Getting Protein Right …
… it’s all about meal choices

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Disclosures:

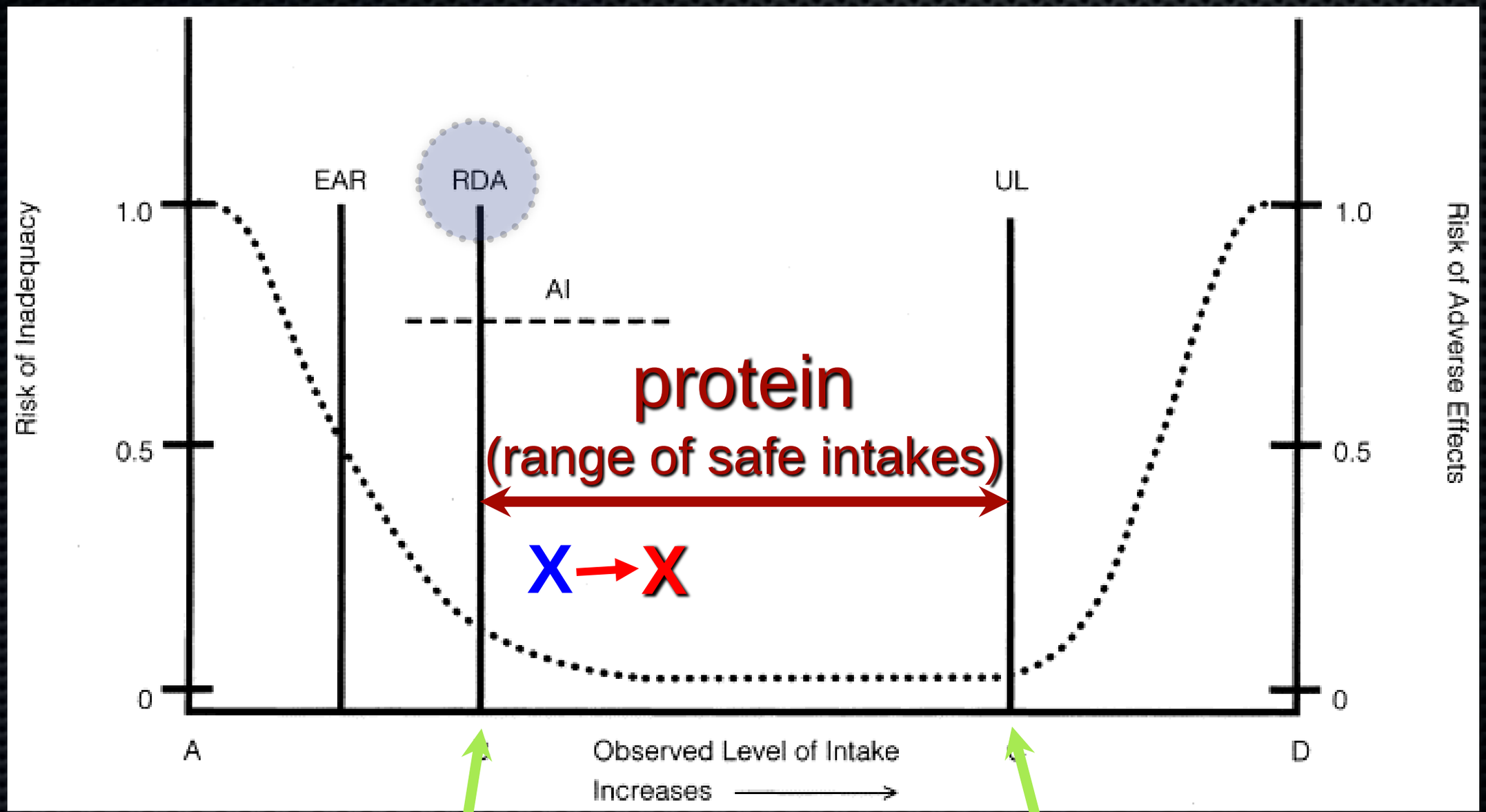
- Director of Research, Egg Nutrition Center
- Chief Science Officer, Qivana
- Consulting:
  - Ajinomoto
  - ZoneLiving
  - Davisco
- Speaker's Bureaus:
  - National Dairy Council
  - National Cattlemen's Beef Association

Protein is the hottest topic in nutrition (and most controversial)

Beliefs about protein involve:

- emotion and personal bias
- religion
- animal rights
- environmental concerns
- cost
- politics
- Nutrition Science ???

Dietary Reference Intakes (DRI)



0.8 g/kg

56 g

> 2.5 g/kg

~ 200 g

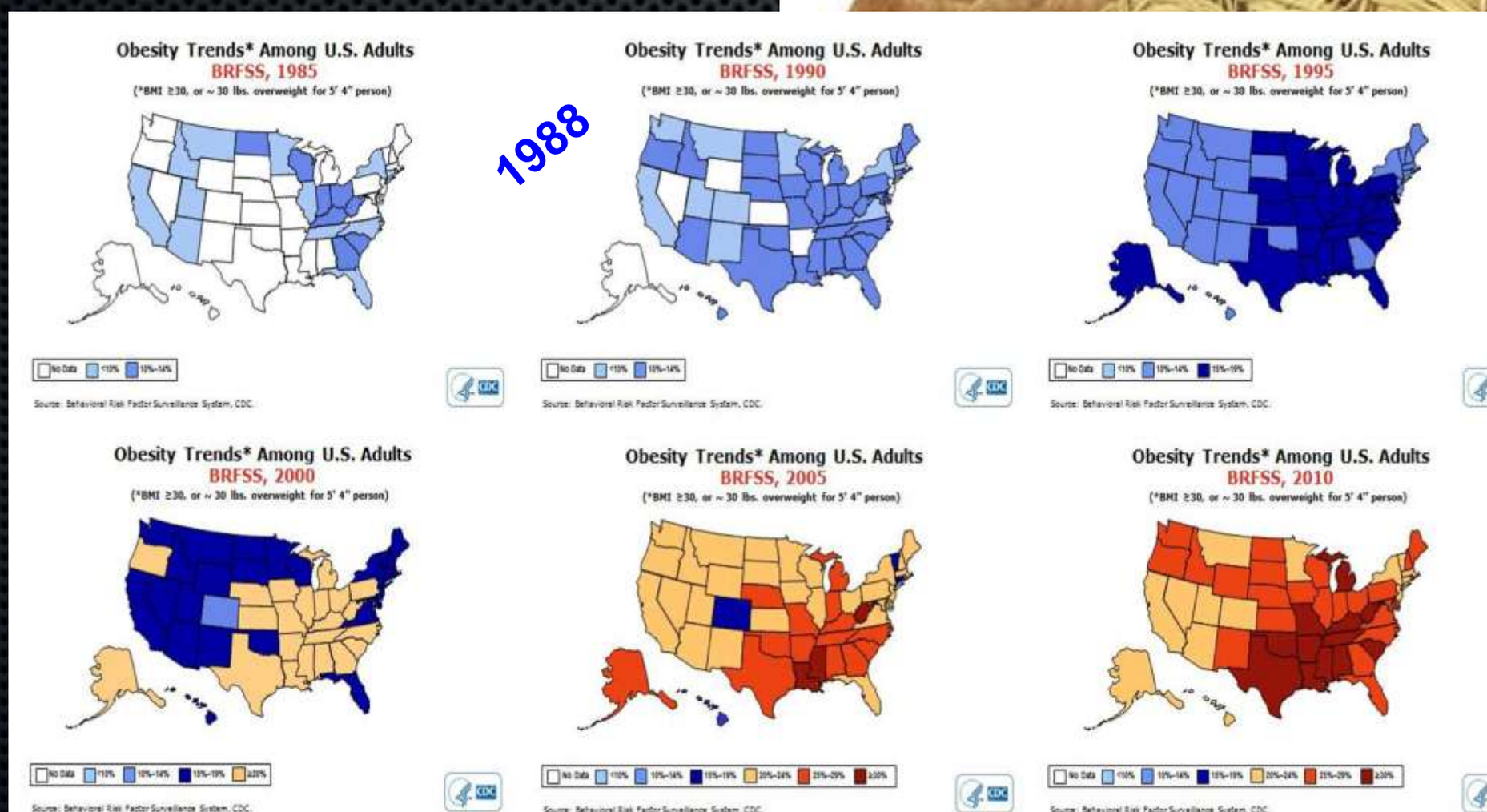
RDA minimum diet definition:

	RDA amounts	current intakes
Protein	56 g (224 kcal)	70 g (280 kcal)
Carbs	130 g (520 kcal)	300 g (1200 kcal)
Fats	30 g (90 kcal)	90 g (820 kcal)
	834 kcal	2300 kcal

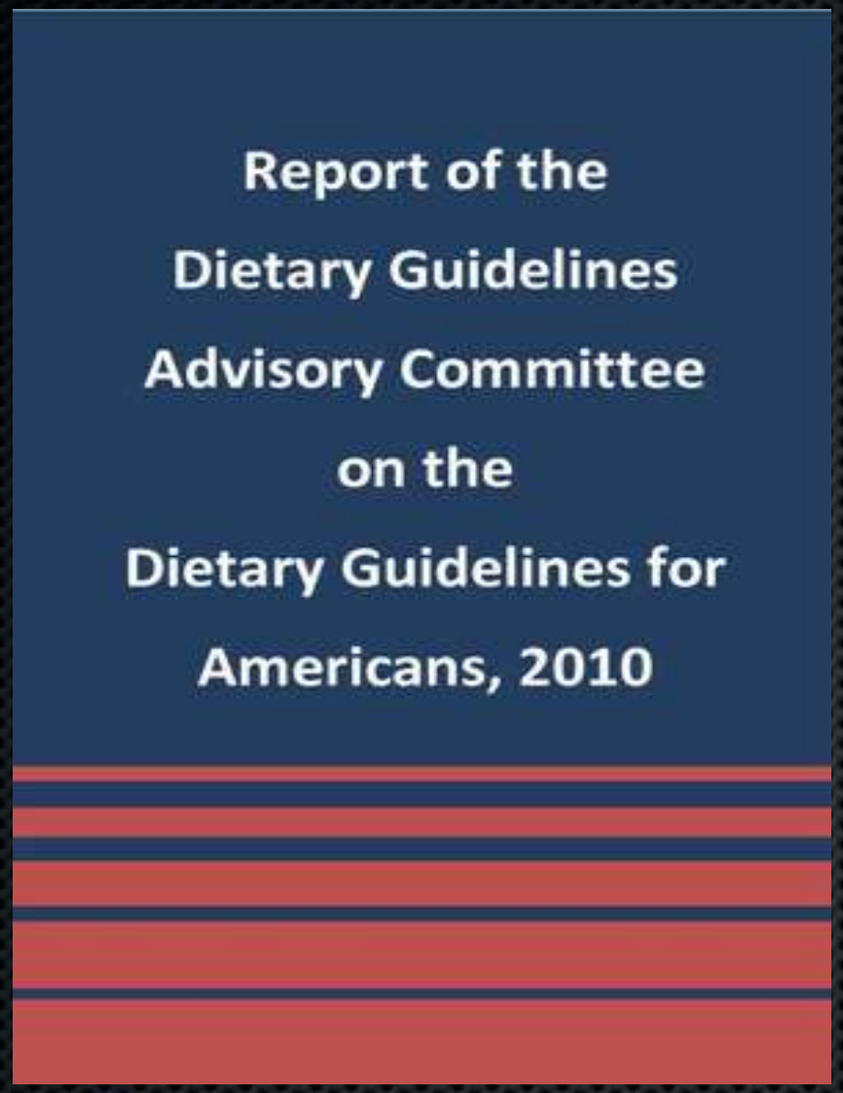
What should we eat?

Fat has higher calorie density, so, reduce calories by reducing fat intake. Seems logical!

(9 kcals/gram of fat)



Increased Calories in U.S. Diet since 1985



Top six categories:

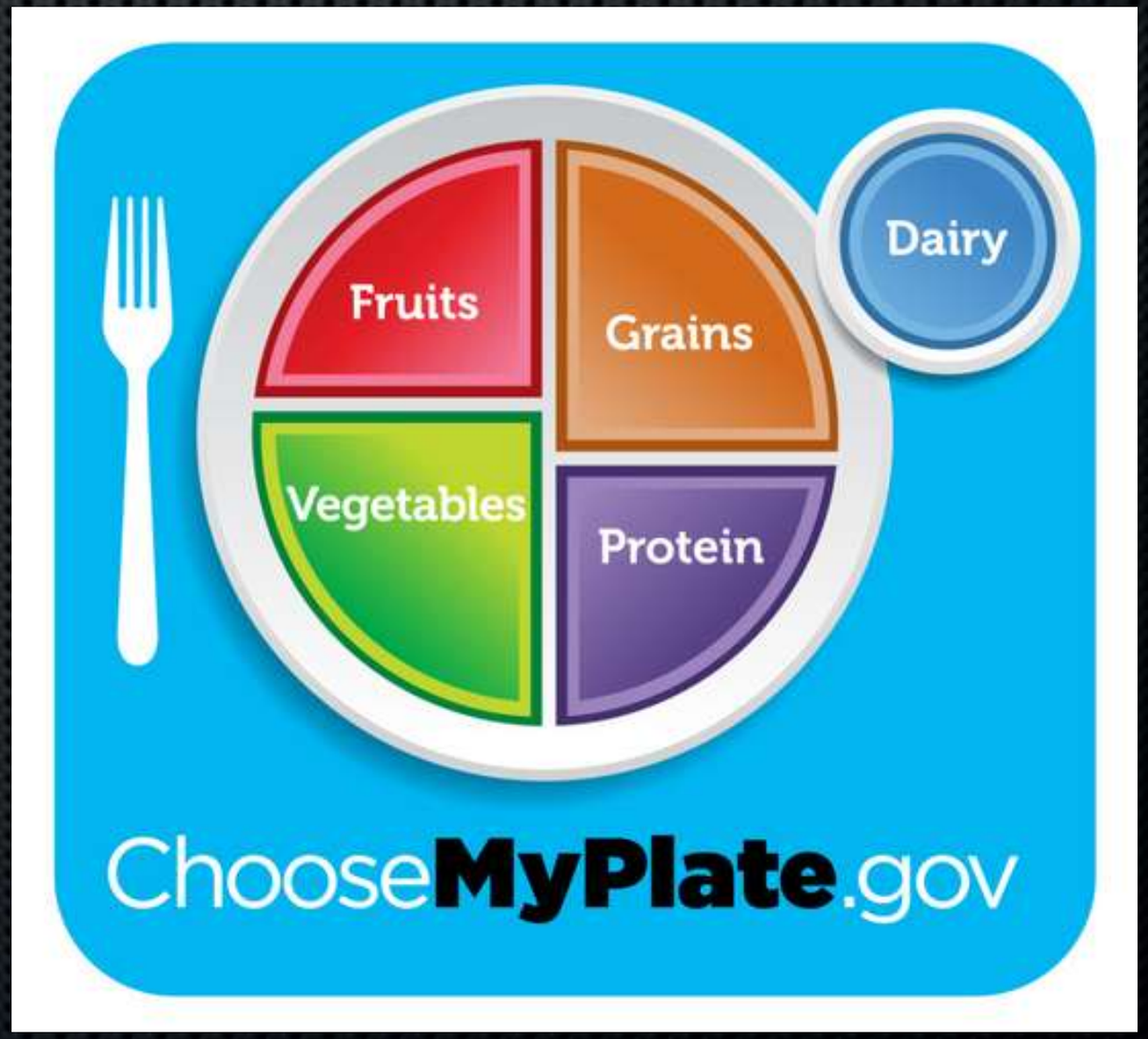
1. grain-based desserts and snacks
2. yeast breads
3. pasta
4. pizza
5. chicken and chicken products
6. soda and sport drinks

Source: USDA, Dietary Guidelines Advisory Committee, 2010

- The changing face of nutrition education

High Carb is out

Higher Protein is in



The Hunter-Gatherer Diet

Hunter-gatherer	Contemporary Agriculture
(60% animal:40% plant)	(40% animal/60% plant)
meats, reptiles, fish, shellfish,	cereal grains
insects, birds, eggs,	legumes
leaves, algae,	sugar
roots, tubers,	plant oils
wild berries and fruits	alcohol
nuts and seeds	dairy

Fruits and vegetables = soluble fiber; prebiotic yields SCFA

Cereal grains – insoluble fiber; high glycemic Carbs

Sugar intake: 1800 = 7.0 kg/year; 2000 = 70 kg/year

Oil intake: 1900 = 6 kg/yr; 2000 = 28 kg/yr

Current vegetables and fruits: potatoes, corn, and bananas

Evolution of Human Metabolism

The human genome reflects thousands of years of evolution to survive in the environment.

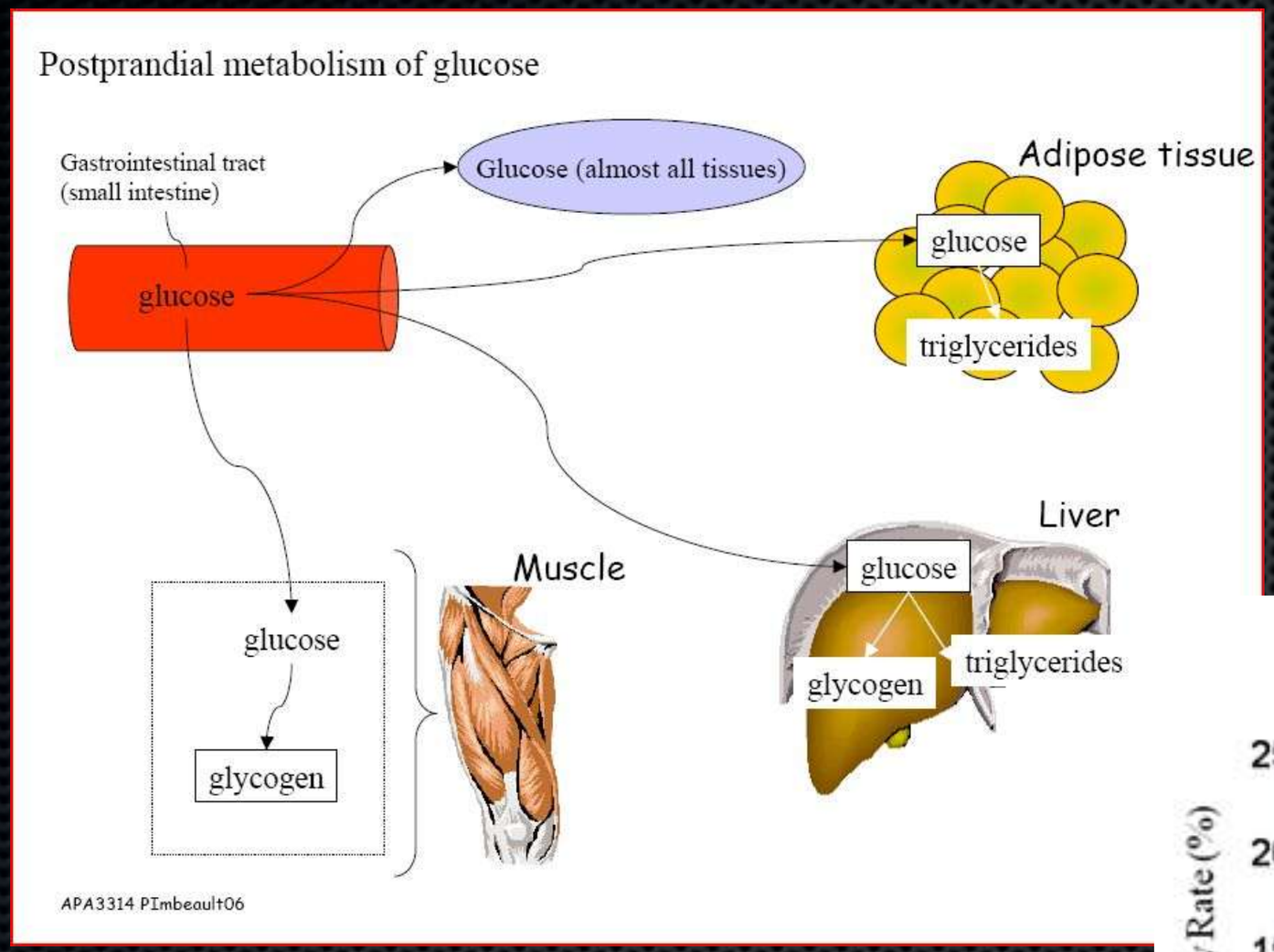
Unique traits for metabolism of protein, Carbs, and fat:

Protein - extensive mechanisms to digest, metabolize, and eliminate; high satiety to avoid excess intake

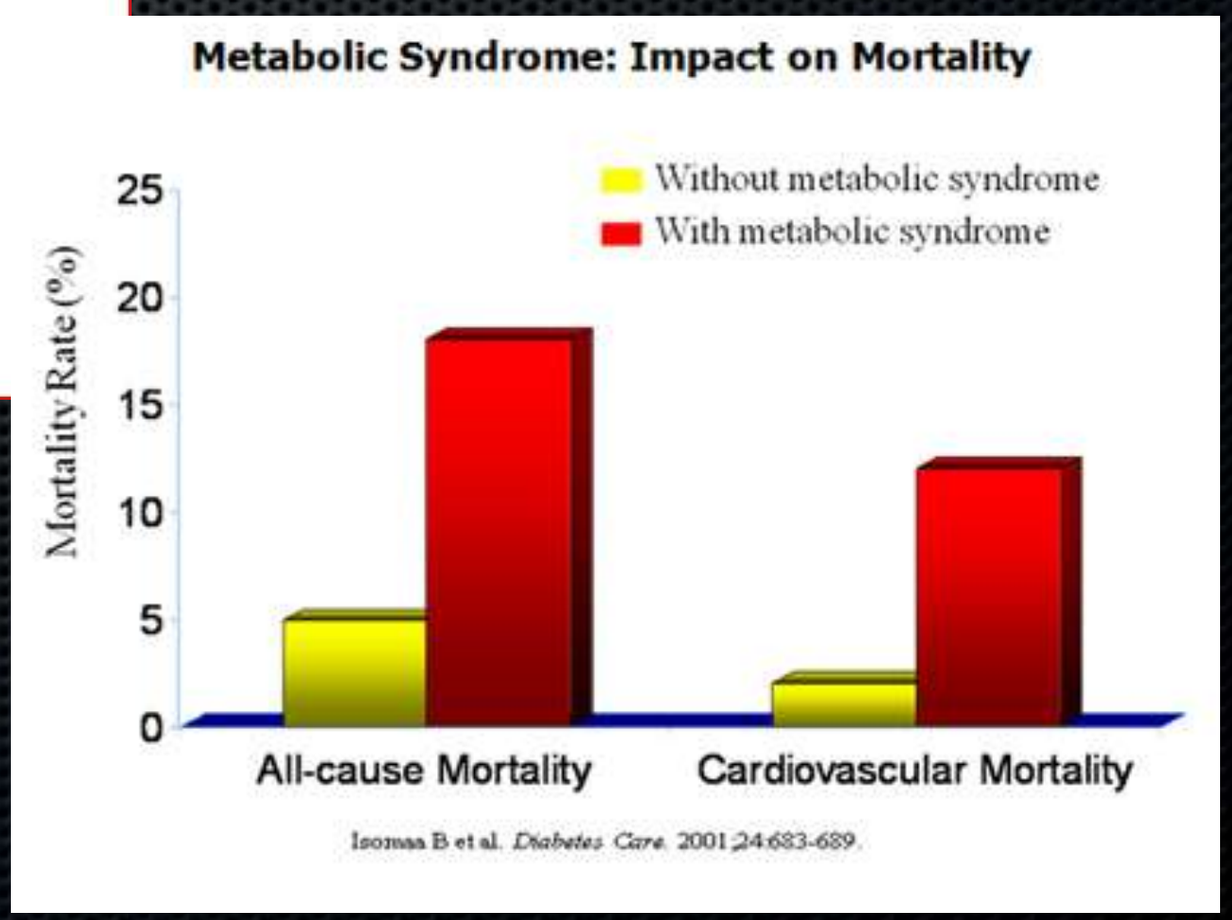
Fat - unlimited energy storage for survival; passive nutrient

Carbs - low evolutionary exposure; highly toxic with rapid clearance; insulin is only safety mechanism

Defining carbohydrate tolerance



Blood glucose is tightly regulated: (70 to 100 mg/dL)

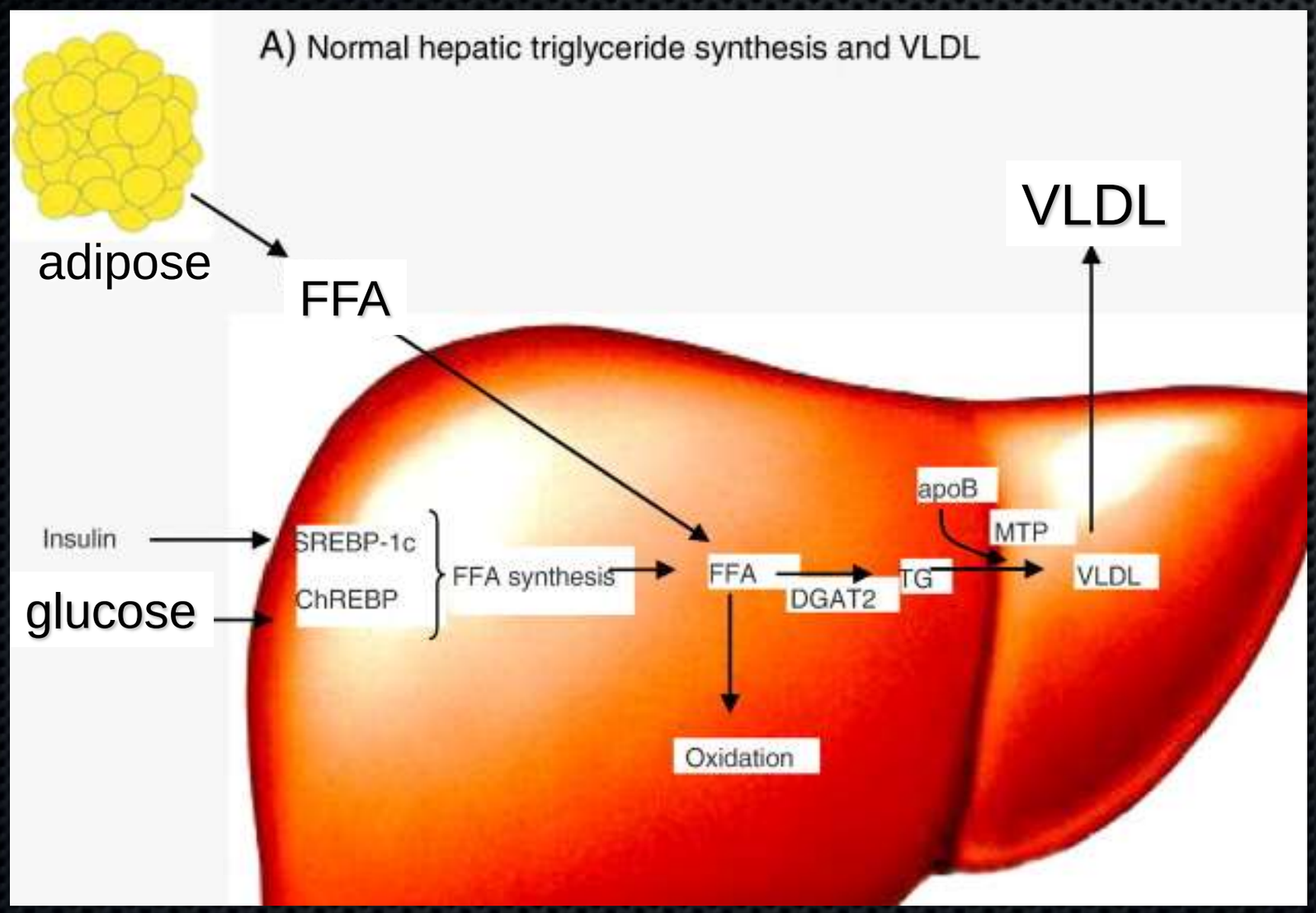


Blood glucose is toxic at high levels (ie. diabetes and MetS)

Capacity for glucose disposal:

- fatty acid synthesis
- VLDL transport

With excessive glucose:
✓prolonged PP glucose
↑free fatty acids (FFA)
↑TAG (VLDL)
✓fatty liver



glucose threshold
~ 30 grams/meal

(without exercise)

- Benefits of higher protein, reduced Carb diets
  - ✓ increased weight loss
  - ✓ protection of skeletal muscle
  - ✓ reduces body fat
  - ✓ increases thermogenesis
  - ✓ increases satiety
  - ✓ enhances glycemic regulation

Why don’t all studies agree?

- ✓ Compliance
- ✓ Lack of definition of “high” protein or “low” carbohydrate diet objectives

- who has higher protein needs?

Each must replace 250 grams of protein every day

Time to move beyond…
…“trial and error” nutrition

To teach nutrition requires clear diet objectives:

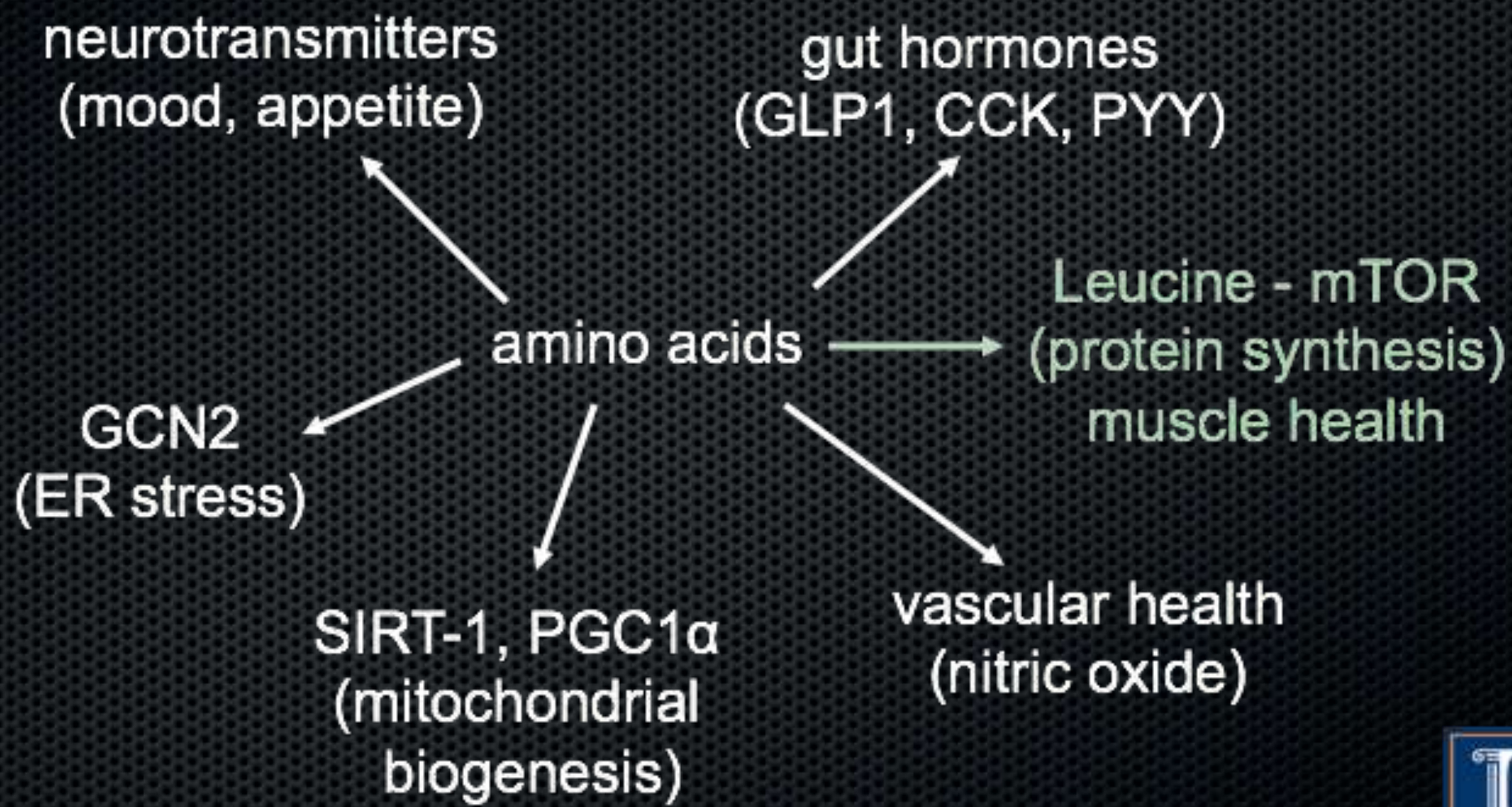
- amounts
- distribution

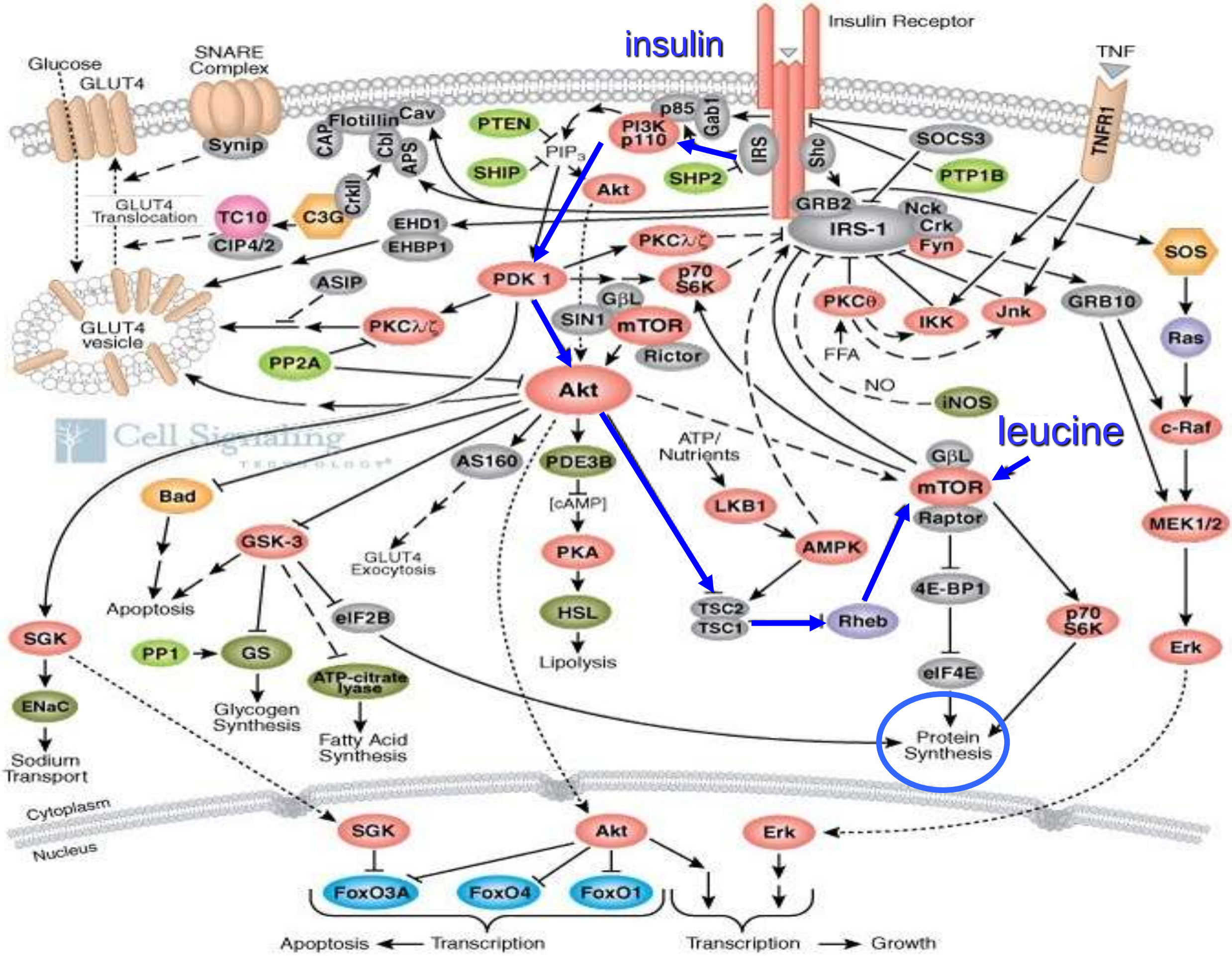
How should you describe protein needs?

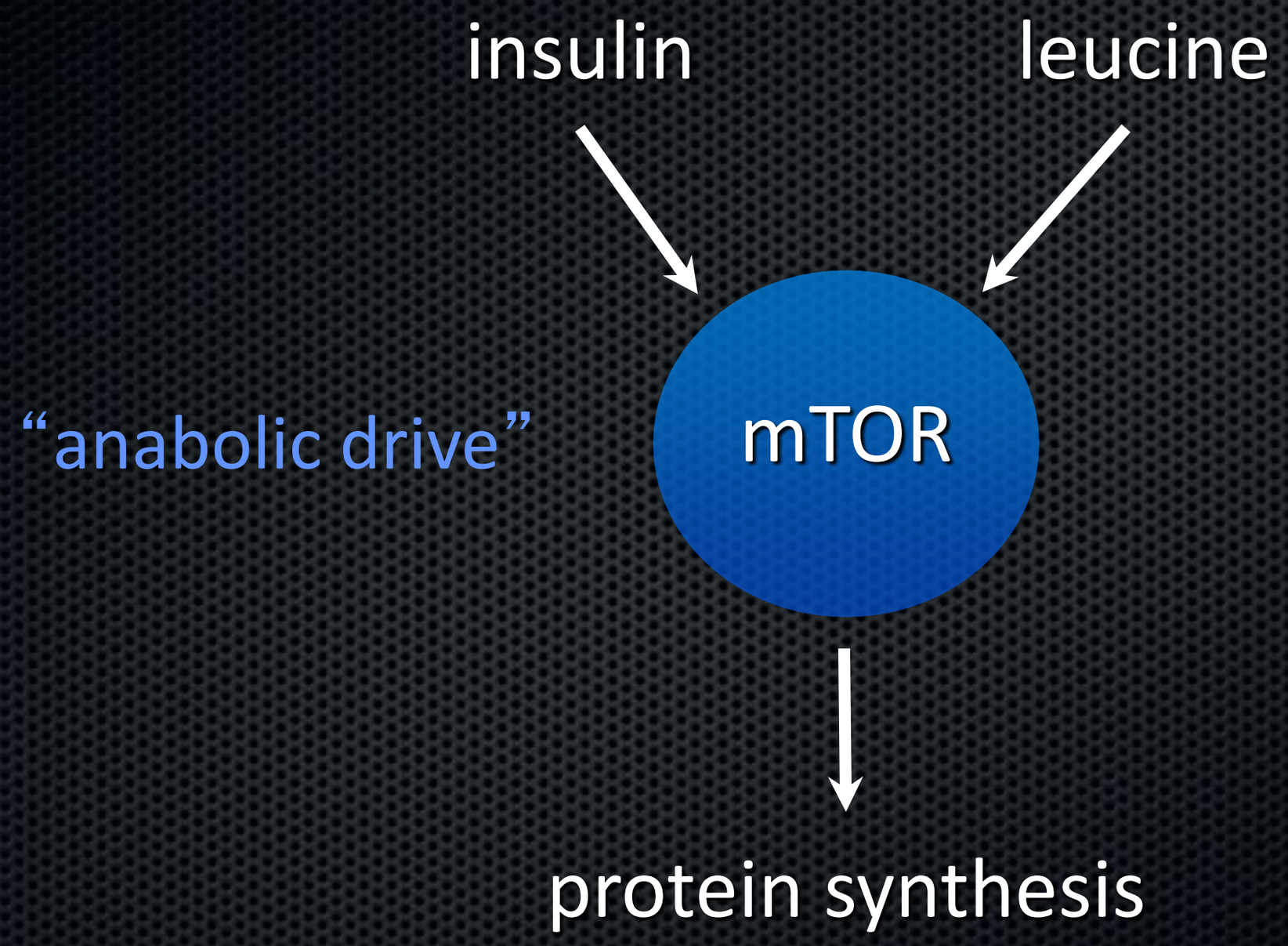
…what are the units?

- Define dietary protein needs with purpose
  - energy substrate - (%kcal)
  - building blocks for new proteins - (g/kg)
  - metabolic signals - (grams/meal)

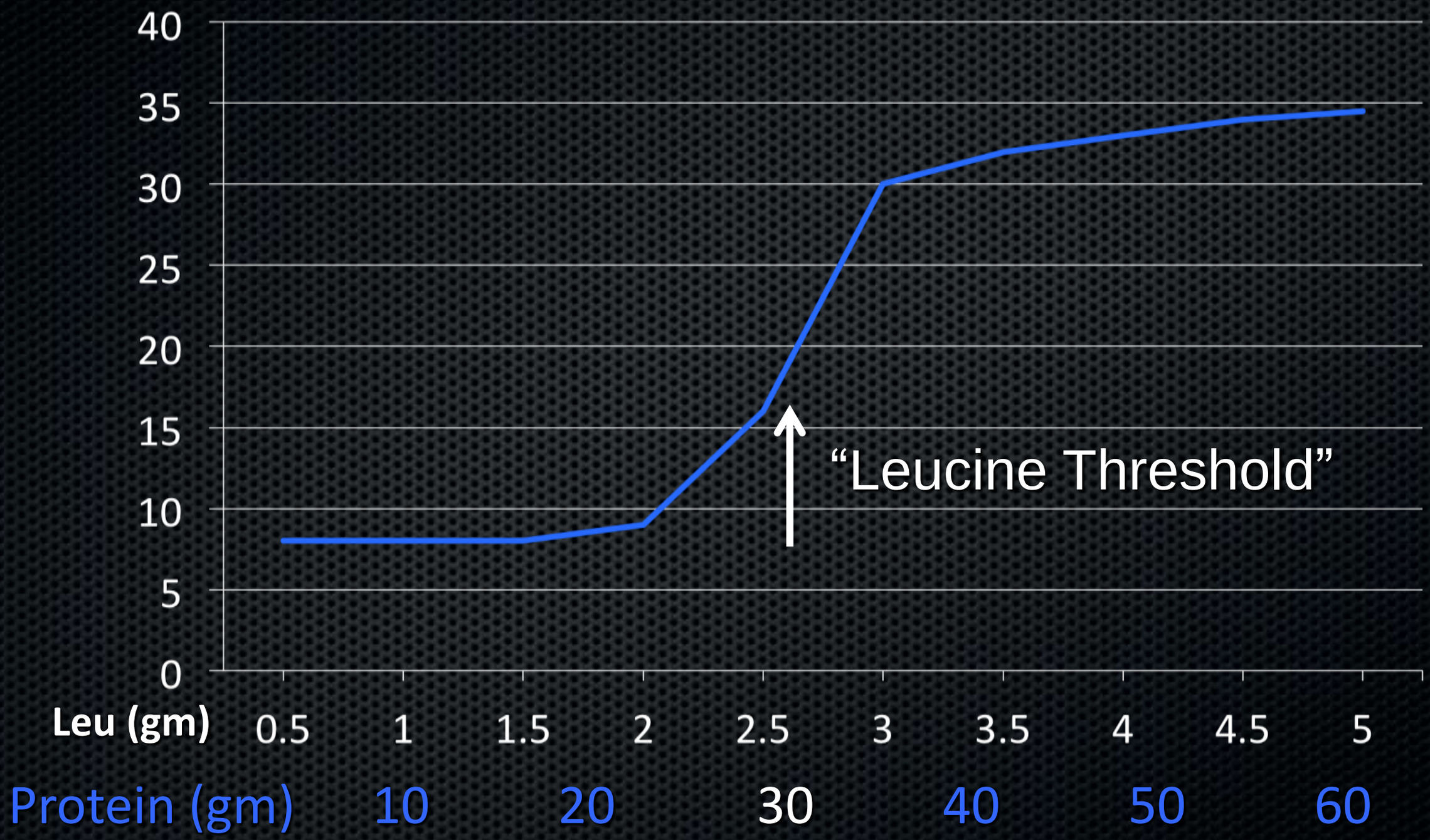
Amino Acids as Metabolic Signals



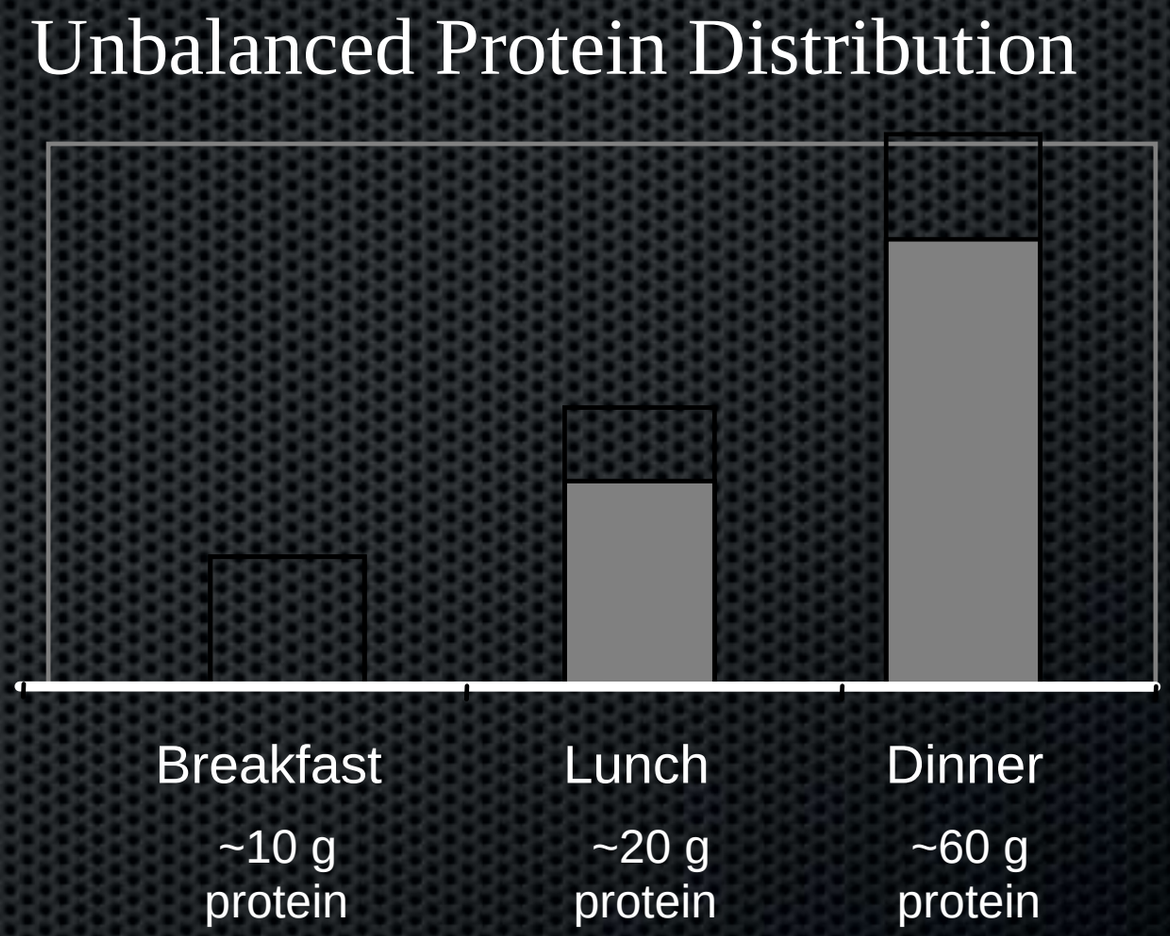

insulin
Insulin Receptor
TNF
TNFR1
Glucose
GLUT4
SNARE Complex
Synip
Flotillin
Cav
CAP
Cbl
APS
PTEN
SHIP
PIP3
PI3K p110
p85
Gab1
IRS
Shc
SHP2
SOCS3
PTP1B
Akt
GRB2
IRS-1
Nck
Crk
Fyn
GLUT4 Translocation
TC10
CIP4/2
C3G
CrkII
EHD1
EHBP1
PKCλ/ζ
PDK 1
p70 S6K
SOS
ASIP
GLUT4 vesicle
PKCλ/ζ
GβL
SIN1
mTOR
Rictor
PKCθ
IKK
Jnk
GRB10
Ras
FFA
PP2A
Akt
NO
iNOS
c-Raf
Cell Signaling TECHNOLOGY
leucine
ATP/ Nutrients
GβL
mTOR
AS160
PDE3B
Bad
[cAMP]
LKB1
Raptor
MEK1/2
GSK-3
GLUT4 Exocytosis
PKA
AMPK
4E-BP1
Apoptosis
HSL
TSC2
TSC1
Rheb
p70 S6K
SGK
eIF2B
PP1
GS
Lipolysis
Erk
ATP-citrate lyase
eIF4E
ENaC
Glycogen Synthesis
Fatty Acid Synthesis
Protein Synthesis
Sodium Transport
Cytoplasm
Nucleus
SGK
Akt
Erk
FoxO3A
FoxO4
FoxO1
Apoptosis ← Transcription
Transcription → Growth


insulin
leucine
"anabolic drive"
mTOR
protein synthesis

Protein synthesis response to Leucine content of meal



Common Meal Pattern:



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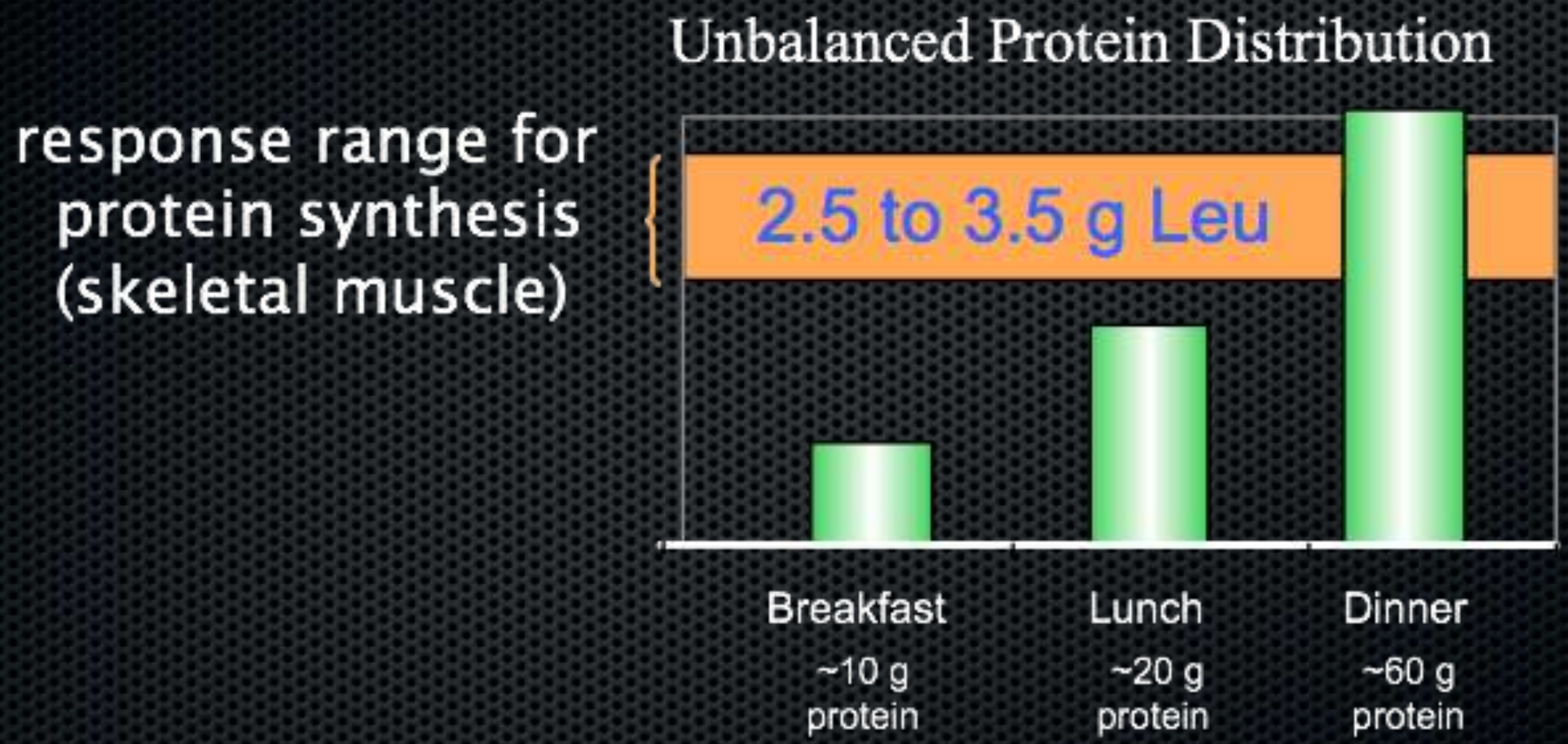
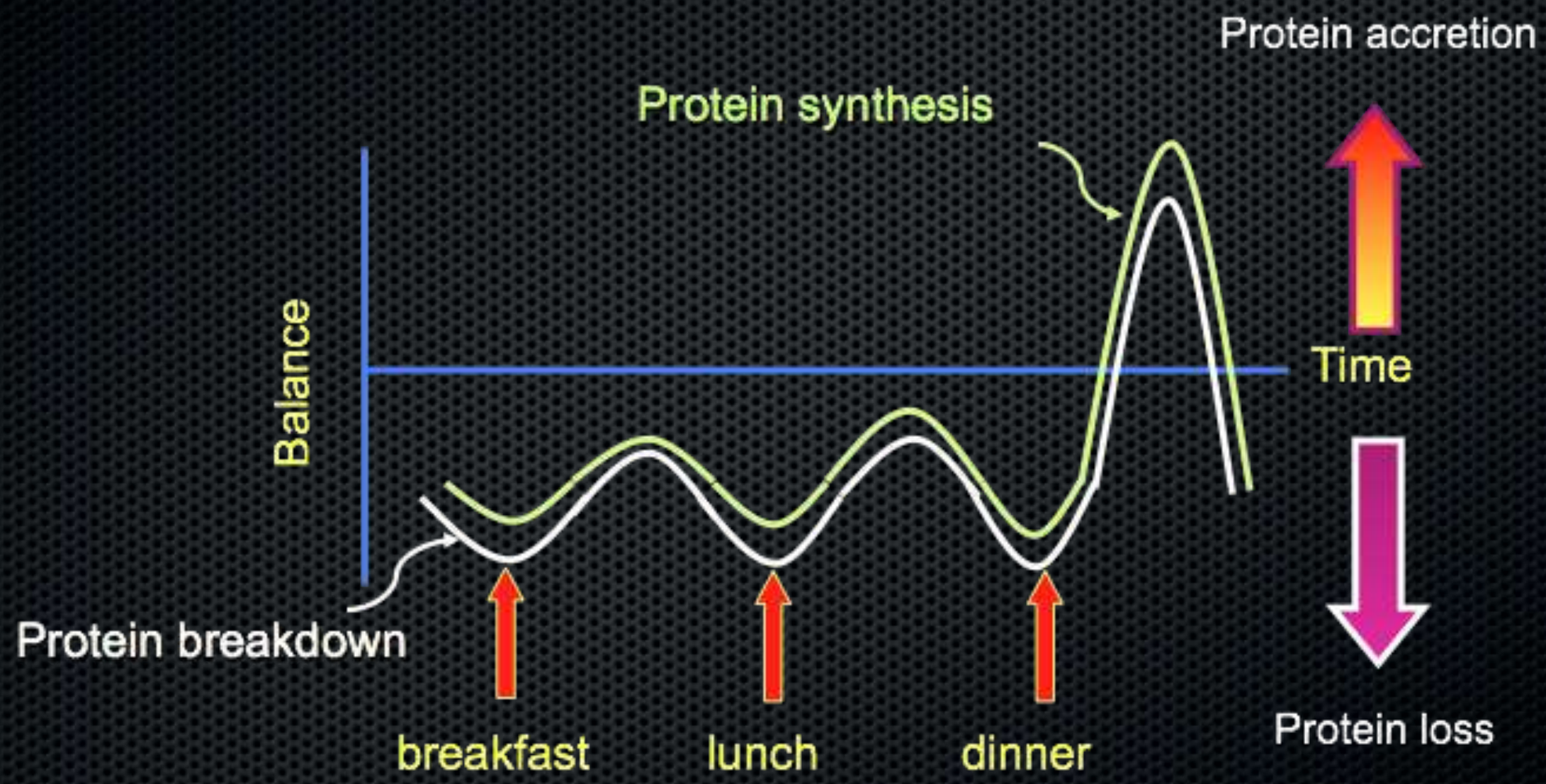


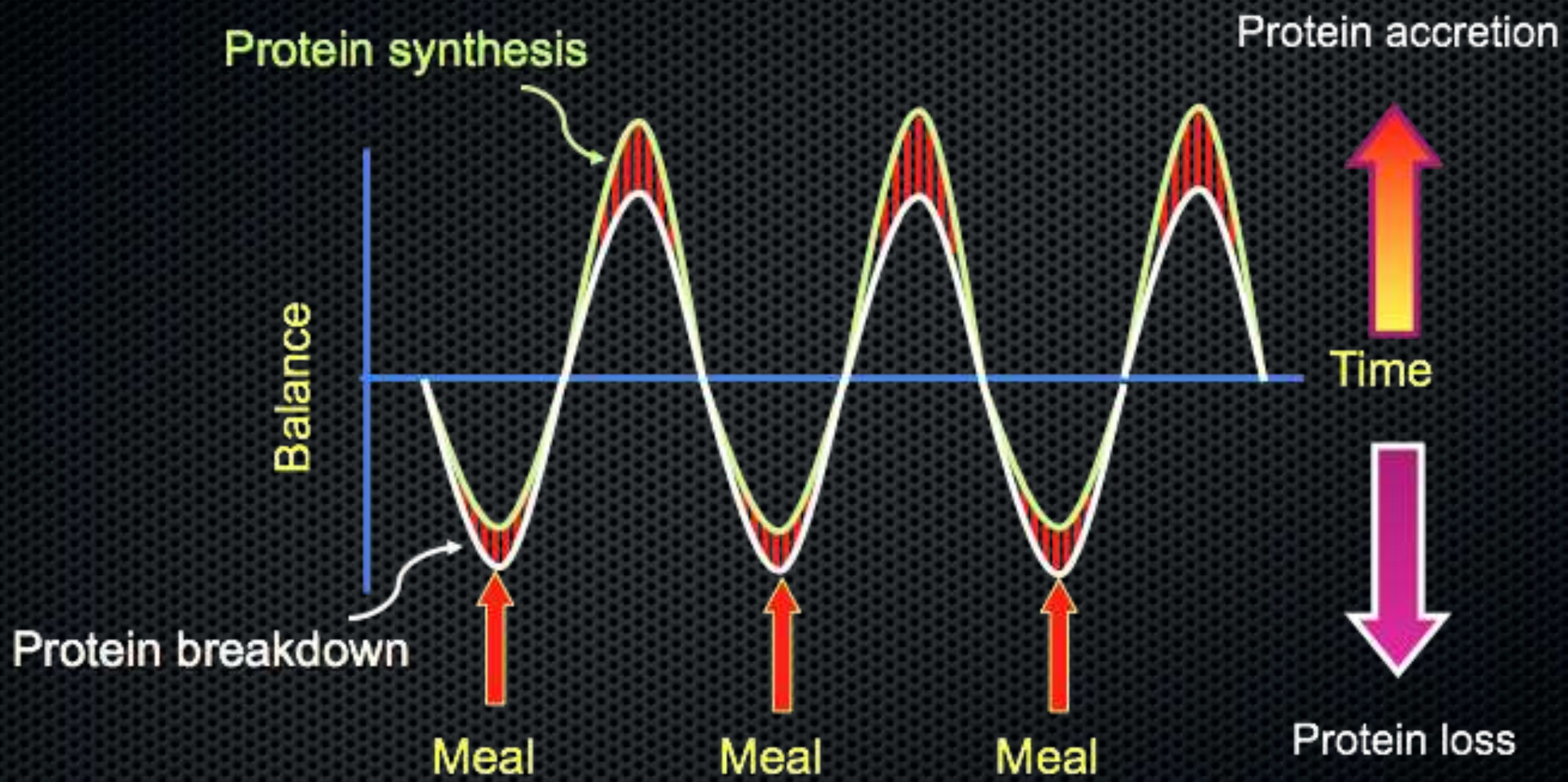
Muscle Protein Balance



Meal Patterns:

Layman Nutr & Metab 6:12, 2009

Muscle Protein Balance



Phillips. Nutrition '04

Potential to design meals around leucine

Experimental Design:

adult rats (>350 g)

3 meals each day; fed for 3 months

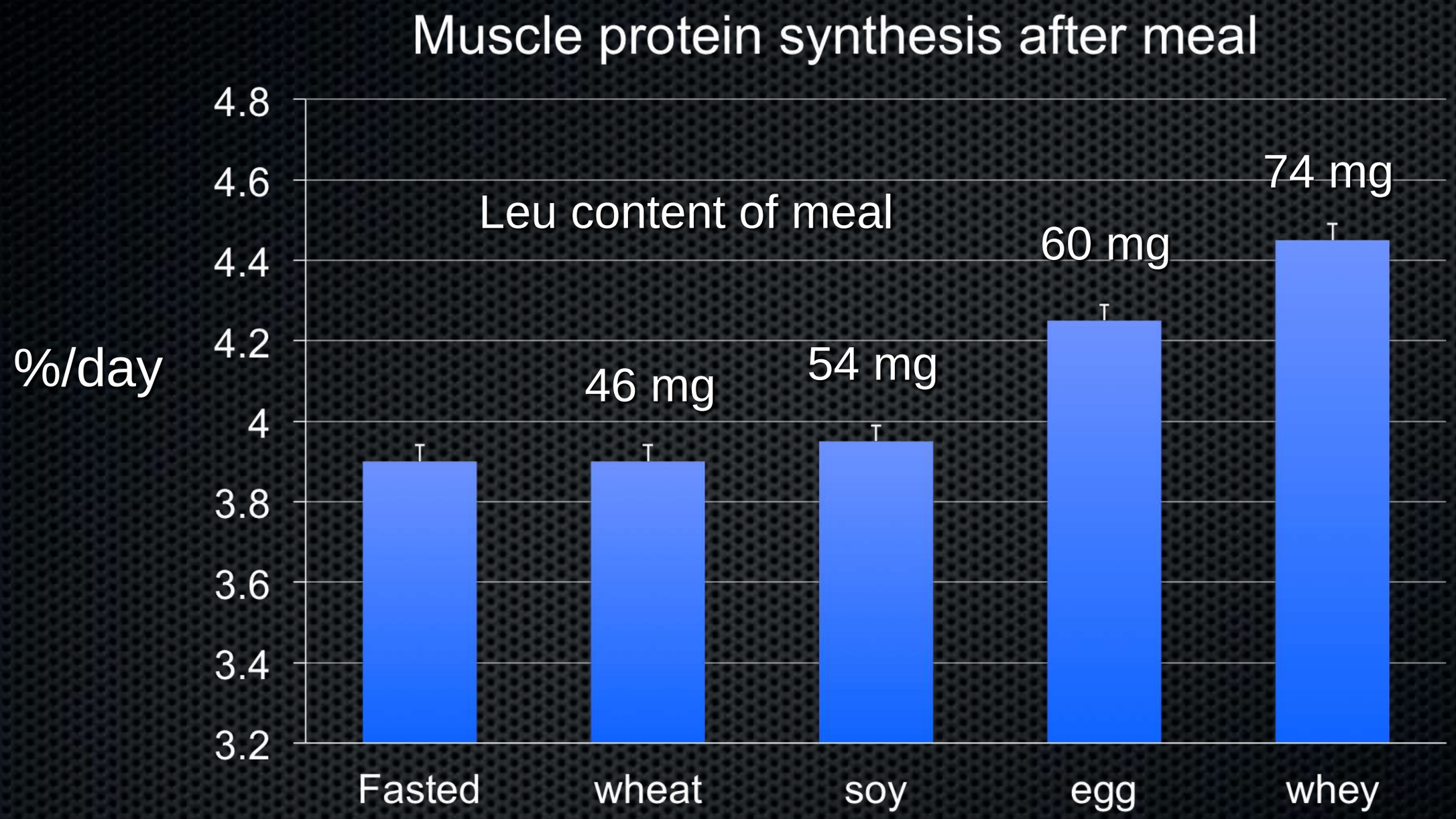
meal size mimics human eating patterns

Diet: 54% Carbs, 16% protein, 30% fat

(ie. Food Guide Pyramid)

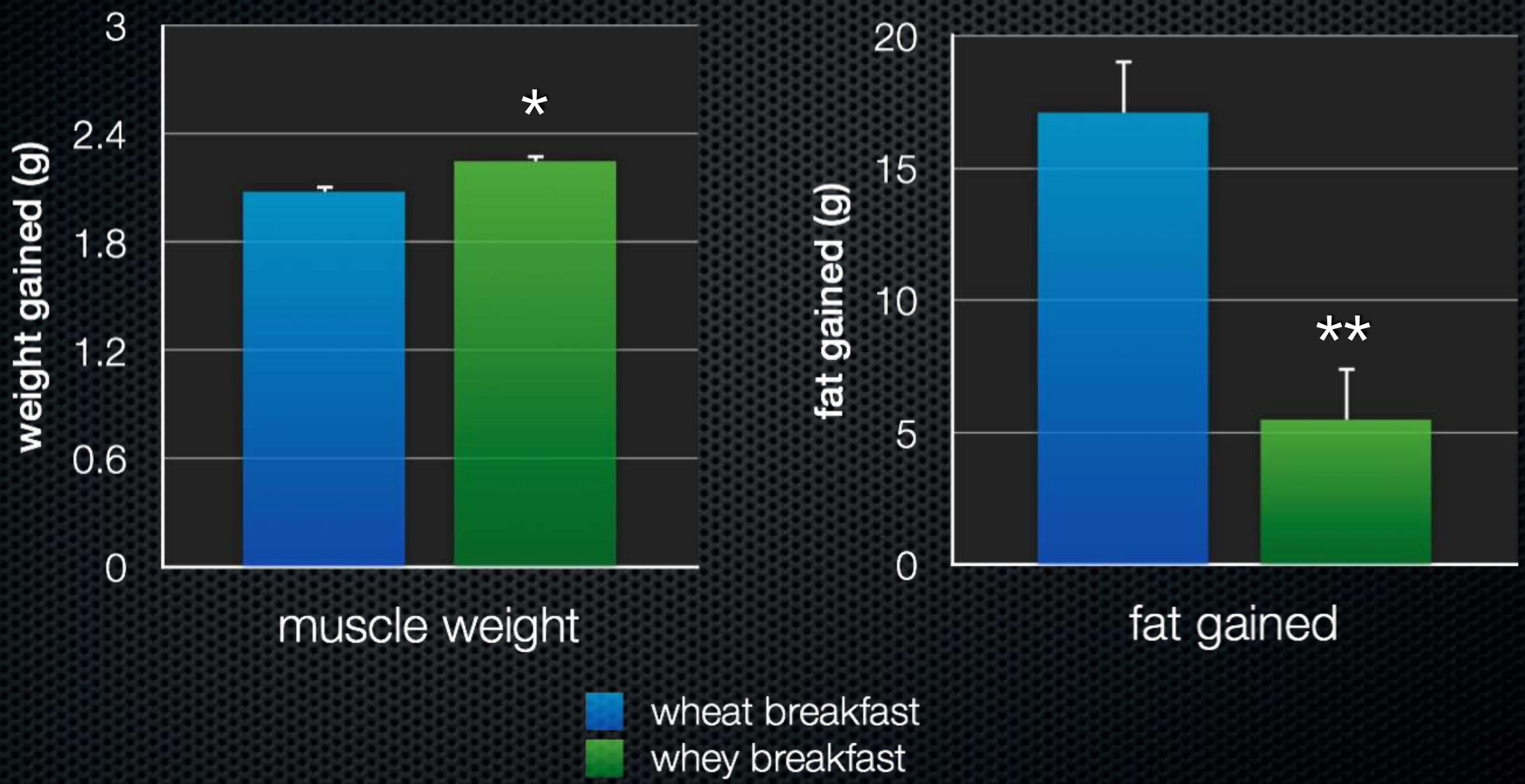
Treatment groups:

wheat (6.8%), soy (8.0%), egg (8.8%), whey (10.9%)



Norton et al. Nutr & Metab 9:67, 2012

Body composition changes after 3 months
Consuming wheat versus whey breakfast



Clinical trials with high protein, low Carb diets

Layman et al. J Nutr 133: 411, 2003
Layman et al. J Nutr 135: 1903, 2005
Layman et al. J Nutr 139: 514, 2009

Food Guide Pyramid (CHO diet) - 65 g/day
Moderate Protein diet (PRO diet) - 125 g/day

<u>body composition changes after 10 wks</u>

PRO	fat loss	5.60 kg
	lean loss	0.88
	ratio:	6.36**
CHO	fat loss	4.74 kg
	lean loss	1.21
	ratio:	3.91

Thermogenesis

Terminology:

Thermic Effect of Food (TEF)

Diet Induced Thermogenesis (DIT)

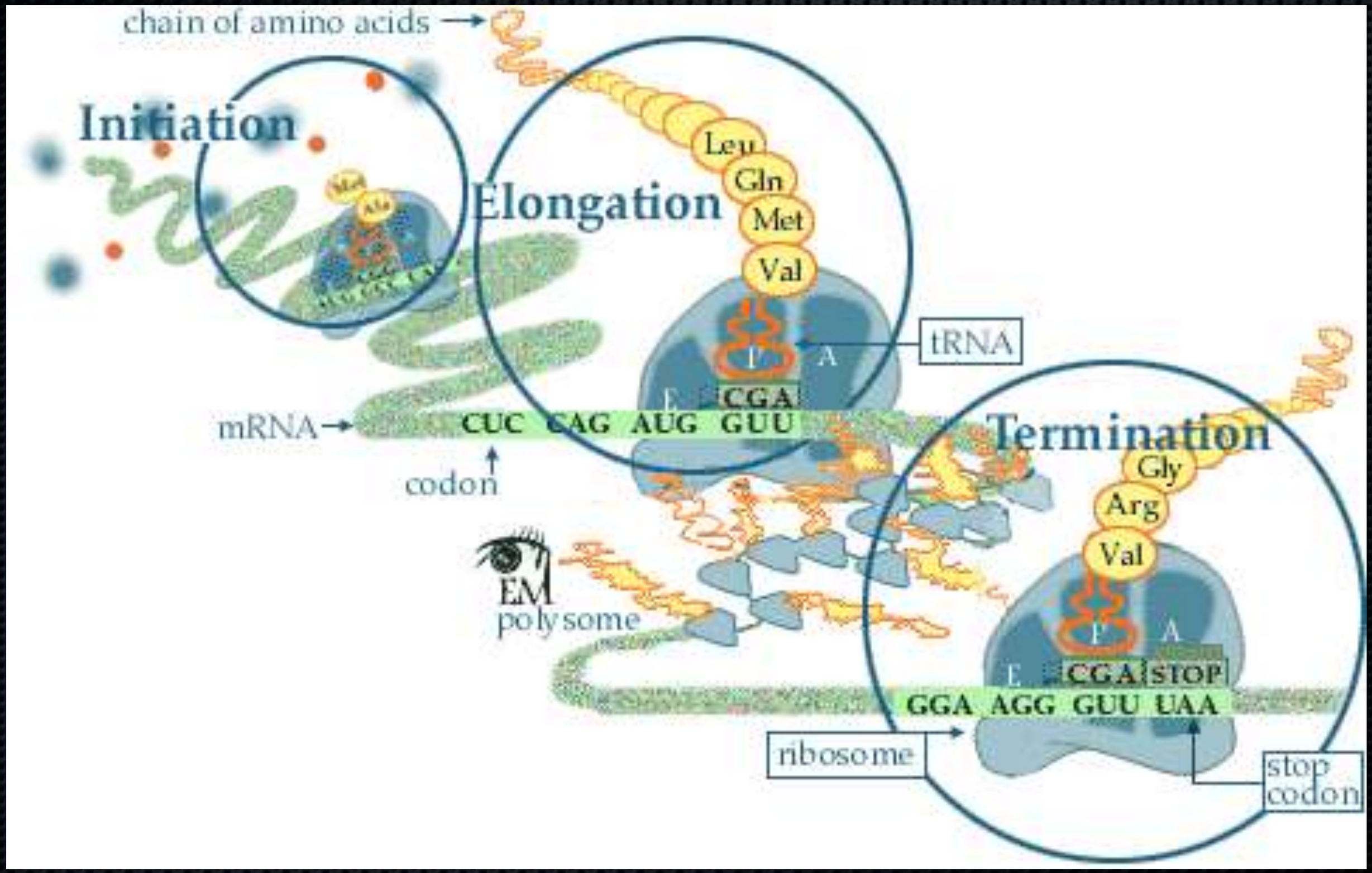
Specific Dynamic Action (SDA)

TEF = energy associated with digestion, absorption, and processing of food.

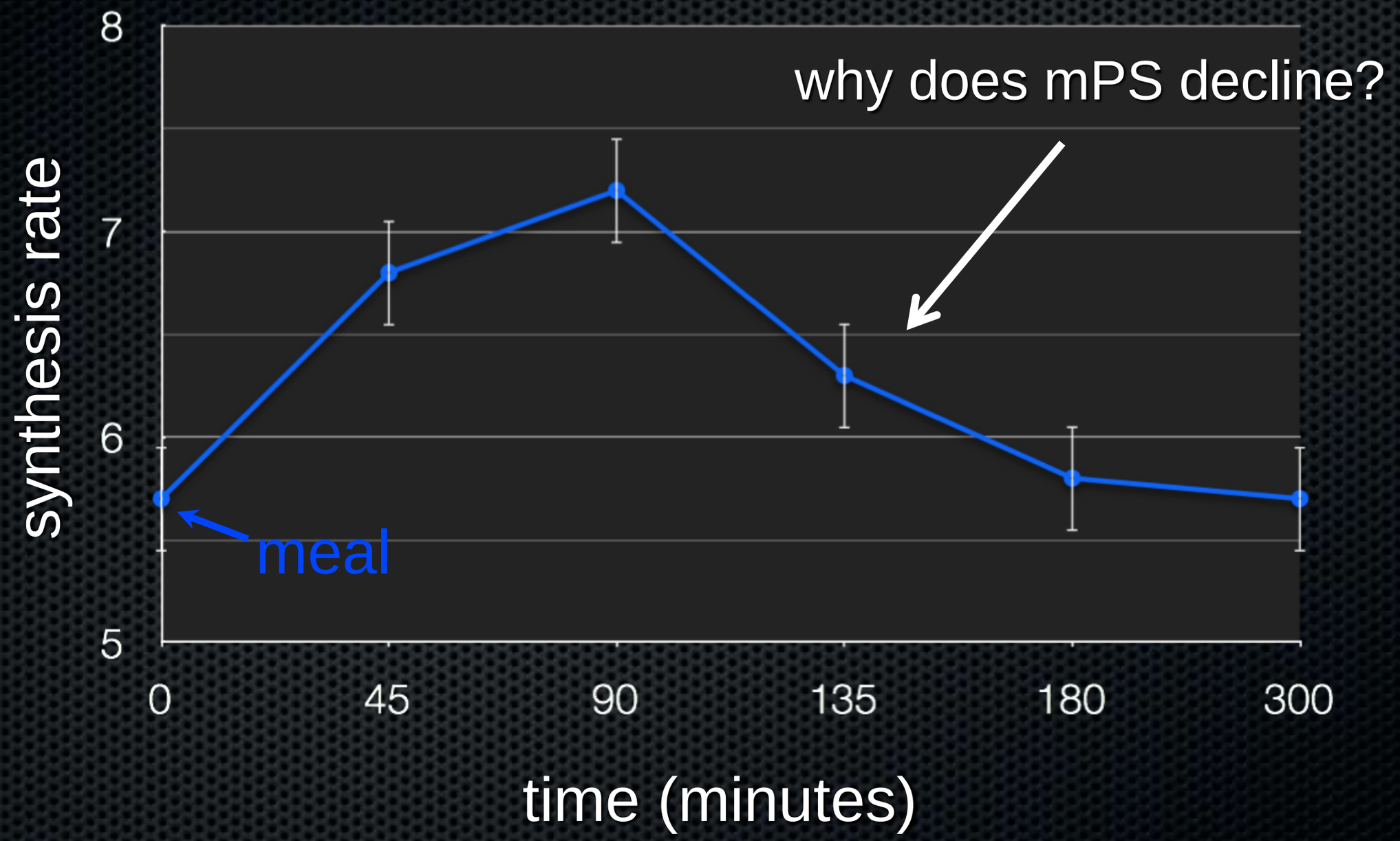
TEF ~ 7% to 10% of energy

TEF for Protein > Carbs > Fat

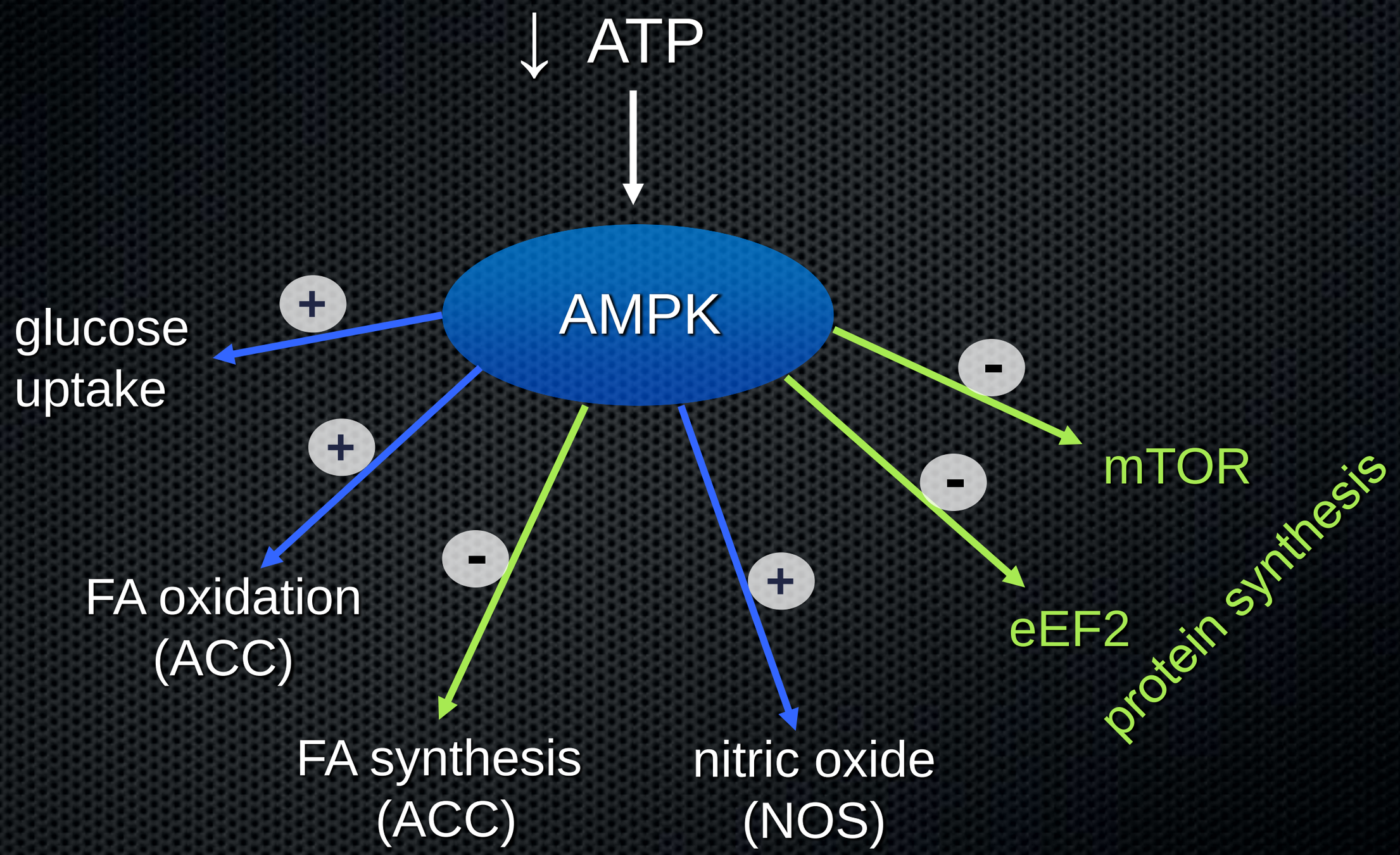
Protein Synthesis – “translation”



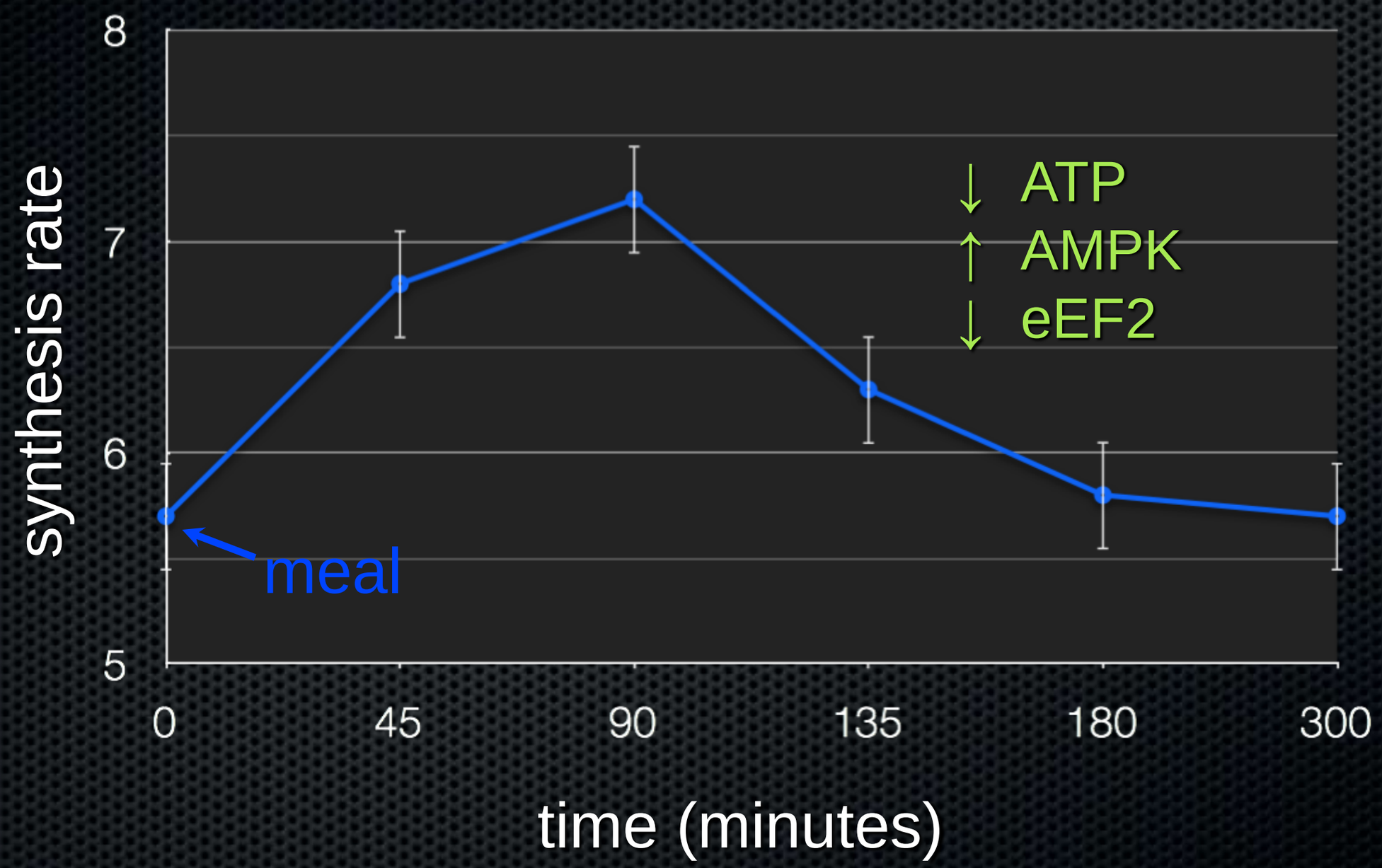
Muscle protein synthesis after a meal



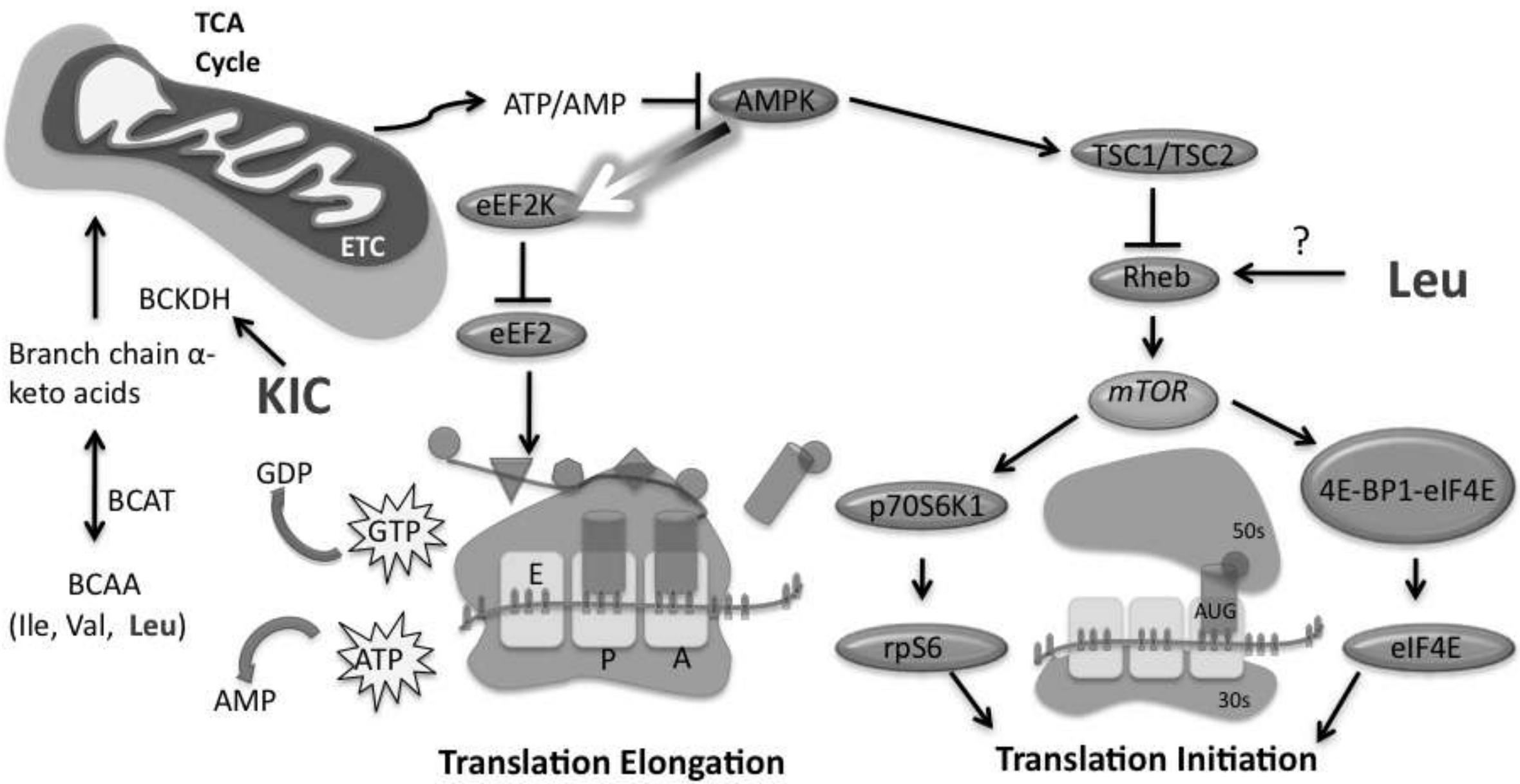
Energy Regulations



Why does mPS decline after a meal



Wilson et al. AJP 301:E1236, 2011
Wilson et al. Nutrients 4;1723, 2012



5 ATPs/amino acid
(~1500 ATPs/protein)

4 ATPs

Studies with high protein, low Carb diets

Layman et al. J Nutr 133: 411, 2003
Layman et al. J Nutr 135: 1903, 2005
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Food Guide Pyramid (CHO diet) - 65 g/day
Moderate Protein diet (PRO diet) - 125 g/day

- ✓ CHO
- ✓ CHO + Ex
- ✓ PRO
- ✓ PRO + Ex

Exercise: to burn calories or
to change body composition

<u>Exercise protocols</u>:

no EX: "sedentary"

EX: > 250 min with 5 days/wk walking
and 2 days resistance training

Interaction of protein and exercise

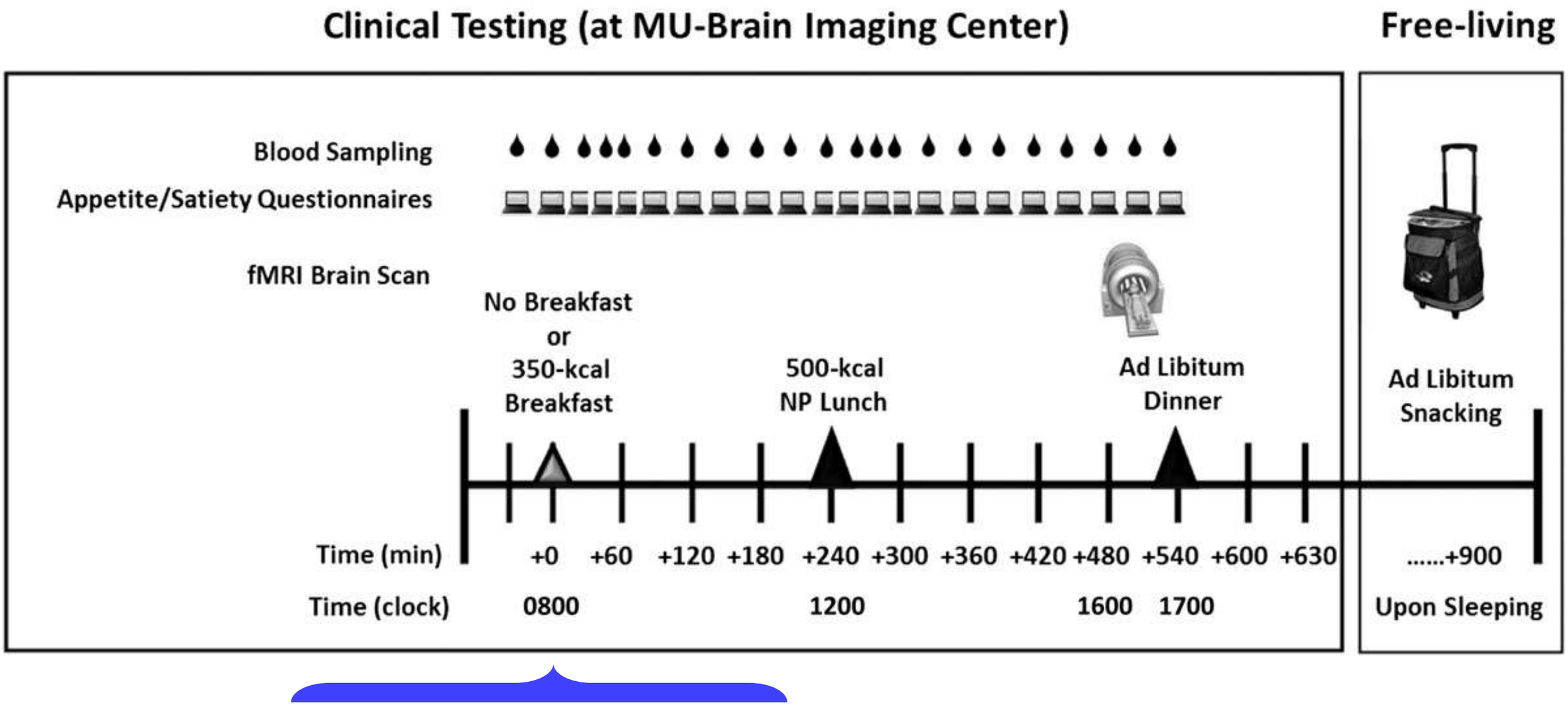
Layman et al. J Nutr 135: 1903, 2005

	Fat loss (lbs)	Fat as % of wt lost
CHO diet	11.0	64%
CHO + Ex	12.1	78%
PRO diet	13.0	74%
PRO + Ex	19.4	90%

Snacks are a major sources of calories

Beneficial effects of a higher-protein breakfast on the appetitive, hormonal, and neural signals controlling energy intake regulation in overweight/obese, "breakfast-skipping," late-adolescent girls[1–3]

Heather J Leidy, Laura C Ortinau, Steve M Douglas, and Heather A Hoertel Am J Clin Nutr 97:677, 2013



- breakfast skipping
- normal protein (NP) = 13 g
- high protein (HP) = 35 g

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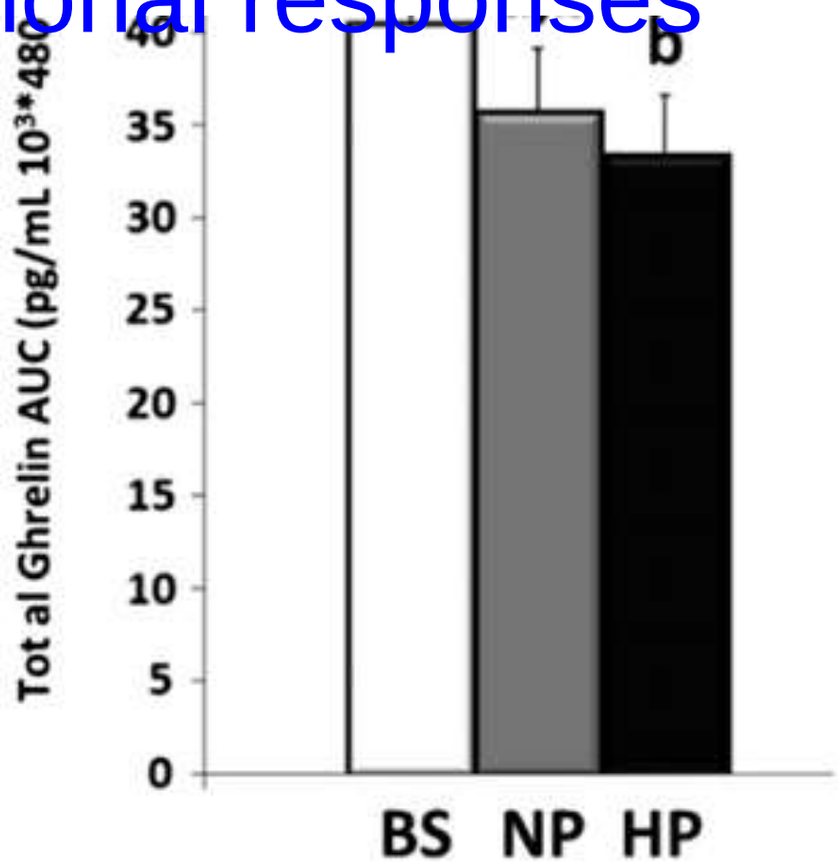
hormonal responses



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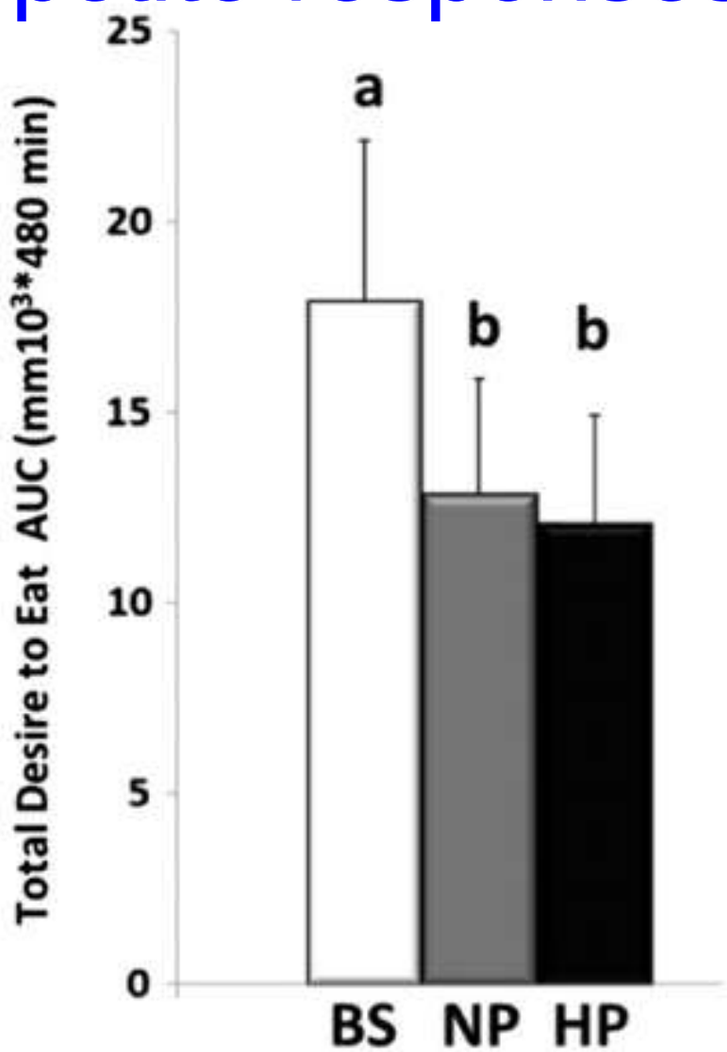
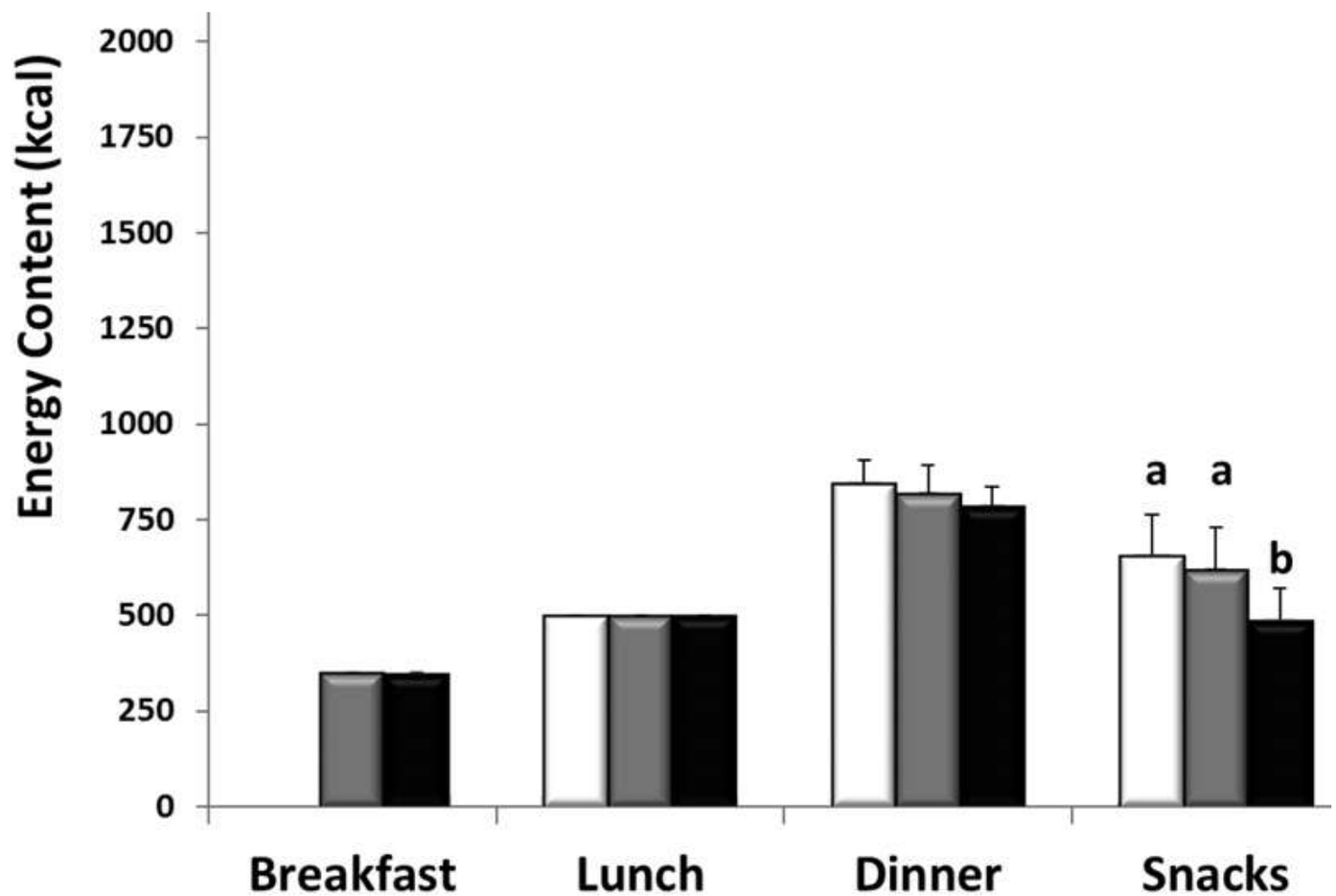
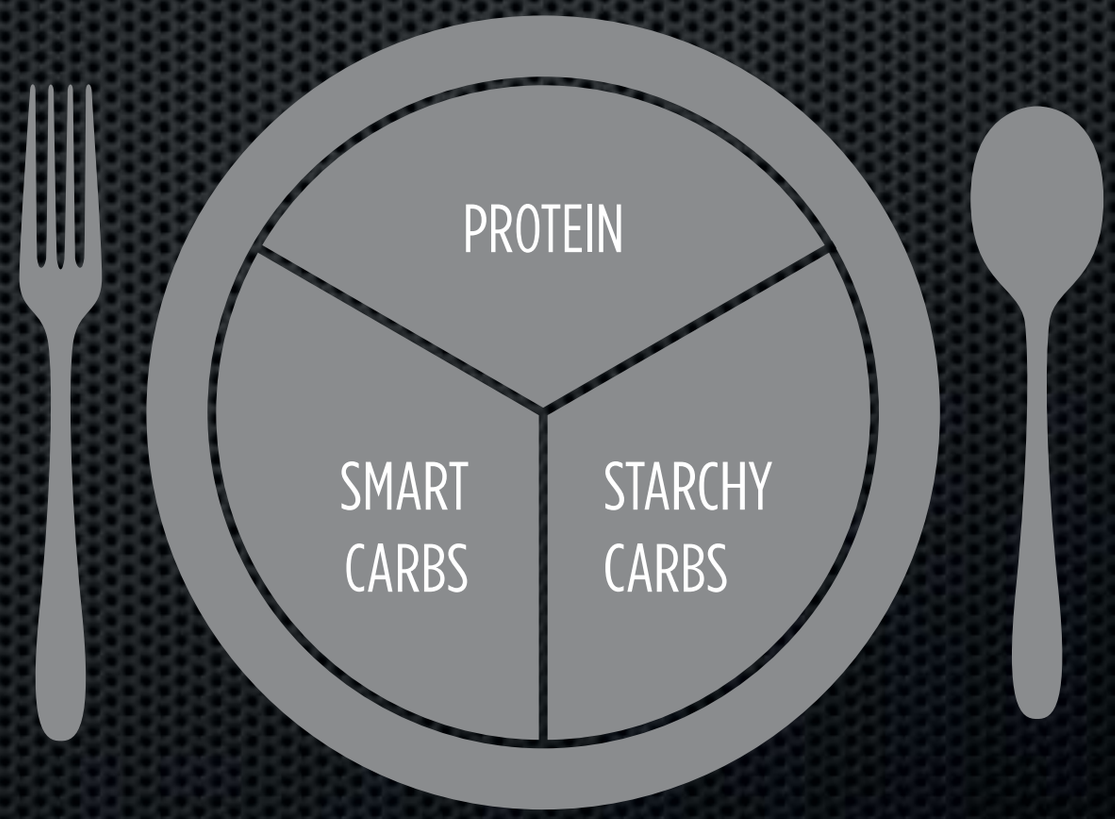
appetite responses





Summary points:

- meal threshold of 30 grams of protein
- leucine is a key determinant of protein threshold
- adults need better protein distribution
- breakfast is a key meal for protein

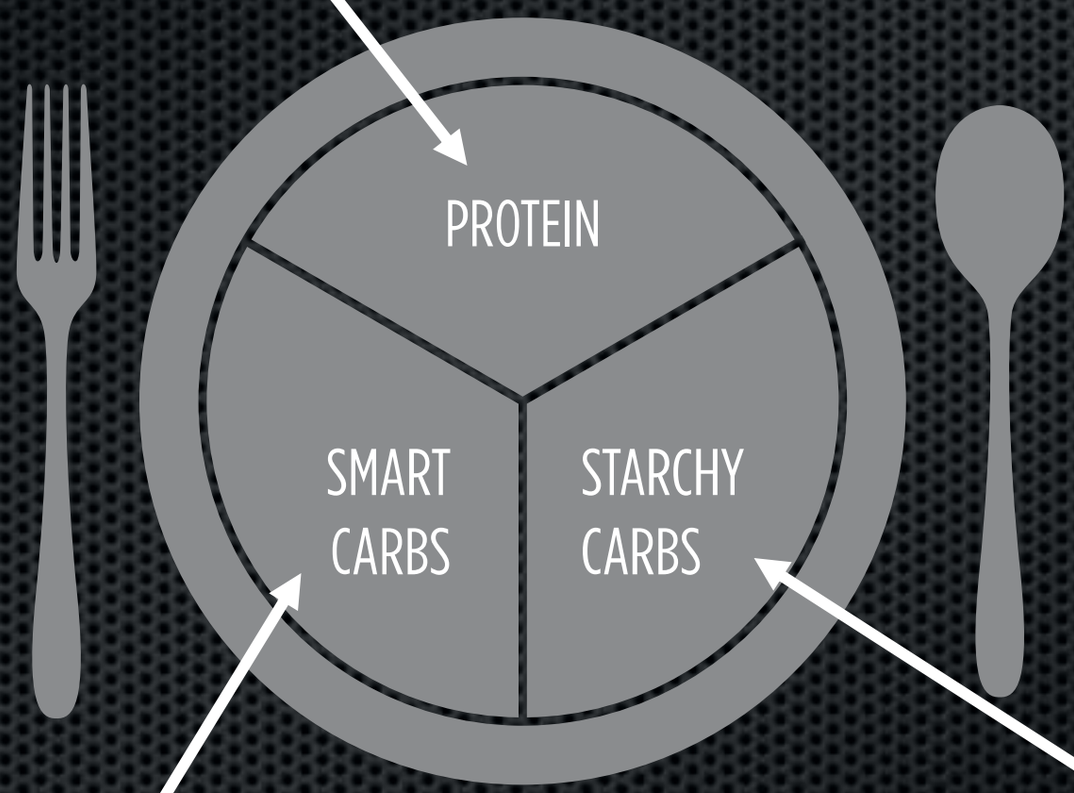


Teaching higher protein, reduced Carb diets

- balance of high quality proteins at each meal
- reduce carbohydrates (processed grains)
- increase fiber (vegetables and berries)
- select reduced fat foods
  (avoid fried foods, pizza, snacks, candy, desserts)
- correct nutrient balance at EVERY meal
- breakfast is most important meal for
  muscle health and metabolic flexibility

Learning to balance the plate:

1st protein at least 30 g/meal (more is okay)



2nd all grains and sugars (Carb/fiber ratio > 6)

3rd colorful vegetables and berries (Carb/fiber ratio < 6)

- Getting Breakfast Right

Egg & meat breakfast

	Prot	Carbs	Fat	kcals
egg	7	1	5	79
Canadian bacon (2 oz)	12	1	2	70
cheese slice	5	2	3	45
English muffin (1/2)	2	13	0	67
milk 1% (1 cup)	8	11	2	102
total =	34	29	12	363

- Getting Breakfast Right

Protein Shake

	Prot	Carbs	Fat	kcals
Kefir (1/2 cup)	7	10	1	80
Greek yogurt (1/2 cup)	10	2	0	50
whey powder	18	3	2	100
berries (3/4 cup)	0	10	0	40
total =	36	27	3	280


ILLINOIS
Thank You!
The Quad