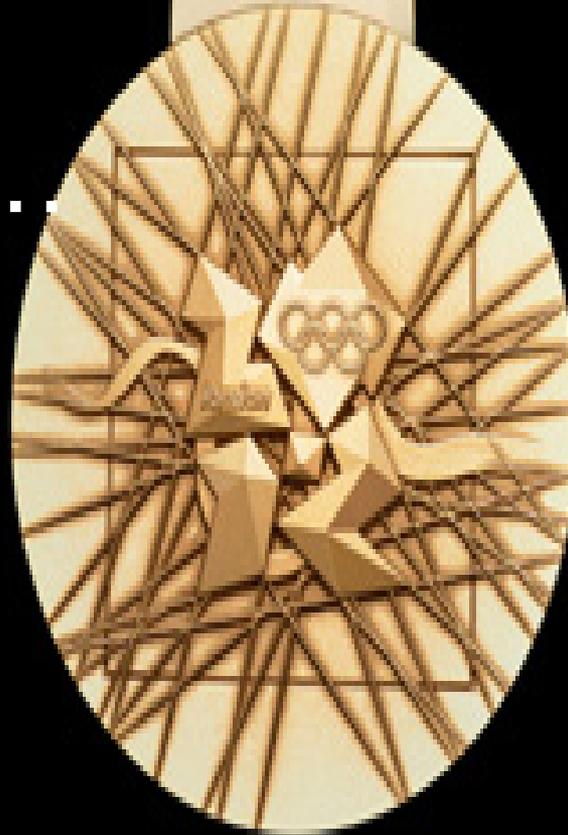
Kate Burks, MS, RD, LD

@kate\_burks

Nutrition can make  
a good athlete GREAT



or...



it can make a great athlete GOOD

# Objectives

- Role of Carbohydrates as Fuel – Pre/During
- Role of Protein in Repair – Post
- Role of Fluids with Thermoregulation
- Impact of Recovery on Performance

❖ What occurs with improper fueling?

❖ 1) Nausea or stomach discomfort

❖ 2) Fatigue

❖ 3) Blurred vision

❖ 4) Temperature regulation

❖ 5) Upset stomach

**F O C U S**

# FOCUS

❖ What occurs with i

❖ 1) Nausea

❖ 2)

e regulation

et stomach

**TWO primary goals for  
OPTIMAL performance!**

# Small CHOICES CHANGES

1. Mind Power

## Maintain Blood Sugar



## Reaction

## Concentration Decision Making

# 2. Muscle Energy

## ATP-CP System

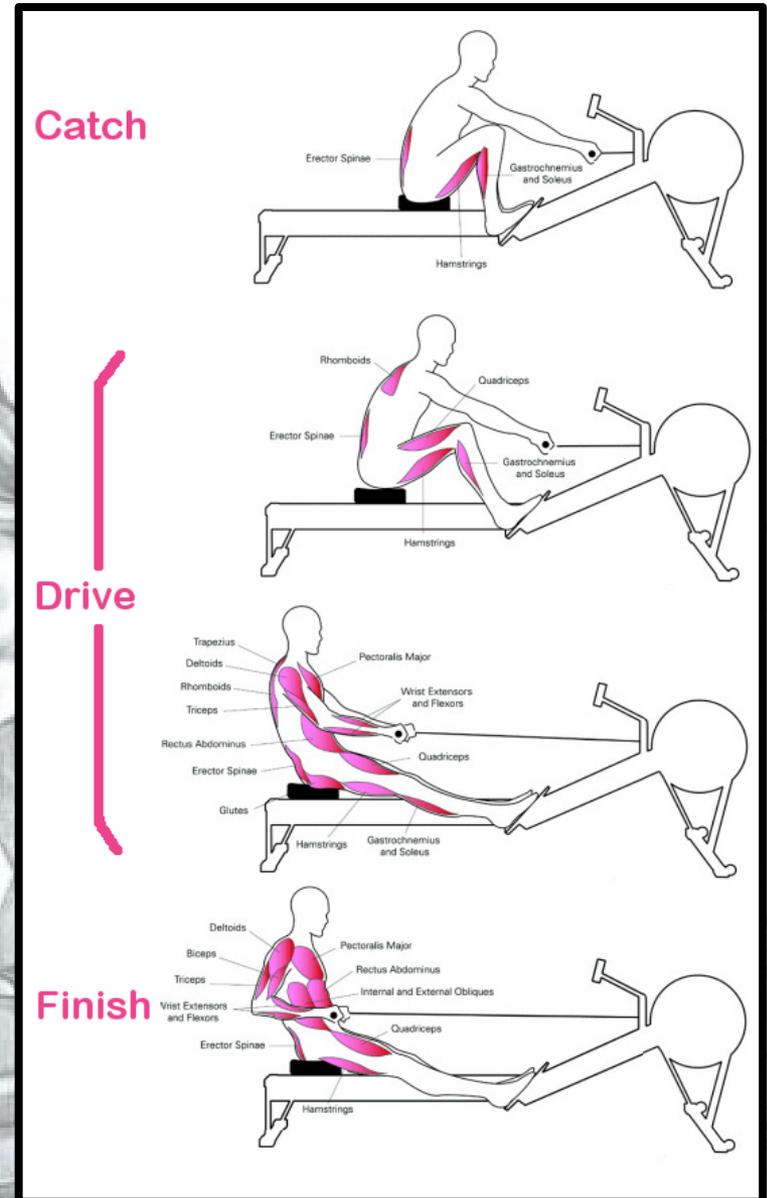
Explosive movements, less than 10 seconds

## Glycolysis System

30-90 seconds

## Aerobic System

Greater than 90 seconds



# Roles of Carbohydrates

1. Energy for Muscles & Brain
2. Spare Muscle Loss During Exercise
3. Rapid Replenishment of Fuel Stores After Exercise



# Glycogen

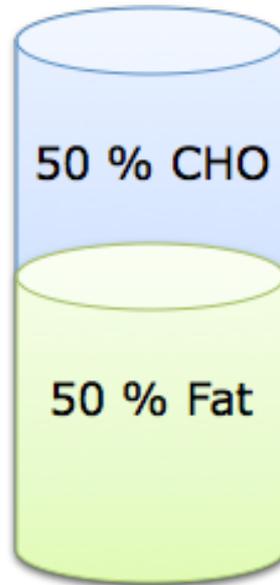
- Storage form of carbohydrate for animals and humans
- Found in the liver and muscles
- Stores are limited, unlike fat



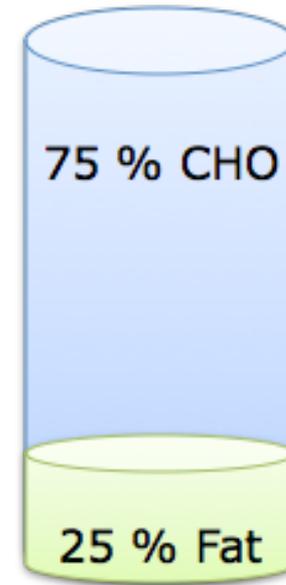
# Effects of Exercise Intensity on Fuel Use



Low  
Intensity



Moderate  
Intensity



High  
Intensity

Energy



A

— Long Lasting (High Fiber)

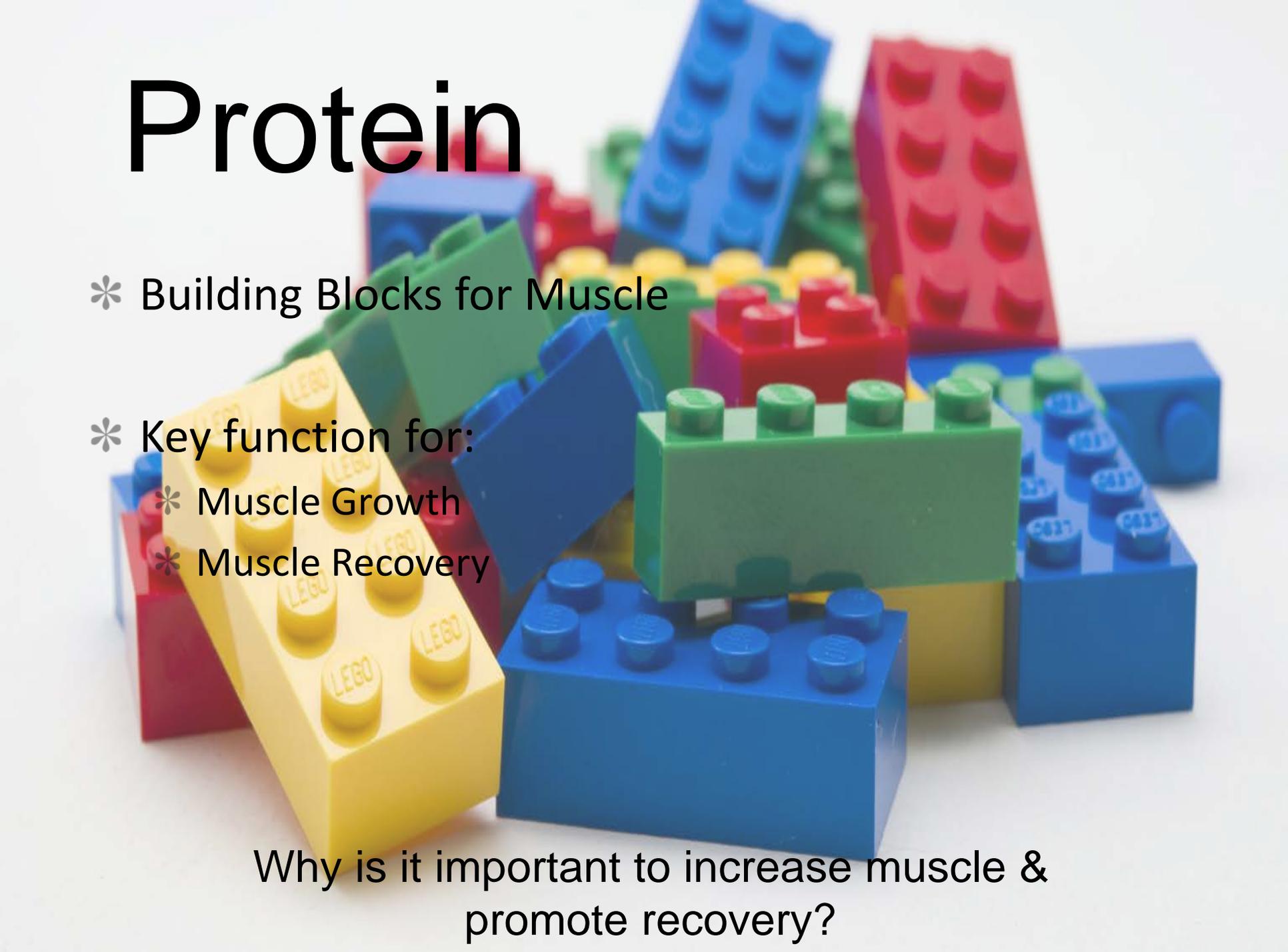
— Fast Digesting (Low Fiber)

B



HOW DOES THIS FUEL  
ME?

# Protein



- \* Building Blocks for Muscle

- \* Key function for:

- \* Muscle Growth

- \* Muscle Recovery

Why is it important to increase muscle & promote recovery?

# How do muscles grow?



- \* More muscle = more active tissue
  - \* Increases metabolic rate
- \* Contributes to explosive movements:
  - \* Force, strength, power, & speed
- \* Strengthen bones

**Muscle Building**

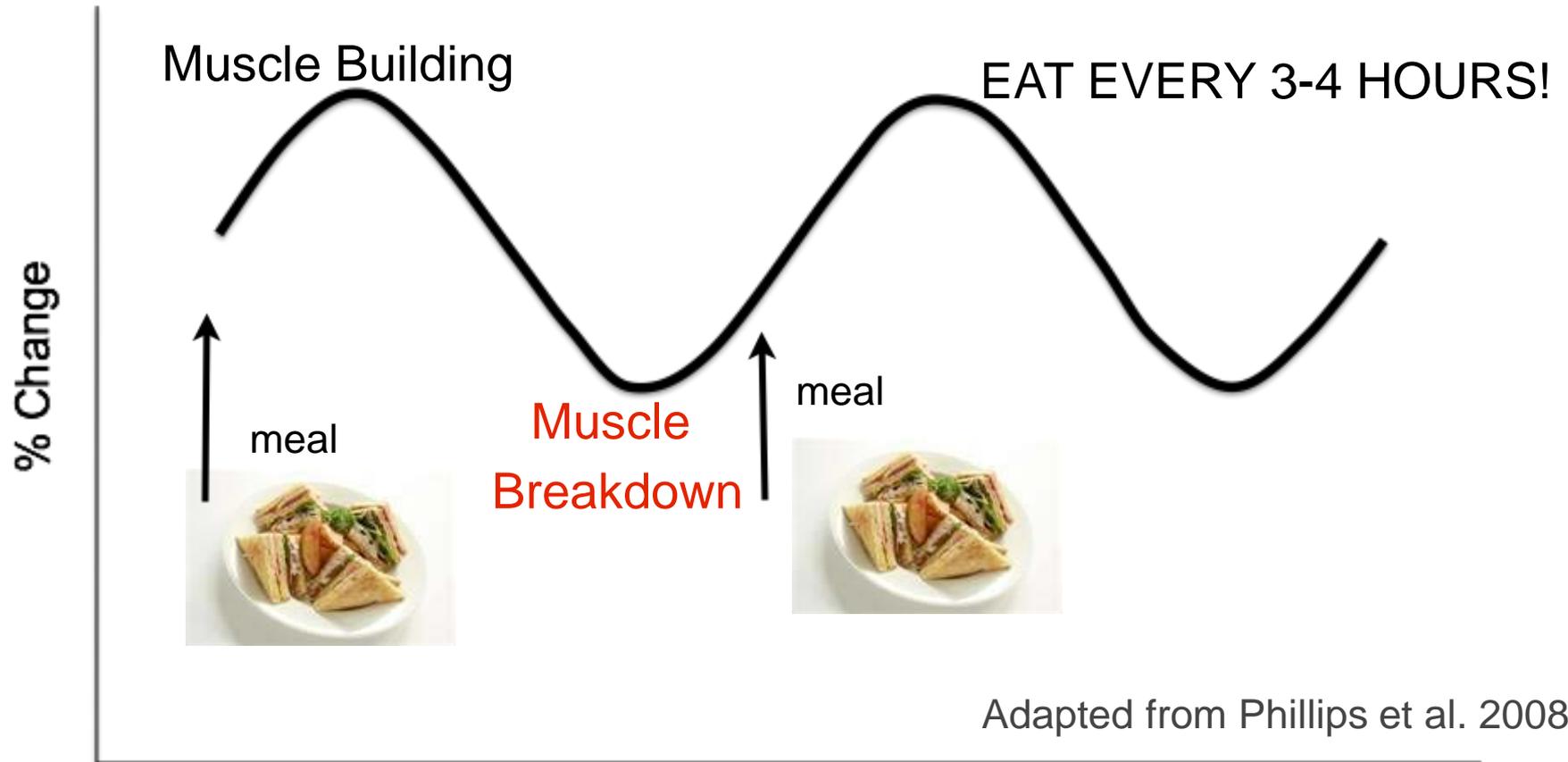
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**Muscle Breakdown**

# 1. Protein Timing

## Meal Timing & Muscle Breakdown Changes

— Muscle growth



Adapted from Phillips et al. 2008

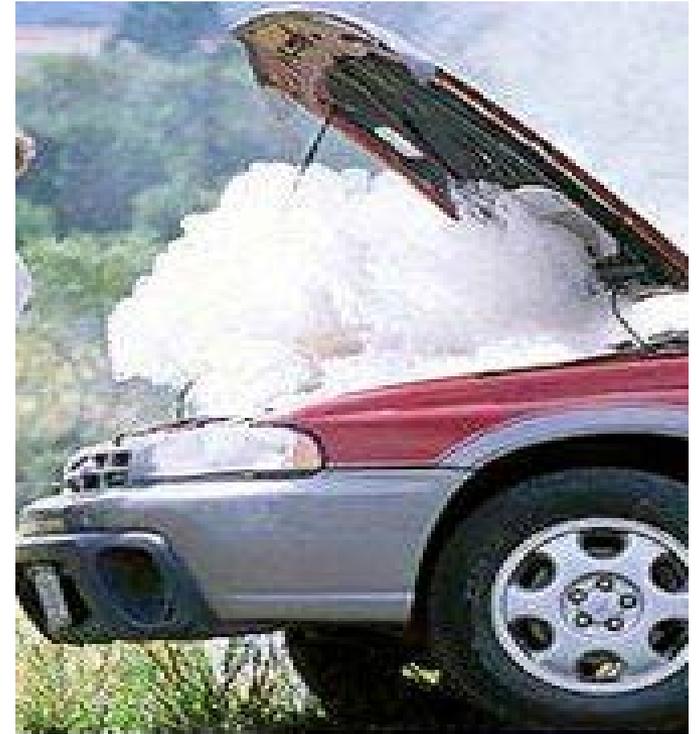
# 1. Protein Timing

## Skipping Meals

\* **Decreases energy within your muscle cells**

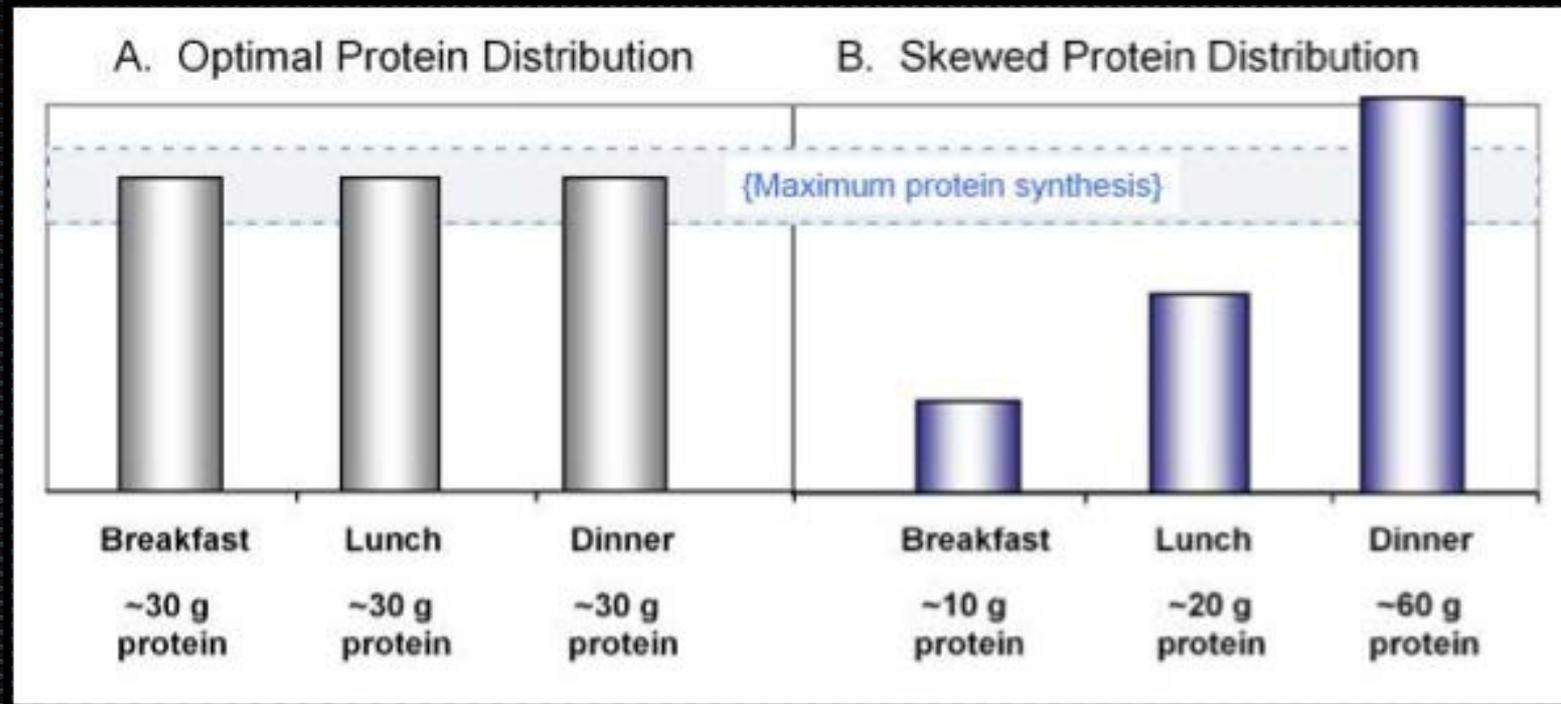
↓ Energy = ↓ Ability for Muscle Building

↓ Energy = ↑ Muscle Breakdown



# 1. Protein timing

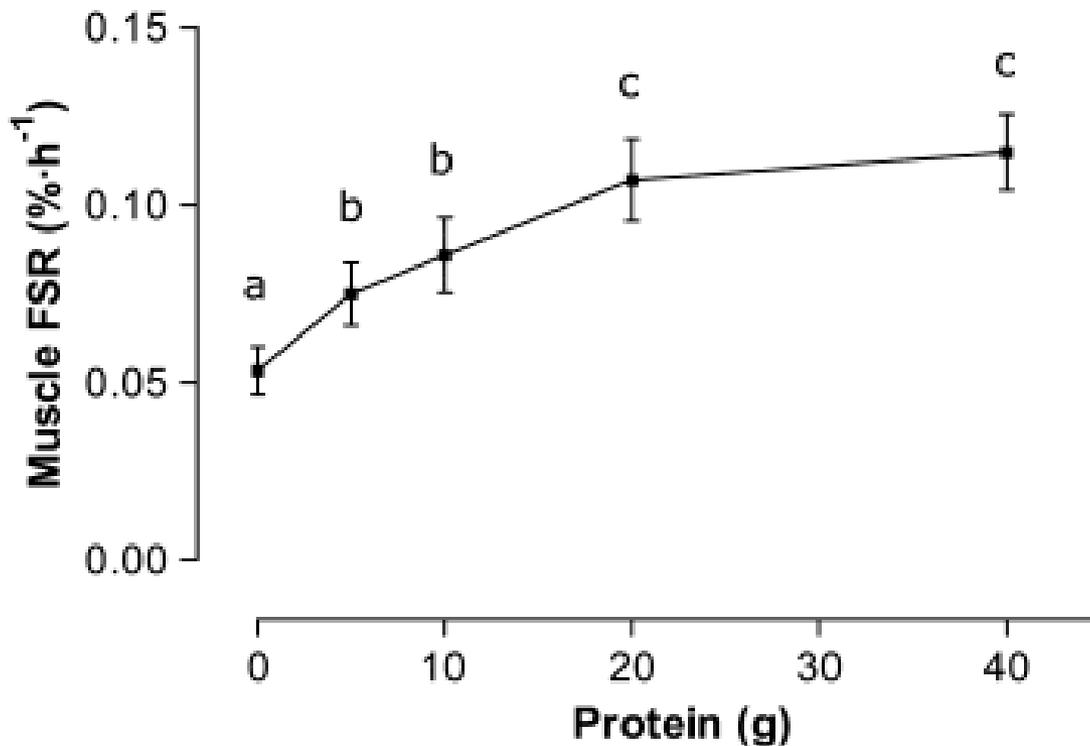
## Protein Distribution



Norton & Wilson et al. 2013

## 2. Protein Quantity

Protein synthesis after resistance training in response to varying doses of dietary protein intake



Fractional Protein Synthesis (FSR) illustrates muscle protein synthesis

Egg protein used

### 3. Protein quality

# Protein Sources



Dairy



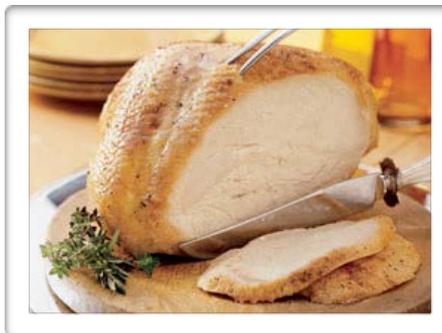
Seafood



Peas, Beans,  
Nuts



Eggs



Poultry



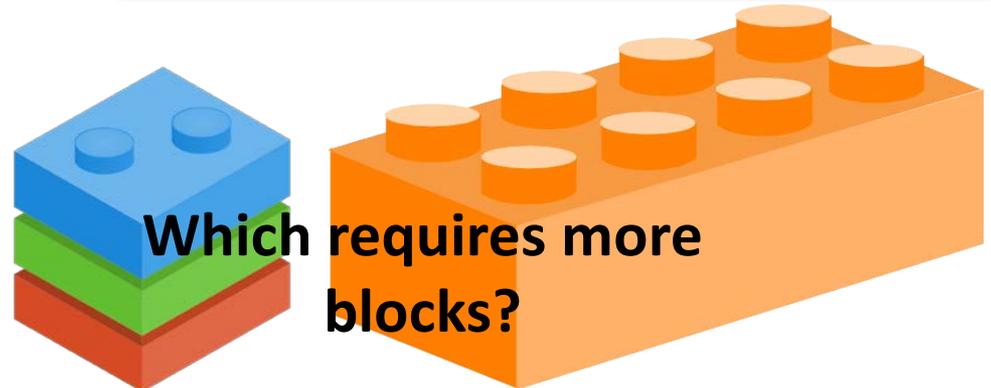
Red Meat

### 3. Protein quality

# Protein Sources

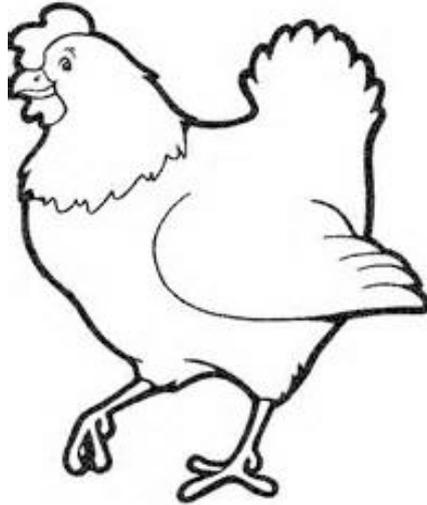
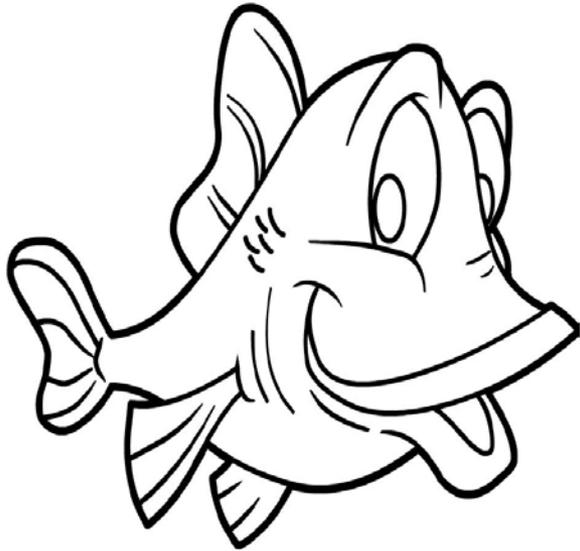


The Higher the EAA and particularly leucine content the better, so consume meat and dairy based products.



### 3. Protein quality

# Protein Type: Lean Proteins



\* The Less Legs The Better!

# FLUIDS

Regulates  
Temperature

75% of Muscles

Utilizes &   
Distributes Water  
Soluble Vitamins

Cushions &  
Lubricates Joints

Converts Food to  
Energy

Carries Nutrients  
and Oxygen to the  
Muscles & Cells

83% of Blood

Helps Absorb  
Nutrients

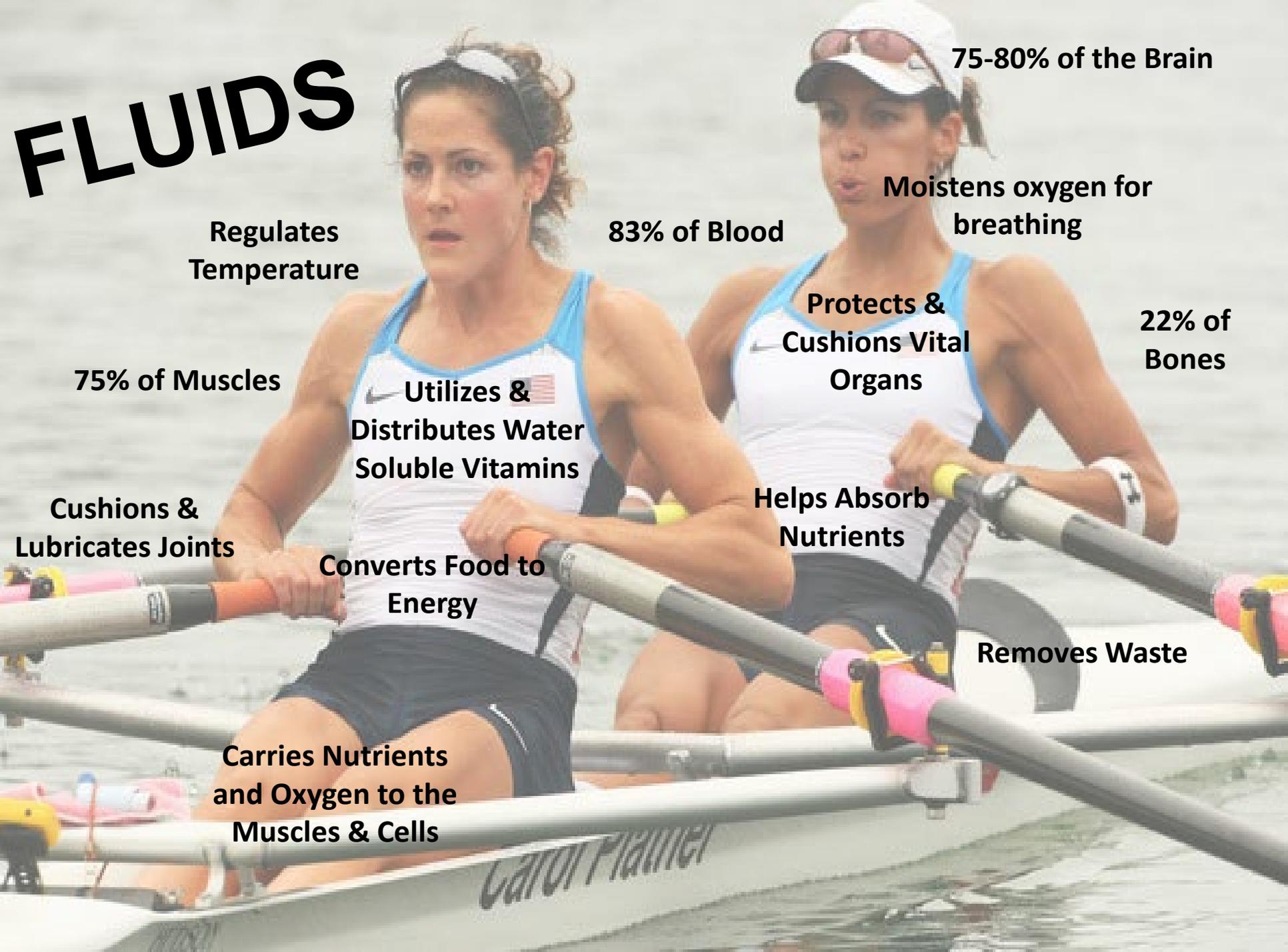
Protects &  
Cushions Vital  
Organs

Moistens oxygen for  
breathing

75-80% of the Brain

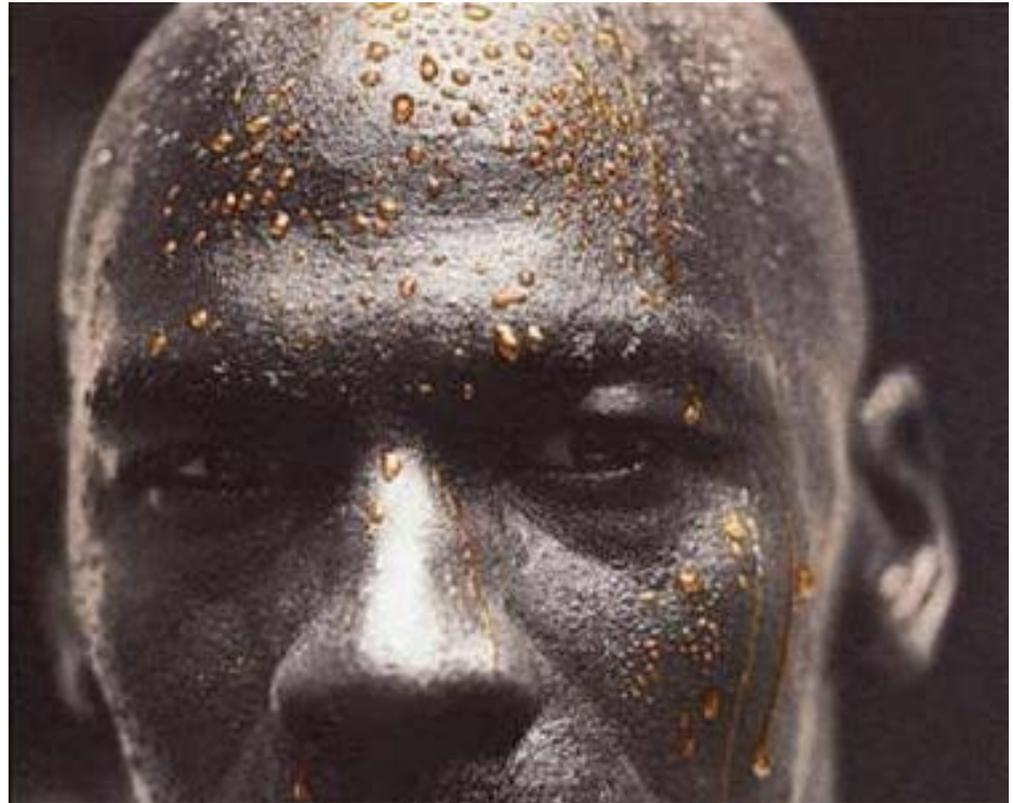
22% of  
Bones

Removes Waste



# “you gotta sweat it to get it”

- Water
- Electrolytes: Sodium, Potassium, Chloride
- Must be replaced!
- Sweating is less effective at cooling in humid environments



# Hydration & Performance

## Training dehydrated (>3%):

- ↓ circulating fluids in bloodstream & surrounding cells  
= heart works ↑  
= ↑ heat production & ↓ sweat production
  - ↑ Body's core temperature
  - ↓ Endurance
- ↓ mental performance
  - ↓ Concentration
  - ↑ Self-reported tiredness
  - ↓ Ability to do simple math
  - ↓ Ability to stay in sync
  - ↑ Irritability
- ↑ risk of heat injury
  - ↑ Dizziness
  - ↓ Thermoregulation; lost at 1-2%
- ↓ aerobic & anaerobic performance
  - Running times ↓ 6-7%
  - ↑ Muscle Cramps Risk
- ↓ recovery
  - ↓ Intracellular volume can ↓ glycogen & protein synthesis
  - ↑ Increases muscle breakdown
- ↑ cortisol to testosterone ratio
  - ↑ Muscle mass loss at rest

Effect of hydration state on resistance exercise-induced endocrine markers of anabolism, catabolism, and metabolism. Jedelson DA et al. J Appl Physiol, 2008;105:816-824.

Dehydration effects on Endurance Performance IOC Susan Shirreffs Fluids and Endurance Performance (Gonzalez-Alonso et al 1995, 1997, 1998, 1999, 2000; Gonzalez-Alonso 1998; Gonzalez-Alonso & Calbet 2003; Hargreaves et al 1996)

# Dehydration: Signs & Symptoms

- Dark yellow, strong smelling urine
- Decreased urination frequency
- Rapid resting Heart Rate
- Muscle soreness & cramping
- Thirst (too late)
- Headache & discomfort
- Lethargy & chills



# Performance Nutrient Timing

48 hours before competition:

- Eat every 2-4 hours
- Choose low fat protein
- Choose long-lasting carbohydrates
- Monitor hydration
- Aim for 9-10 hours of sleep



# Pre-Fuel Meal

## 1. Long Lasting Carbohydrate



Oatmeal

Whole grain breads

Brown rice

Fruits

Vegetables



**Snack:** 30-60 mins.  
before with  
carbohydrate and 1-  
1.5 cups of fluid

**Meal timing:** 2-4 hours before

**Meal hydration:** 4 hours before,  
consume minimum of 3 cups  
of water or sports drink

**Limit Added Fats!**

## 2. Fast Digesting Protein



Roasted chicken

Broiled fish

Egg whites

Baked turkey

Grilled sirloin

Lean ham

# Limited meal time or pre snack

If you have <2 hrs to Start of Training/Mission

– CARBOHYDRATES

- 30g carbohydrate
- Can be solid or fluid

– FLUIDS

- 30 minutes before training/mission = 5-10 oz
- There is no benefit to taking in more fluid than this

– Can combine in CHO containing Fluids

# Hydration During Exercise

- If exercising <1 hour:
  - Choose water OR low calorie fluid with electrolytes
- If exercising >1 hour:
  - Hydrate with fluids containing **electrolytes**
  - **6-8% solution** of glucose/fructose
  - 5-8 ounces every 15-20 minutes OR according to sweat rate
  - Drink before you feel thirsty!

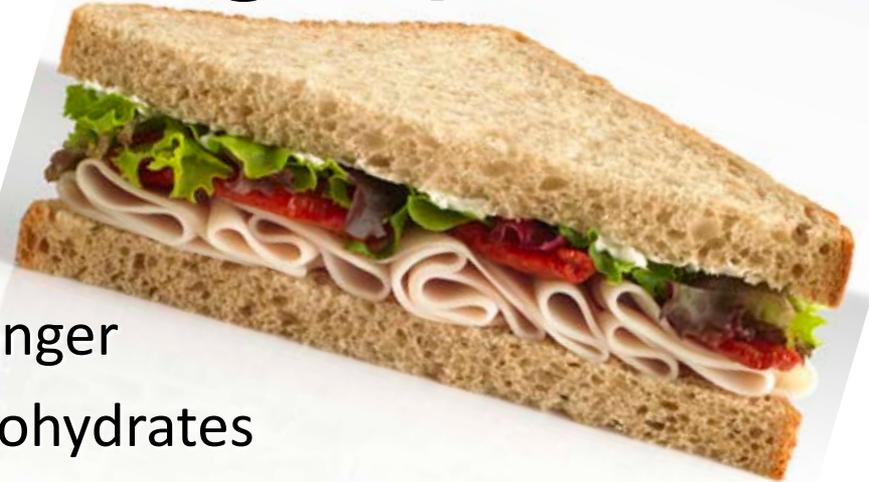


# Fueling During Sport

## ☐ Low Intensity

### ☐ Food for fuel:

- Muscle fuel and prevent hunger
- Low to moderate fiber carbohydrates
- Small amounts of non-fat proteins are acceptable
- Carry fast-digesting carbohydrates
- Prevent blood sugar crashes

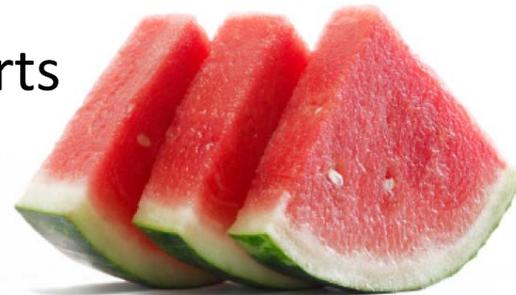


# Fueling During Sport

## Intermittent & High-Intensity Sports

Brain/Muscle fuel: Fast-digesting carbohydrates

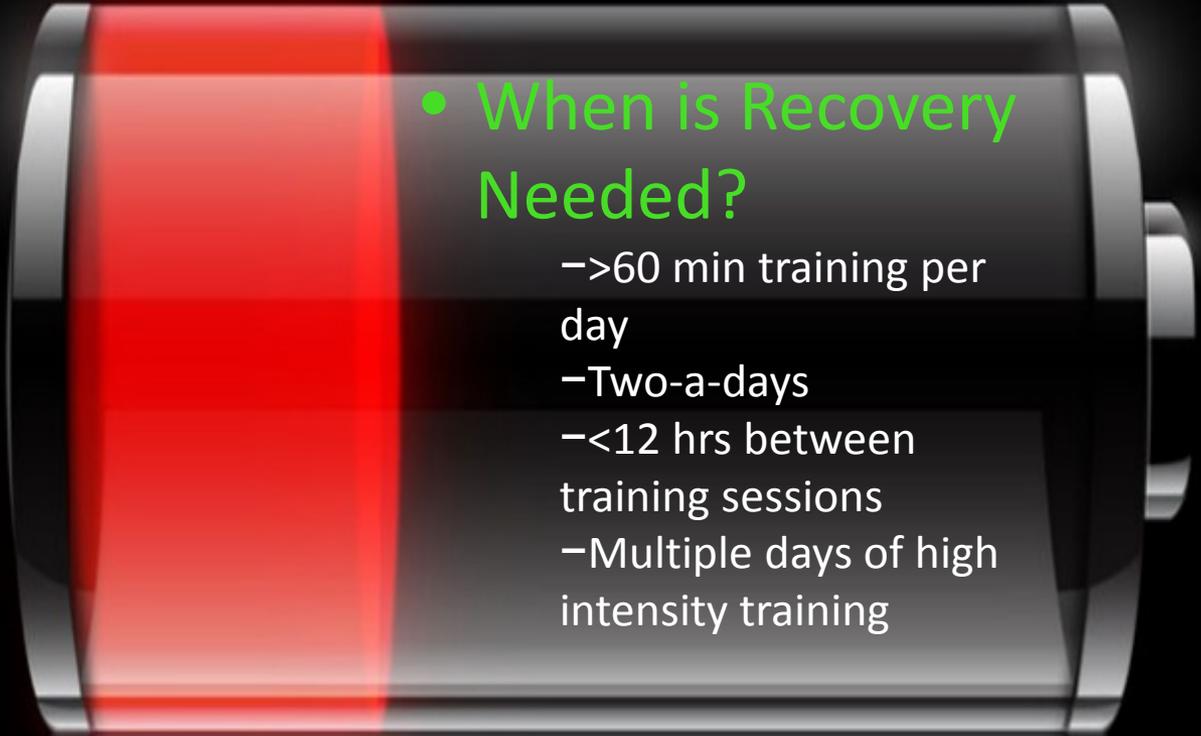
- Too much fiber= upset stomach
- Simple sugars are ideal
- Activity > 60 minutes, include carbohydrate in fluids
- Replace electrolytes lost using sports drink
- Be careful of too much fluids





## The 4 R's of Recovery:

- ✦ Refuel
- ✦ Repair
- ✦ Rehydrate
- ✦ Rest



- When is Recovery Needed?

- >60 min training per day

- Two-a-days

- <12 hrs between training sessions

- Multiple days of high intensity training

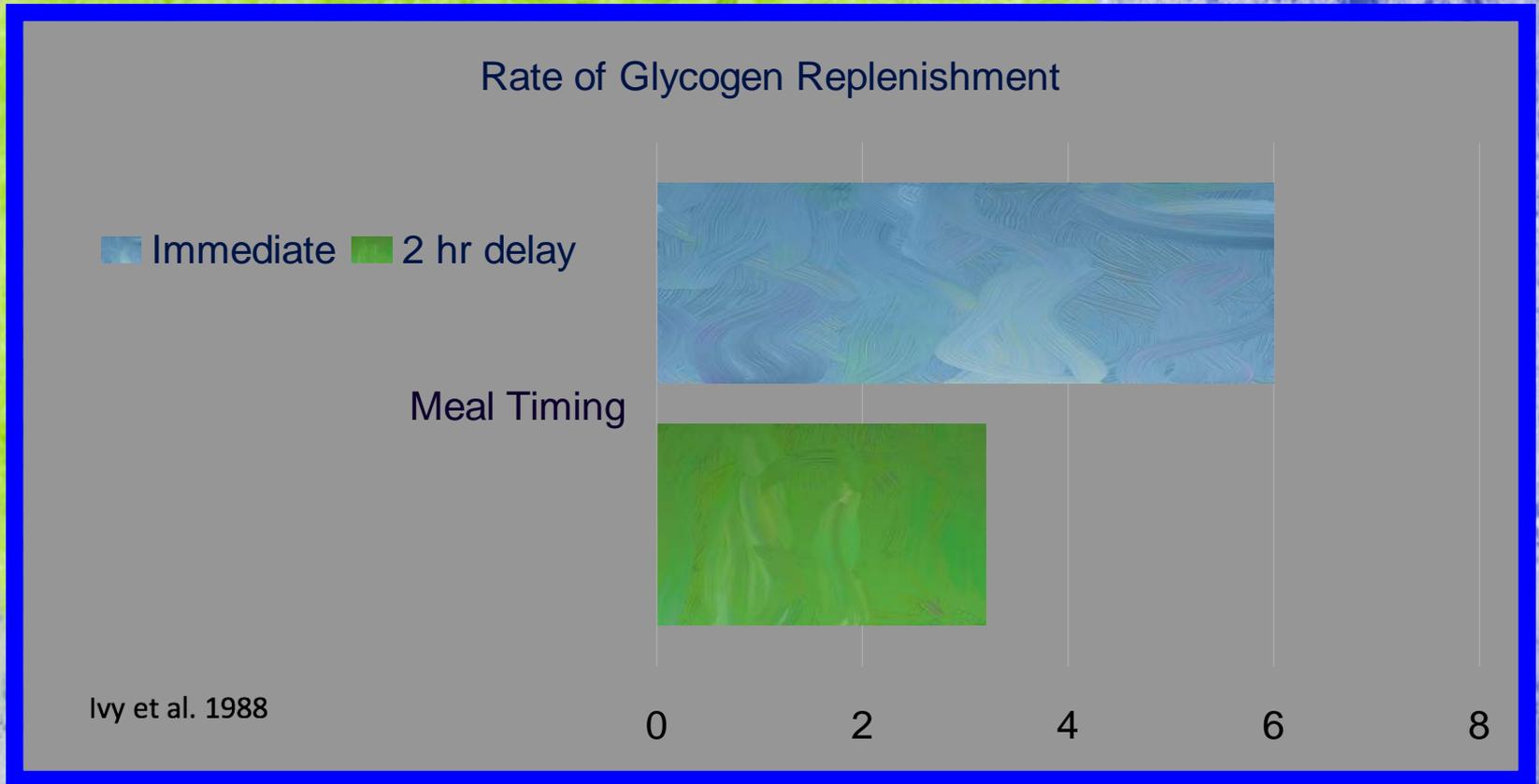
1. Ivy J and Portman R. *Nutrient Timing*. Basic Health Publications, Inc. 2004.
2. Position Stand: Nutrition and Athletic Performance. *Med Sci in Sports and Exerc.* 2009. 41:709-731.
3. Levenhagen DK et al. Postexercise nutrient intake timing in humans is critical to recovery of leg glucose and protein homeostasis. *Am J Physiol Endocrinol Metab.* 2001;280:E982-E993.

# Eat



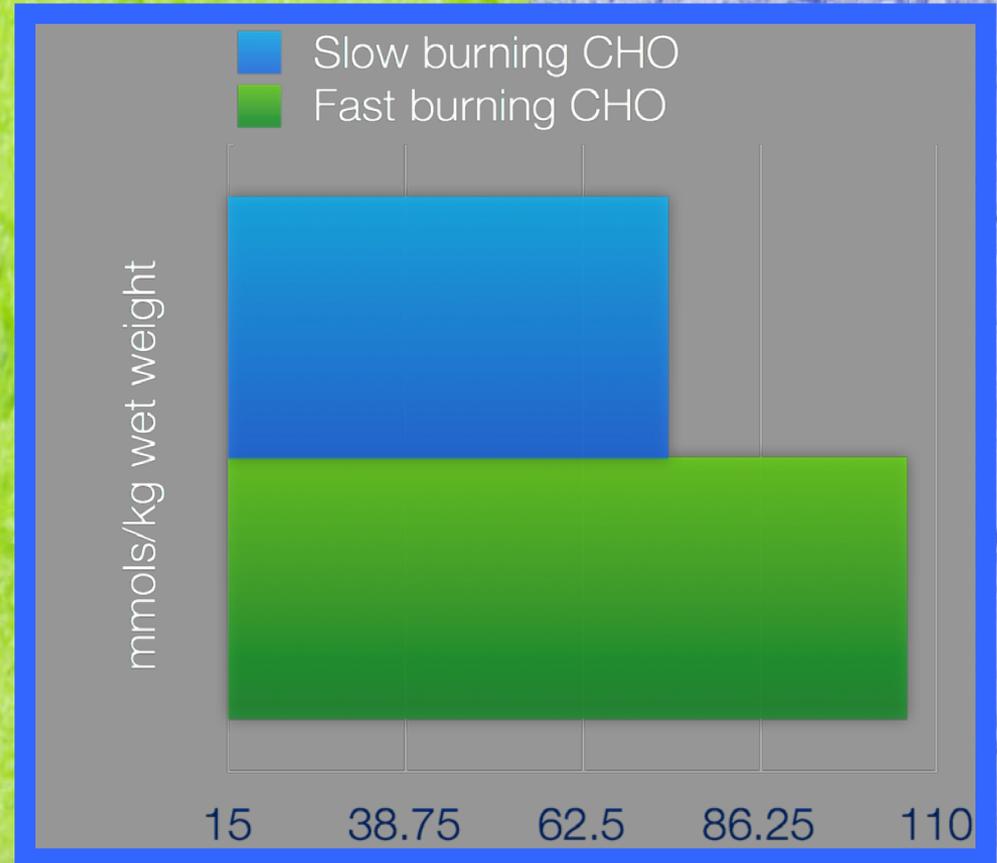
## Refuel

# Post Exercise Carbohydrate Timing



# The Effect of Carbohydrate Type on Glycogen Resynthesis

- ✿ After exercise, fast burning carbohydrates increase muscle glycogen to a greater extent than slow burning carbohydrates.



Burke et al. 2003

Speed up muscle **Repair**

with high quality

**Protein**

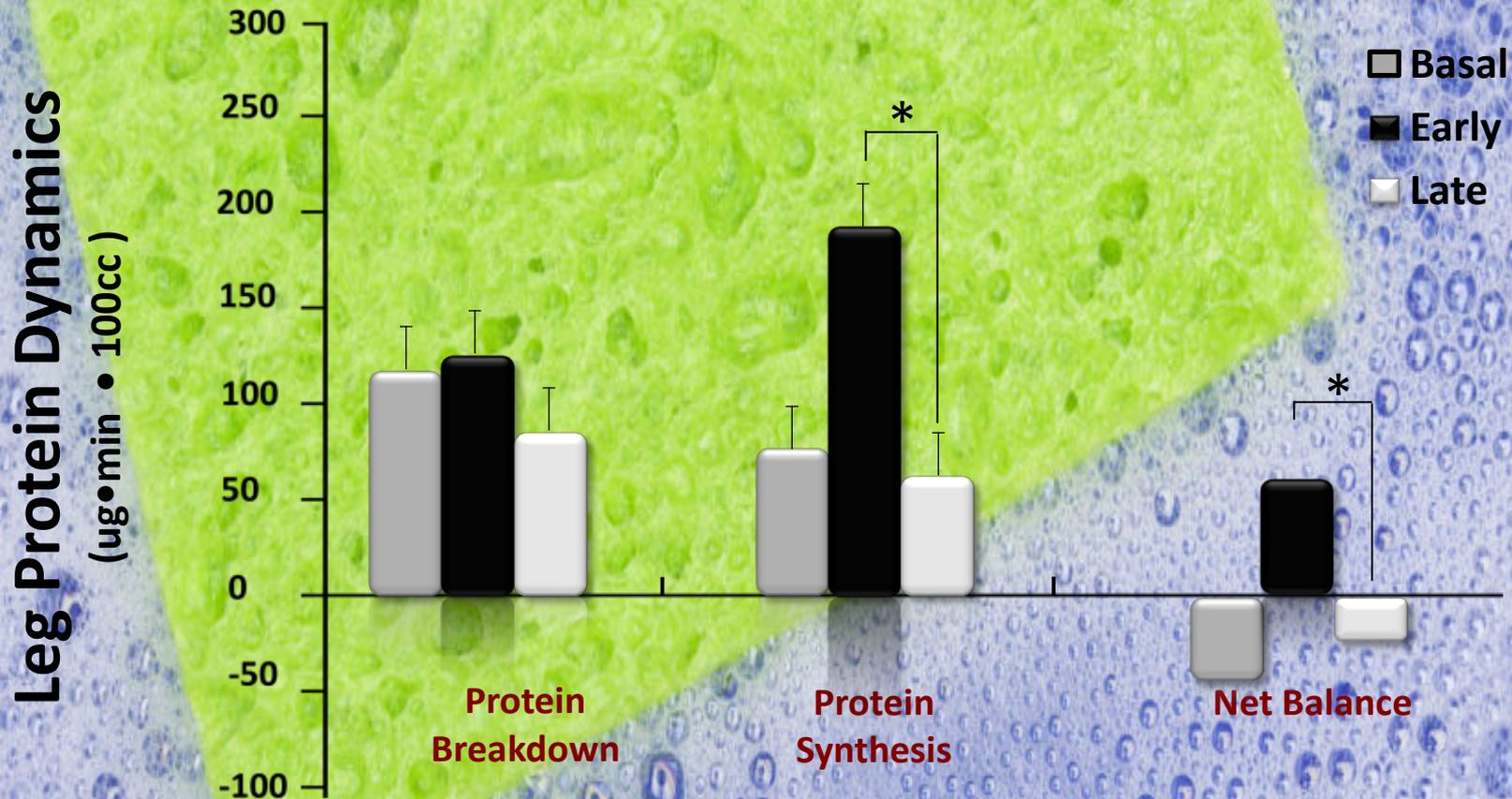


**20 grams**



# Timing of Protein Intake

## Muscle Breakdown/Build-up With Protein Supplement



# Drink

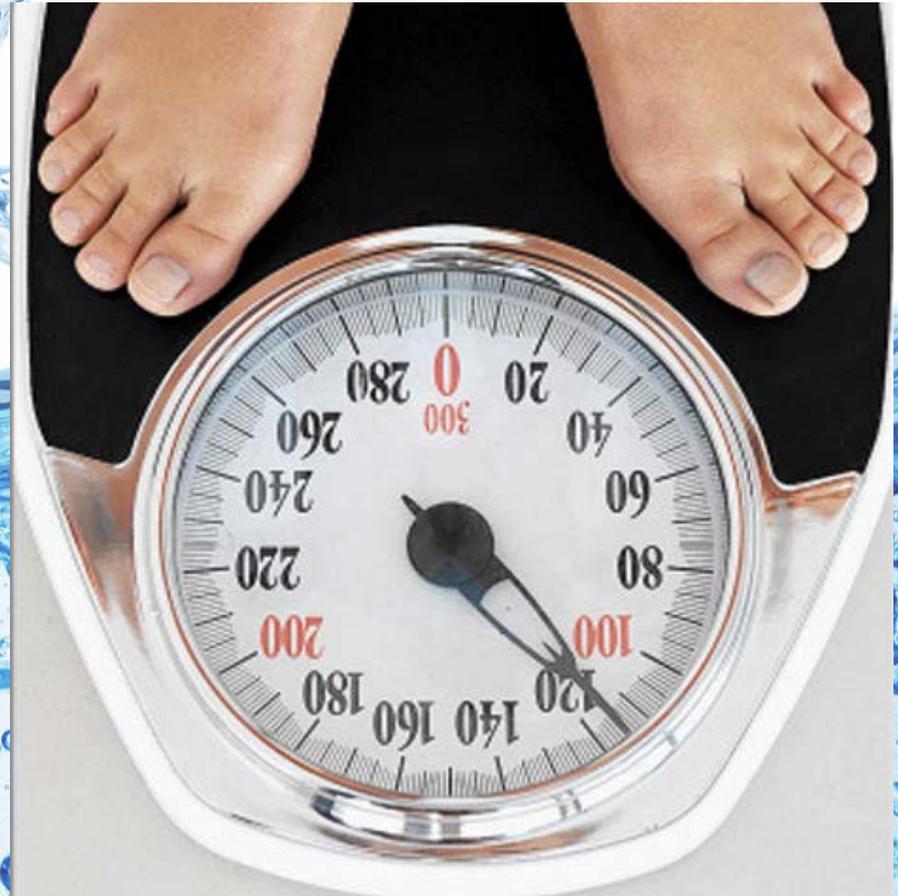
# Rehydrate

fluids immediately!



\* Step 1 - Weigh yourself before & after practice

\* Step 2 - For every pound you lose, replace with 2-3 cups of fluids with sodium.



# Recovery Nutrition Recommendations

- Carbohydrates

- Optimally = 1-1.2 g/kg bodyweight immediately after training

- 75-90g

- Repeat every hour for next 4 hours

- Practically =  $\geq 60-75$  g

- Protein

- 20-25 grams

- Hydration

- Replace 150% weight loss

- Practically = 16-24oz for every 1lb lost during training



got milk?

**PROTEIN**  
TO HELP REBUILD



Get quality **Slee**

to promote Recovery

**p**



10 Hours

**Rest**

**EAT**



**SLEEP**



**ROW**



# Supplements

## ... good or bad idea?



The build up of lactic acid seems to cause fatigue

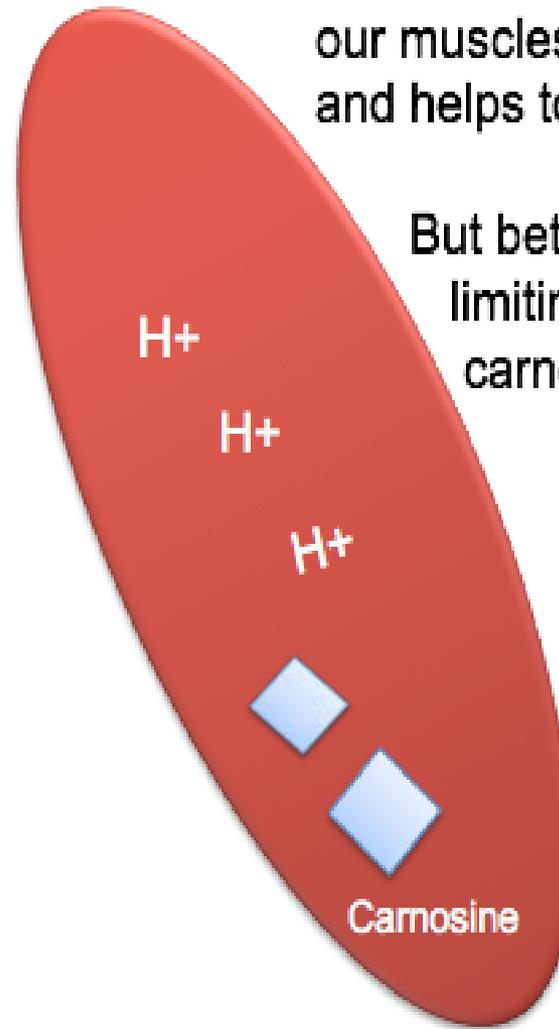
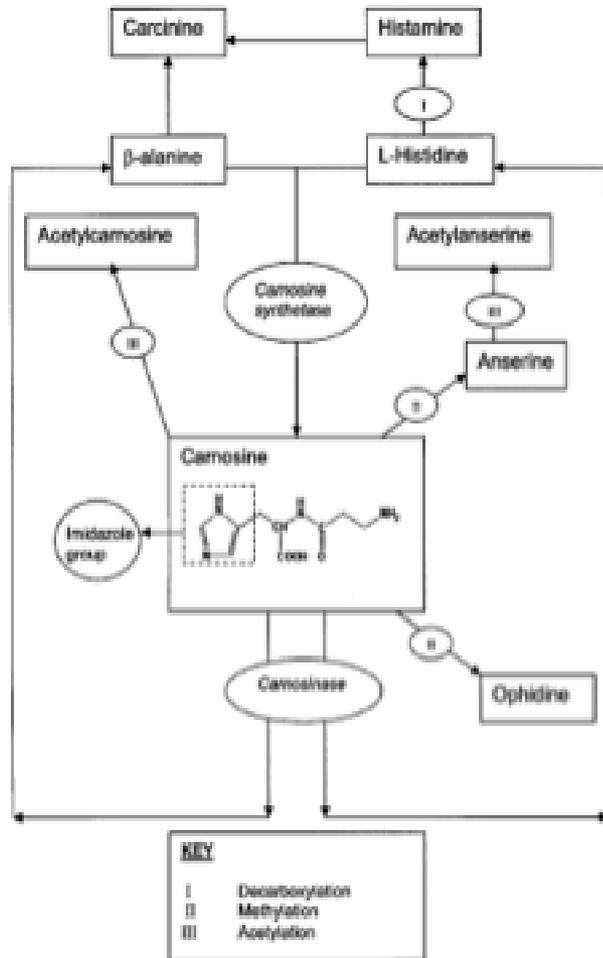
The lack of oxygen delivered to muscles seems to cause fatigue

Some fuel creates explosive energy

# Carnosine Delays Fatigue

Carnosine represents 10 % of our muscles buffering capacity and helps to maintain PH.

But beta-alanine is the rate limiting substrate for carnosine production



# Beta-Alanine Supplementation Improves Aerobic and Anaerobic Indices of Performance

Beta-Alanine can increase Carnosine buffering capacity from normal 10 to 18 %

Jacob M. Wilson, MS, CSCS,<sup>1</sup> Gabriel J. Wilson, MS, CSCS,<sup>2</sup> Michael C. Zourdos, MS, CSCS,<sup>1</sup> Abbie E. Smith, MS, CSCS, CISSN,<sup>1,3</sup> and Jeffery R. Stout, PhD, CSCS<sup>3</sup>

<sup>1</sup>Department of Nutrition, Food and Exercise Science, Florida State University, Tallahassee, Florida; <sup>2</sup>Division of Nutritional Sciences, University of Illinois, Urbana, Illinois; and <sup>3</sup>Department of Health and Exercise Science, University of Oklahoma, Norman, Oklahoma

## SUMMARY

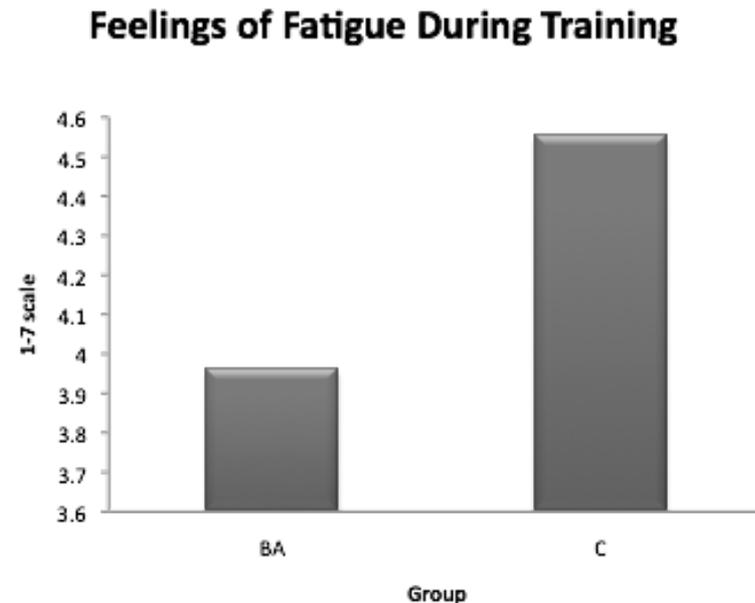
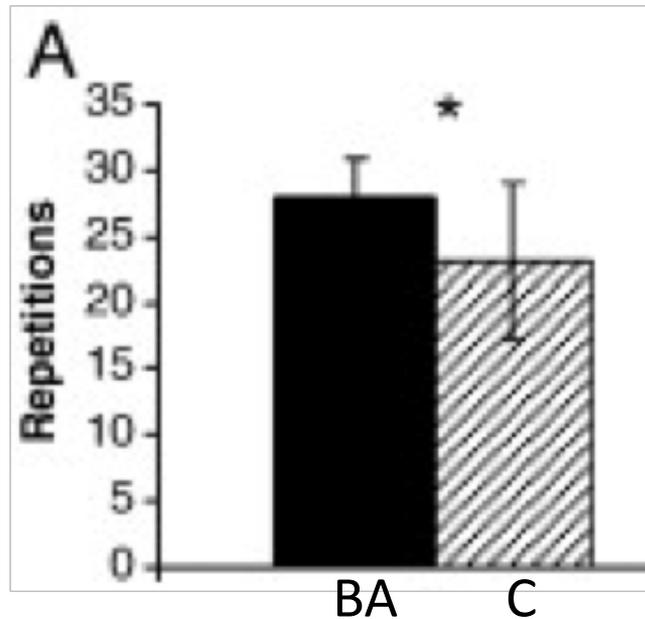
BETA-ALANINE SUPPLEMENTATION HAS BEEN FOUND TO INCREASE INTRAMUSCULAR CARNOSINE, STRENGTH, POWER, VOLUME PER TRAINING SESSION AND A HOST OF OTHER INDICES OF AEROBIC AND ANAEROBIC CAPACITY. HOWEVER, THERE IS A NEED TO SYNTHESIZE THIS RESEARCH SO THAT THE ATHLETE AND STRENGTH COACH ALIKE CAN OPTIMALLY BENEFIT FROM

maintain low to moderately high contractions for extended periods. For example, the world record marathon time is 2:03:59 run by Haile Gebrselassie of Ethiopia. At the opposite end of the spectrum, strength and power athletes can exert extreme torques and forces such that today a 1,000 lb back squat is no longer unthinkable in the world of powerlifting. In between these extremes lie sports such as hockey, basketball, and speed skating, which require brief intermittent bouts of high-intensity activity. Although the time

some models of exercise. Chronically, intense training can stimulate oxidative stress, with both excess H<sup>+</sup> and oxidative stress demonstrating to impair excitation-contraction coupling (EC coupling) processes, leading to reported decrements in force.

An athletes' ability to resist fatigue may determine the intensity and duration of their training and ultimately dictate performance outcomes. Resistance to fatigue is thought to be limited, in part, by intramuscular concentrations of carnosine (28). Carnosine appears to

# Beta Alanine Delays Fatigue During Resistance Training



- ◆ Consume it 2-4 weeks or more before your chosen event
- ◆ Dosing: Ranges between 1.4-6.4 g/day; Optimally <0.8 g every 3 hours

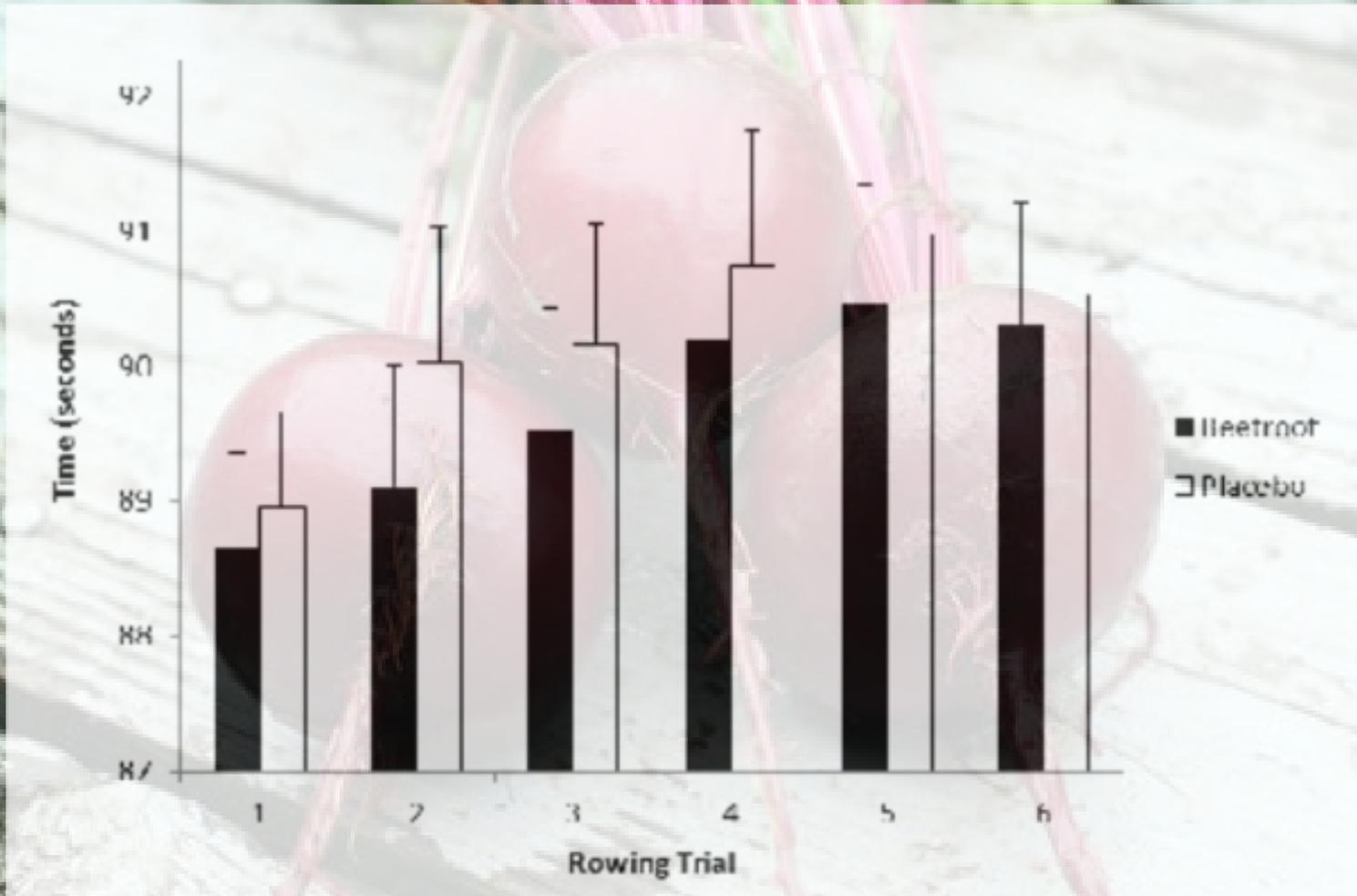
# Beet root juice and performance

## Improves:

- ▶ Exercise Endurance
- ▶ Stamina
- ▶ Energy Efficiency
- ▶ Circulation
- ▶ Oxygen Efficiency
- ▶ Fuel Delivery to Working Muscles



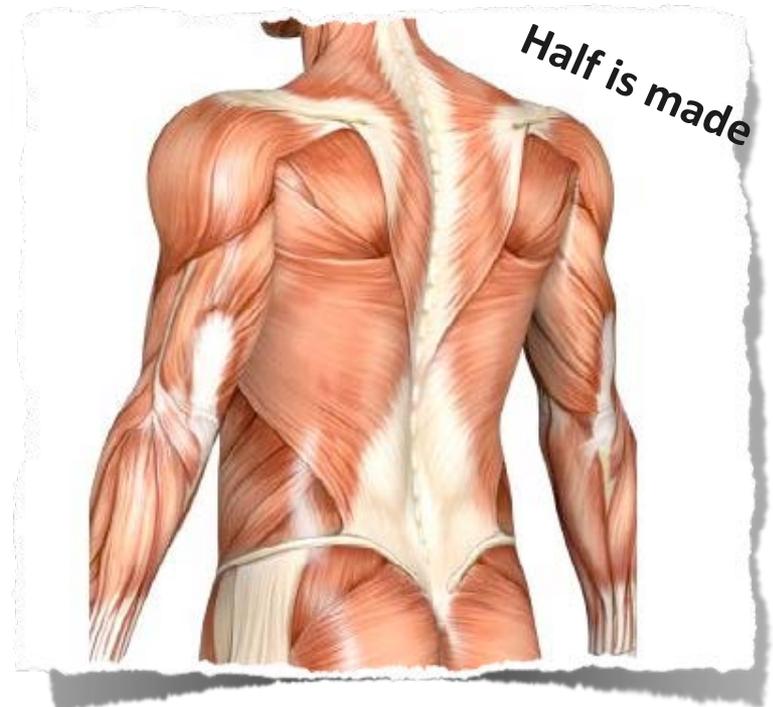
# Dietary nitrate supplementation improves rowing performance



# Creatine and explosive fuel

Creatine occurs naturally in vertebrates and helps to supply energy to all cells in the body, primarily muscle, by increasing the formation of Adenosine Triphosphate (ATP).

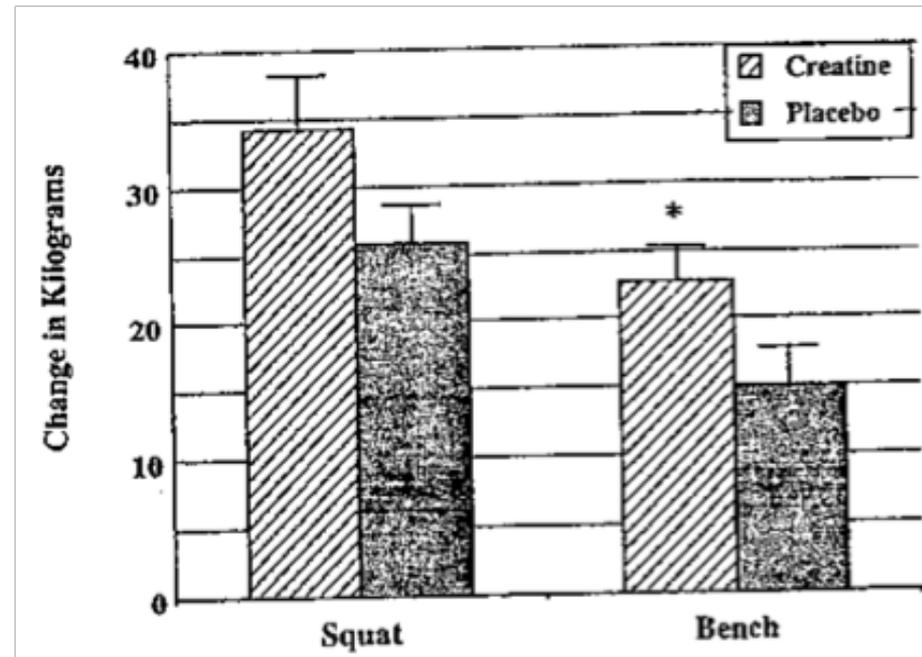
- ◆ Approximately 95% of the human body's total creatine is located in skeletal muscle.
- ◆ Creatine is made from 3 amino acids in the body L-arginine, glycine, and L-methionine.



Half is from food



# Creatine Supplementation Increases Squat and Bench Strength



[Volek et al. \(1997\) J Am Diet Assoc. 97\(7\):765-70](#)

- ◆ In order to get an ergogenic effect from creatine you need to increase intramuscular levels by about 20 mmols.
- ◆ 5 grams X 4 times per day with carbs increases intramuscular Creatine Phosphate concentrations by 9 mMols.
- ◆ Thus, it would take approximately 2 days to raise muscle stores, but typical loading protocols are 5 days.
- ◆ After this you should maintain with 3-5 grams daily, depending on weight.

# Summary & Conclusions

- Pre exercise: high fiber (slow digesting) carbohydrates during the day & 1-2 hours before exercise
- During exercise, 8 oz. sport drink every 15-20 minutes is ideal.
- Immediately after exercise a moderate amount of carbohydrate plus a fast digesting protein source will both optimize glycogen re-synthesis and protein repair.
- Aim for 10-12 hours of sleep/day for optimal recovery.



**“Athletes don’t plan  
to fail,  
they fail to plan.”**

**Questions?**