NUTRITION · STUDY GUIDE

Final Exam Study Guide

The final covers all fourteen chapters. Each chapter here is shorter than in the exam guides: three paragraphs of what to know, the points to lock in, one table, one worked example, the traps and six new self-test items. If a chapter feels shaky, go back to its exam guide for the full treatment. The long cram sheet at the end pulls every number in the course into one place. Work two chapters a day and the whole course fits into a week.

WHAT THIS GUIDE COVERS

- Foundations: chapters 1 and 2 (nutrients, energy, DRIs; digestion and transport).
- The macronutrients: chapters 3, 4 and 5 (carbohydrates, lipids, proteins).
- The micronutrients and water: chapters 6 and 7 (vitamins; minerals and water).
- Energy and the body: chapters 8 and 9 (energy balance and weight; physical activity).
- Life and safety: chapters 10 and 11 (the lifespan; food safety).
- Health and the wider world: chapters 12, 13 and 14 (chronic disease; assessment and planning; food security and sustainability).
- Every chapter carries what to know, a table, a worked example, the traps and a six-item self-test, and the cram sheet holds all the numbers.

CHAPTER 1

Nutrition Basics

Read it in full: **Chapter 1 in the textbook**. Practice it in the lab: **What a Nutrient Does** and **Nutrients per Calorie**.

What to know

Food is what you eat; a nutrient is a chemical in it the body needs. A nutrient is essential when removing it causes a deficiency that restoring it cures. There are about forty: nine amino acids,

linoleic and alpha-linolenic acid, thirteen vitamins, a set of minerals and water. There is no essential carbohydrate.

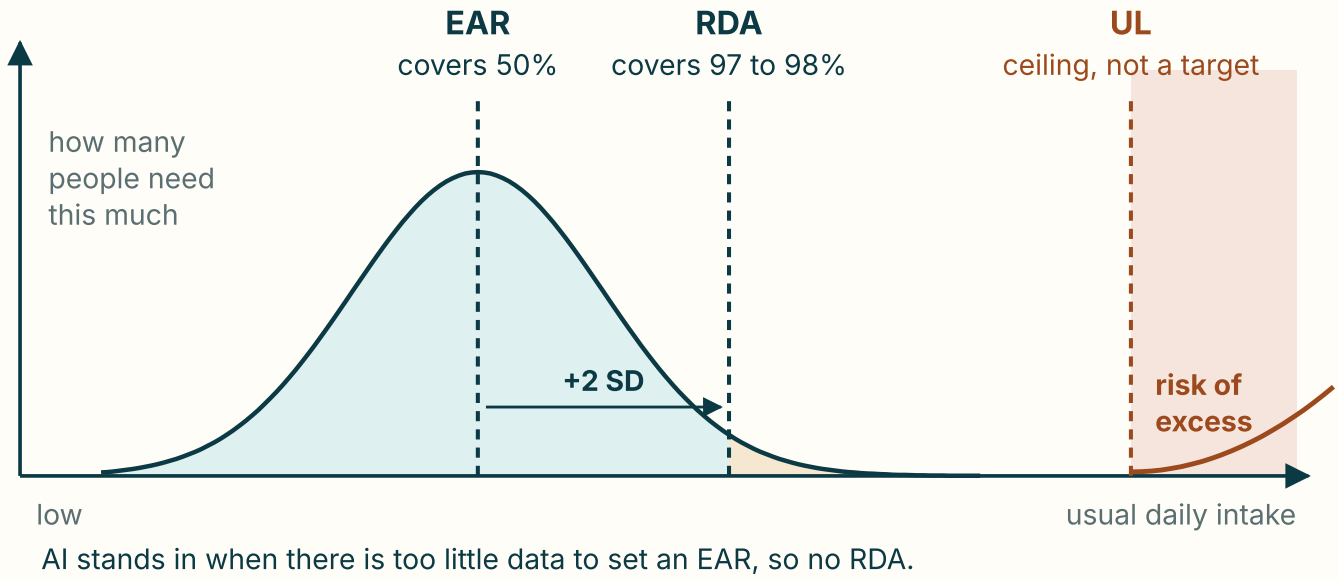
The six classes are carbohydrate, lipid, protein, vitamin, mineral and water. Only the first three yield energy: 4, 9 and 4 kcal/g, with alcohol 7 and fiber about 2. A label Calorie is a kcal, and 1 kcal = 4.184 kJ. Macro and micro describe the amount needed, not importance.

The DRIs are for healthy people by life stage and sex. EAR covers 50% (for groups), RDA covers 97 to 98% (the individual goal), AI stands in when data are thin, and UL is a ceiling. AMDRs for adults: carbohydrate 45 to 65%, fat 20 to 35%, protein 10 to 35%. Energy has an EER, not an RDA. Guidelines: added sugars and saturated fat each under 10% of calories, sodium under 2,300 mg. Nutrient density is nutrients per kcal; energy density is kcal per gram.

Evidence comes in tiers. Deficiency diseases are causally settled; dietary patterns rich in vegetables, fruits, legumes, whole grains, nuts and unsaturated fats have good evidence; single-nutrient supplements for chronic disease are weak or negative. Beta-carotene pills raised lung cancer in smokers, and vitamin D trials did not match the observational hopes. A nutrient inside a whole diet does not behave like the same nutrient in a pill.

LOCK THESE IN

- Six classes; only carbohydrate, fat and protein give energy.
- 4 4 9 and 7; 1 kcal = 4.184 kJ.
- EAR 50%, RDA 97 to 98%, AI thin data, UL ceiling.
- AMDRs 45 to 65, 20 to 35, 10 to 35%.
- Every DRI needs its group and units.
- No foods are "good" or "bad"; the pattern over time is what the evidence judges.



AI stands in when there is too little data to set an EAR, so no RDA.

Where the DRIs sit. Needs spread across a group. The EAR covers half, the RDA two standard deviations higher covers 97 to 98%, and the UL is a ceiling, not a goal.

Chapter 1 numbers

Item	Value
Energy factors	Carb 4, protein 4, fat 9, alcohol 7, fiber about 2 kcal/g
Expenditure	BMR 60 to 70%; thermic effect about 10%
Iron RDA	8 mg men; 18 mg women 19 to 50; 27 mg pregnancy
Fiber AI	38 g men; 25 g women (14 g per 1,000 kcal)
Water AI	3.7 L men; 2.7 L women

Worked examples

EXAMPLE 1.1 · ENERGY AND FAT SHARE

A granola serving has 25 g carbohydrate, 8 g protein and 9 g fat. Find the kcal and the share from fat.

STEP 1 · MULTIPLY

25 × 4 = 100; 8 × 4 = 32; 9 × 9 = 81.

STEP 2 · ADD

100 + 32 + 81 = **213 kcal**.

STEP 3 · FAT SHARE

81 ÷ 213 = **38%**. That is above 20 to 35% for this one food, but AMDRs apply to the whole day, not to each food.

EXAMPLE 1.2 · WHOSE VITAMIN C NUMBER?

Find the vitamin C RDA for a 30-year-old man who smokes.

STEP 1 · BASE VALUE

Adult men: 90 mg/day.

STEP 2 · ADJUST

People who smoke add 35 mg: 90 + 35 = **125 mg/day**.

THE LESSON

Vitamin C is one of the few RDAs adjusted for a behavior rather than a life stage.

TRAPS PEOPLE FALL INTO

- **Vitamins as fuel.** They give 0 kcal.
- **The EAR as a personal goal.** Half the group needs more.
- **The UL as a target.** It is a ceiling.
- **A DRI with no group.** Iron 18 mg is only for women 19 to 50.

Chapter 1 self-test · six items

1. Which nutrient class is organic but supplies no energy?

A. Minerals

B. Vitamins

C. Lipids

D. Proteins

B. Vitamins Vitamins contain carbon but yield 0 kcal. Minerals are inorganic; proteins and lipids yield energy.

2. A food has 10 g fat and 30 g carbohydrate and nothing else. How many kcal does it give?

A. 210 kcal
B. 270 kcal
C. 400 kcal
D. 160 kcal

A. 210 kcal (10 × 9) + (30 × 4) = 90 + 120 = 210 kcal.

3. Why is there an AI rather than an RDA for total water?

A. Water has no deficiency syndrome at all
B. Water needs are identical for all adults
C. Evidence could not support an EAR
D. Water is not counted as a nutrient

C. Evidence could not support an EAR An AI is set when data are too thin for an EAR, so no RDA can be calculated.

4. Which statement about nutrient density fits the chapter?

A. It ranks foods as approved or forbidden
B. It is the same as energy density in kcal
C. It measures kcal per gram of food weight
D. It compares nutrients per kcal of food

D. It compares nutrients per kcal of food Nutrient density is nutrients per calorie. Energy density is calories per gram, and the two vary independently.

5. For a 2,400 kcal day, what is the most saturated fat under the 10% target?

A. About 27 g
B. About 24 g
C. About 60 g
D. About 40 g

A. About 27 g 10% of 2,400 is 240 kcal, and 240 ÷ 9 = 26.7 g.

6. What does the absence of a UL for a nutrient mean?

A. The RDA doubles as the ceiling value
B. The data were too thin to set one
C. The nutrient has no known function
D. Any amount has been proven to be safe

B. The data were too thin to set one No UL means insufficient data, not proof of safety.

CHAPTER 2

Digestion, Absorption and Transport

Read it in full: **Chapter 2 in the textbook**. Practice it in the lab: **Match the Enzyme** and **Why Villi Matter**.

What to know

The GI tract is one tube, about five meters in a living person, and its inside is outside the body until absorption. Accessory organs (salivary glands, liver, gallbladder, pancreas) add secretions through ducts. Mechanical digestion buys surface area; chemical digestion is hydrolysis by hydrolases.

Carbohydrate ends as monosaccharides (brush border lactase, sucrase, maltase), protein as amino acids and di and tripeptides (pepsin, then trypsin and others from zymogens, then peptidases), fat

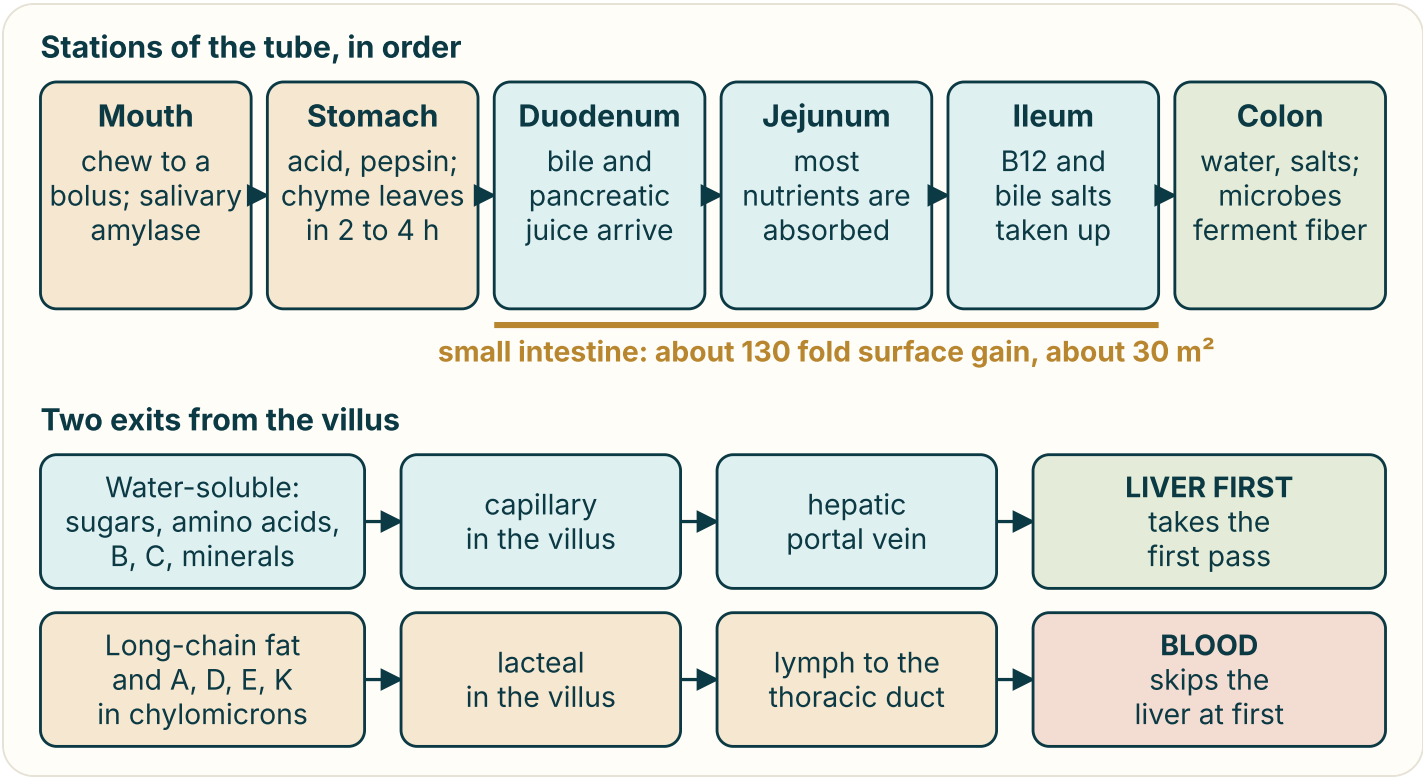
as monoglycerides and fatty acids (bile emulsifies, lipase with colipase splits, micelles carry). Pancreatic bicarbonate neutralizes acid. Gastrin, secretin and CCK time it all.

Folds give about 130 fold more surface, about 30 m^2. Glucose and galactose use SGLT1; fructose uses GLUT5. Iron and calcium are absorbed mostly in the duodenum, most nutrients in the jejunum, B12 (with intrinsic factor) and bile salts in the terminal ileum. Water-soluble nutrients go by the portal vein to the liver; chylomicrons go by the lacteal and lymph and skip the first pass. The microbiota ferments fiber into short chain fatty acids.

Bioavailability is the share actually absorbed. Vitamin C raises nonheme iron absorption; tea, coffee and large calcium doses lower it in single meals; fat-soluble vitamins need fat and bile. The liver buffers the absorbed stream: it stores glycogen, turns extra amino acid nitrogen into urea, builds lipoproteins, stores vitamins A, D and B12 and iron, and makes bile. Lactase non-persistence is the human norm, and tolerance varies.

LOCK THESE IN

- Bile has no enzymes.
- Zymogens: pepsinogen by acid; trypsinogen by enteropeptidase.
- SGLT1 for glucose and galactose; GLUT5 for fructose.
- B12 and bile salts: terminal ileum.
- Portal vein to the liver; chylomicrons to the lymph.
- Fiber benefits are strong; most microbiome claims are preliminary.



Six stations and two exits. Water-soluble nutrients go to the liver first by the portal vein. Long-chain fat rides chylomicrons into the lymph and skips the liver at first.

Chapter 2 sites and secretions

Item	Detail
Stomach	HCl pH 1.5 to 3.5; pepsinogen; intrinsic factor; 2 to 4 h
Pancreas	About 1.5 L/day of enzymes and bicarbonate
Bile	500 to 600 mL/day; emulsifier, recycled in the ileum
Duodenum	Iron, calcium
Terminal ileum	B12, bile salts

Worked examples

EXAMPLE 2.1 · FOLLOW A GLASS OF MILK

Trace the lactose, protein, fat and calcium in a glass of milk.

STEP 1 · LACTOSE

Lactase on the brush border splits it into glucose and galactose, which enter by SGLT1 and go to the liver by the portal vein.

STEP 2 · PROTEIN

Acid unfolds it and pepsin starts cutting; pancreatic proteases and brush border peptidases finish. Amino acids go to the liver.

STEP 3 · FAT

Bile emulsifies it, lipase splits it, micelles carry it, and the cell packs it into chylomicrons that enter the lymph.

STEP 4 · CALCIUM

Absorbed mainly in the duodenum.

EXAMPLE 2.2 · BLOOD OR LYMPH?

Sort these by exit route: glucose, leucine, vitamin A, an 8-carbon fatty acid and a 16-carbon fatty acid.

STEP 1 · PORTAL VEIN

Glucose, leucine and the 8-carbon (medium chain) fatty acid go into villus capillaries and on to the liver.

STEP 2 · LYMPH

Vitamin A and the 16-carbon (long chain) fatty acid are packed into chylomicrons and enter the lacteal.

RULE

Water-soluble and short or medium chain go to the liver first; fat-soluble and long chain skip it.

TRAPS PEOPLE FALL INTO

- **Calling bile an enzyme.** It is a detergent.
- **Sending chylomicrons to the liver first.** They enter the lymph.
- **Placing B12 uptake in the stomach.** The stomach makes intrinsic factor; the ileum absorbs.
- **Adding the fold multipliers.** They multiply.

Chapter 2 self-test · six items

1. What does secretin signal when acid reaches the duodenum?

A. The pancreas to release bicarbonate
B. The liver to store extra glycogen now
C. The stomach to make more acid at once
D. The gallbladder to contract and squeeze

A. The pancreas to release bicarbonate Secretin calls for bicarbonate to neutralize acid. CCK squeezes the gallbladder, and gastrin raises acid.

2. What does every digestive enzyme have in common?

A. Each one is made by the pancreas
B. Each one breaks bonds by hydrolysis
C. Each one works best in strong acid
D. Each one is stored in the gallbladder

B. Each one breaks bonds by hydrolysis All digestive enzymes are hydrolases, adding water across a bond.

3. Which nutrient leaves the intestine mainly by the lymph?

A. Water-soluble B vitamins
B. Glucose from digested starch
C. Long chain fat in chylomicrons
D. Amino acids from protein

C. Long chain fat in chylomicrons Chylomicrons are too large for capillaries, so they enter the lacteal.

4. A person lacks intrinsic factor. Where would their B12 absorption fail?

A. The ascending colon
B. The upper duodenum
C. The stomach body
D. The terminal ileum

D. The terminal ileum Intrinsic factor binds B12 so it can be taken up in the terminal ileum.

5. What do gut bacteria make when they ferment fiber?

A. Intrinsic factor for vitamin B12 uptake
B. Bile salts to be used at the next meal
C. Short chain fatty acids like butyrate
D. Lactase for digesting the milk sugar

C. Short chain fatty acids like butyrate Fermentation yields acetate, propionate and butyrate, and butyrate fuels colon cells.

6. About how large is the small intestine's absorptive surface by careful measurement?

A. About 3 m^2
B. About 30 m^2
C. About 300 m^2
D. About 3,000 m^2

B. About 30 m^2 Newer measurements give about 130 fold amplification and about 30 m^2, not a tennis court.

Carbohydrates

Read it in full: **Chapter 3 in the textbook**. Practice it in the lab: **Soluble vs Insoluble Fiber** and **The Added Sugar Detective**.

What to know

Monosaccharides are glucose, fructose and galactose. Disaccharides: sucrose (glucose + fructose), lactose (glucose + galactose), maltose (two glucoses). Starch and glycogen have alpha bonds; cellulose has beta 1,4 bonds no human enzyme cuts. Lactose intolerance is a lactase shortage, not an allergy.

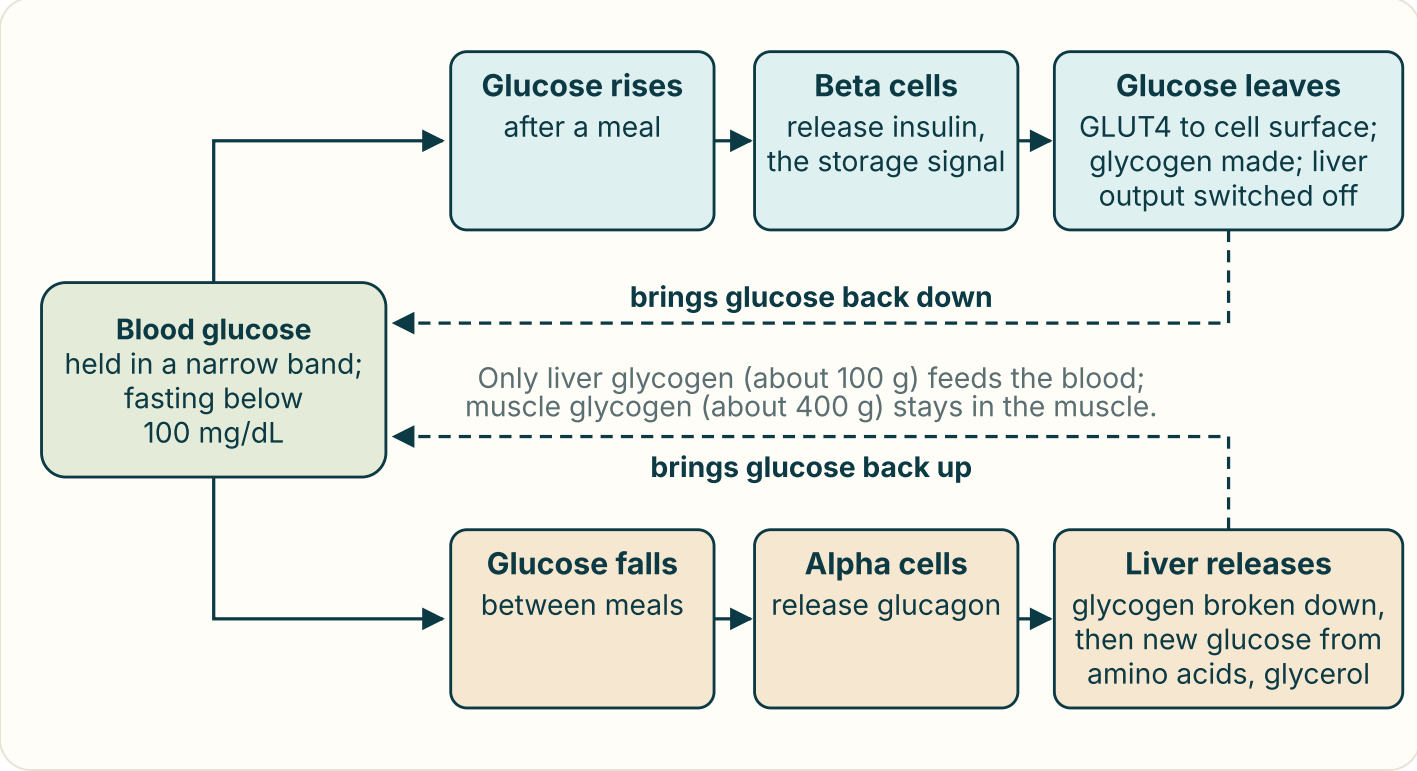
Viscous soluble fiber (oat beta-glucan, psyllium, pectin) gels, slows glucose and modestly lowers LDL by binding bile acids. Insoluble fiber adds bulk. Bacteria ferment fiber into short chain fatty acids. Fiber AI is 14 g per 1,000 kcal: 38 g men and 25 g women (19 to 50), 28 g in pregnancy; no UL. Resistant starch forms when cooked starch cools.

Insulin (beta cells) lowers blood glucose; glucagon (alpha cells) raises it through glycogenolysis and gluconeogenesis. Liver glycogen (about 100 g) feeds the blood; muscle glycogen (about 400 g) does not. GL = GI × grams of available carbohydrate ÷ 100. Carbohydrate RDA 130 g (175 pregnancy, 210 lactation), AMDR 45 to 65%, added sugars under 10%. Quality, not total amount, tracks type 2 diabetes risk.

Resistant starch and fermentable fiber give about 2 kcal/g. The GI uses 50 g of available carbohydrate compared with glucose at 100, and it shifts with ripeness, cooking, cooling and the rest of the meal. Type 1 diabetes is autoimmune and not caused by diet. Sugar-sweetened beverages track with higher type 2 risk, much of it through energy intake, while whole fruit tracks with lower risk.

LOCK THESE IN

- Sucrose = glu + fru; lactose = glu + gal; maltose = glu + glu.
- Cellulose's beta 1,4 bond is uncuttable by humans.
- Insulin from beta cells; glucagon from alpha cells.
- GL = GI × g carb ÷ 100.
- RDA 130 g; AMDR 45 to 65%.
- Free sugars and caries: strong evidence.



Insulin down, glucagon up. Two hormones from the pancreas push blood glucose back toward its narrow band after a meal and between meals.

Chapter 3 numbers

Item	Value
GI bands	Low 55 or less; high 70 or more
GL bands	Low 10 or less; high 20 or more
Fiber AI	14 g per 1,000 kcal
Fasting glucose	Below 100 mg/dL without diabetes
Glycogen	Liver about 100 g; muscle about 400 g

Worked examples

EXAMPLE 3.1 · A GLYCEMIC LOAD

A food has a GI of 80, and a serving holds 15 g of available carbohydrate. Find its GL and band.

STEP 1 · APPLY THE FORMULA

80 × 15 ÷ 100 = **12**.

STEP 2 · BAND

12 is above 10 and below 20, so **medium**, even though the GI is high.

WHY

The serving holds little carbohydrate, so the high GI matters less.

EXAMPLE 3.2 · AN ENERGY-SCALED FIBER TARGET

Find the fiber target for someone eating 2,200 kcal a day.

STEP 1 · SCALE

14 g × 2,200 ÷ 1,000 = **30.8 g/day**.

RAISE IT SLOWLY

Increase over several weeks with fluid to avoid gas and cramping.

TRAPS PEOPLE FALL INTO

- **Muscle glycogen feeding the blood.** Muscle cannot release free glucose.

- **"Complex" means slow.** Milled starch digests fast.
- **Fiber with an RDA.** It has an AI.
- **"Sugar causes diabetes."** Quality and pattern track risk.

Chapter 3 self-test · six items

1. Which sugar is split by sucrase into glucose and fructose?

A. Sucrose
B. Galactose
C. Maltose
D. Lactose

A. Sucrose Sucrose is glucose plus fructose. Lactase splits lactose; maltase splits maltose.

2. Which fiber is best known for lowering LDL cholesterol modestly?

A. Lignin in seeds
B. Cellulose in bran
C. Wheat bran husk
D. Oat beta-glucan

D. Oat beta-glucan Viscous soluble fiber such as beta-glucan binds bile acids. Cellulose and lignin are insoluble.

3. What is the carbohydrate RDA in lactation?

A. 260 g/day
B. 130 g/day
C. 210 g/day
D. 175 g/day

C. 210 g/day The RDA is 130 g for ages 1 and older, 175 g in pregnancy and 210 g in lactation.

4. Which hormone drives glycogenolysis in the liver between meals?

A. Gastrin
B. Glucagon
C. Leptin
D. Insulin

B. Glucagon Glucagon from alpha cells breaks down liver glycogen when blood glucose falls.

5. Which transporter moves glucose into the cell with sodium?

A. GLUT5
B. GLUT4
C. GLUT2
D. SGLT1

D. SGLT1 SGLT1 is sodium-linked active transport for glucose and galactose.

6. A man aged 60 asks about his fiber target. What is his AI?

A. 38 g/day
B. 30 g/day
C. 21 g/day
D. 25 g/day

B. 30 g/day Men 51 and older have a fiber AI of 30 g; 38 g applies to men 19 to 50.

CHAPTER 4

Lipids

Read it in full: **Chapter 4 in the textbook**. Practice it in the lab: **Three Kinds of Lipid** and **The Fat Journey**.

What to know

Triglycerides (glycerol plus three fatty acids) are about 95% of dietary fat and give 9 kcal/g. Phospholipids build membranes and emulsify (lecithin). Cholesterol is found only in animal foods; the body makes about 800 to 1,000 mg a day. Saturated chains are straight; cis double bonds kink; trans bonds straighten and act like saturated fat.

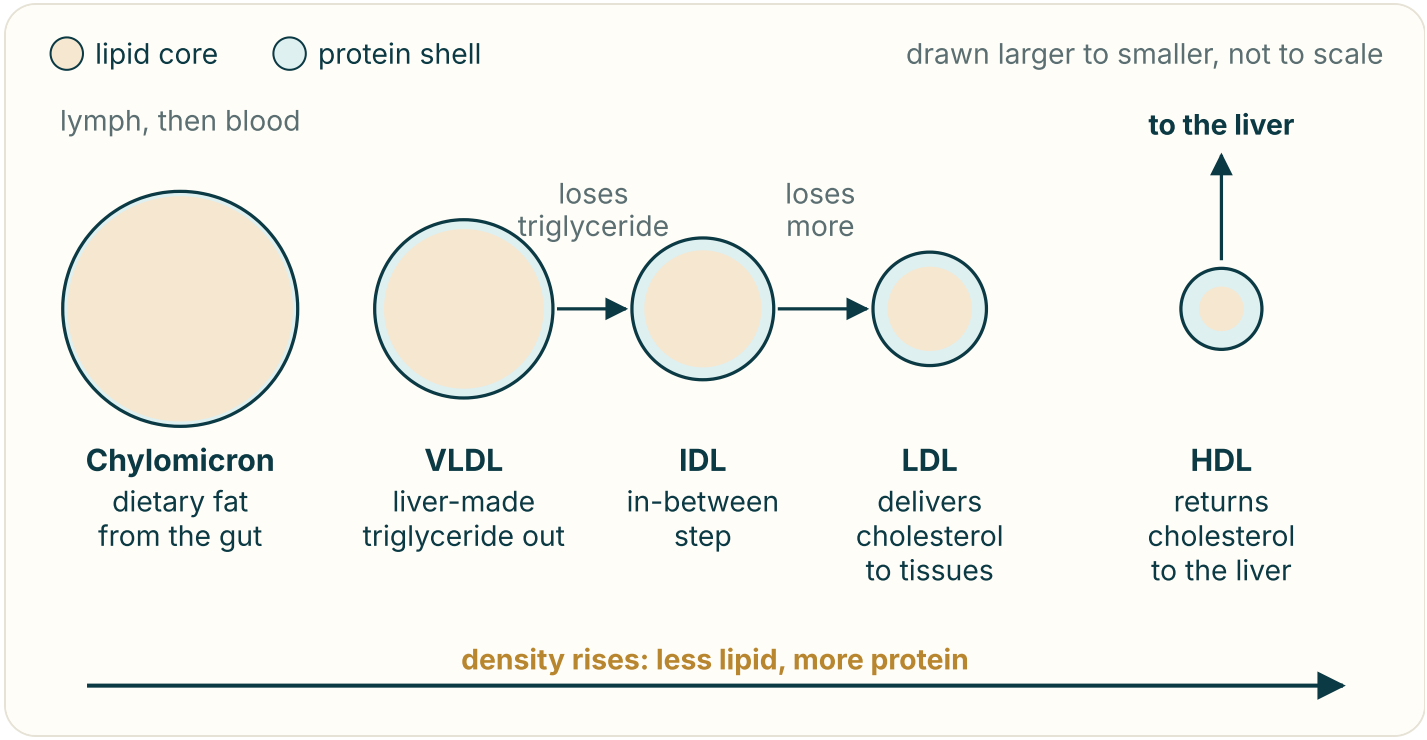
The two essential fatty acids are linoleic acid (omega-6, AI 17 g men and 12 g women at 19 to 50) and alpha-linolenic acid (omega-3, AI 1.6 g men and 1.1 g women). Bile emulsifies, lipase with colipase splits, micelles carry, and long chain fats ride chylomicrons into the lymph while short and medium chains go to the portal vein.

Density rises from chylomicron to VLDL, IDL, LDL and HDL. LDL is causal in atherosclerosis; HDL is a marker. Replacing saturated with polyunsaturated fat lowers LDL and events; replacing it with refined carbohydrate does not. Fat AMDR 20 to 35% (30 to 40% at ages 1 to 3), saturated fat under 10%, trans fat as low as possible.

Fat stores energy almost without water, while glycogen holds about 3 to 4 g of water per gram, so the body keeps tens of thousands of kcal as fat but only 1,500 to 2,000 kcal as glycogen. Subcutaneous fat insulates, visceral fat cushions, and adipose tissue makes leptin and adiponectin. Essential fatty acid deficiency (scaly dermatitis, poor healing) is rare outside fat-free feeding or severe malabsorption. Omega-3 supplements show little benefit in general populations, though eating fish is linked to lower risk.

LOCK THESE IN

- Triglyceride: 95% of dietary fat, 9 kcal/g.
- Linoleic (n-6) and ALA (n-3) are essential.
- Trans fat raises LDL and lowers HDL.
- Chylomicron, VLDL, IDL, LDL, HDL: least to most dense.
- Replace saturated with polyunsaturated fat.
- Fat malabsorption risks A, D, E and K.



Lipoproteins by density. Less lipid and more protein means a denser particle. VLDL becomes IDL and then LDL as it loses triglyceride.

Chapter 4 numbers

Item	Value
Fat AMDR	20 to 35% adults; 25 to 35% ages 4 to 18; 30 to 40% ages 1 to 3
Linoleic acid	AMDR 5 to 10%; AI 17 g men, 12 g women
ALA	AMDR 0.6 to 1.2%; AI 1.6 g men, 1.1 g women
Saturated fat	Under 10% of calories
Seafood	About 8 oz a week

Worked examples

EXAMPLE 4.1 · A FAT BUDGET

On an 1,800 kcal day, how many grams of fat give 30% of energy, and what is the saturated fat cap?

STEP 1 · 30% OF ENERGY

1,800 × 0.30 = 540 kcal; 540 ÷ 9 = **60 g** of fat.

STEP 2 · SATURATED CAP

10% = 180 kcal; 180 ÷ 9 = **20 g**.

CHECK

Both use 9 kcal/g; using 4 would more than double the grams.

EXAMPLE 4.2 · THE ALA RANGE IN GRAMS

On a 2,200 kcal day, turn the ALA AMDR of 0.6 to 1.2% into grams.

STEP 1 · LOW END

2,200 × 0.006 = 13.2 kcal; 13.2 ÷ 9 = 1.5 g.

STEP 2 · HIGH END

2,200 × 0.012 = 26.4 kcal; 26.4 ÷ 9 = 2.9 g.

RESULT

About **1.5 to 2.9 g/day**, from foods such as flaxseed, chia, walnuts and canola oil.

TRAPS PEOPLE FALL INTO

- **Plant oil "cholesterol-free" as a selling point.** Plants never had cholesterol.
- **Trans fat as saturated fat.** It is unsaturated but acts like saturated fat.
- **All fat into the lymph.** Short and medium chains go to the portal vein.
- **HDL as a proven target.** Raising it did not cut events.

Chapter 4 self-test · six items

1. Why does a cis double bond keep an oil liquid?

A. It kinks the chain so molecules cannot pack

B. It shortens the chain to under six carbons

C. It turns the fat into a phospholipid form

D. It adds oxygen that attracts water molecules

A. It kinks the chain so molecules cannot pack Kinked chains stack loosely, so the fat stays liquid at room temperature.

2. Which food is a source of alpha-linolenic acid?

A. Beef fat
B. Butter
C. Flaxseed
D. Coconut oil

C. Flaxseed ALA is in flaxseed, chia, walnuts, canola and soybean oil.

3. Which enzyme strips triglyceride from chylomicrons in the blood?

A. Gastric pepsin
B. Pancreatic amylase
C. Brush border lactase
D. Lipoprotein lipase

D. Lipoprotein lipase Lipoprotein lipase on capillary walls in muscle and fat tissue unloads chylomicrons.

4. Which lipoprotein is made by the liver to carry triglyceride out?

A. HDL
B. VLDL
C. LDL
D. Chylomicron

B. VLDL VLDL carries liver-made triglyceride to tissues. Chylomicrons come from the intestine.

5. What is the fat AMDR for a 2-year-old?

A. 30 to 40% of energy
B. 25 to 35% of energy
C. 10 to 30% of energy
D. 20 to 35% of energy

A. 30 to 40% of energy Young children need more fat for growth and myelin: 30 to 40% at ages 1 to 3.

6. Coconut oil is marketed as heart-friendly. What does the chapter say?

A. It is the main source of omega-3 fat
B. It contains no saturated fat at all
C. It raises LDL like other saturated fats
D. It lowers LDL more than olive oil does

C. It raises LDL like other saturated fats Controlled trials do not support a unique advantage. It raises LDL much as other highly saturated fats do.

CHAPTER 5

Proteins and Amino Acids

Read it in full: **Chapter 5 in the textbook**. Practice it in the lab: **Essential or Not** and **The Six Jobs of Protein**.

What to know

Amino acids share an alpha carbon, amino group, carboxyl group and hydrogen; the side chain differs. Nine are indispensable (histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine). Tyrosine becomes indispensable in PKU. Protein is about 16% nitrogen, so protein = N × 6.25.

Primary structure is the sequence; secondary is helix and sheet; tertiary is the fold; quaternary is several chains. Denaturation unfolds shape but keeps peptide bonds. Digestion: acid and pepsin,

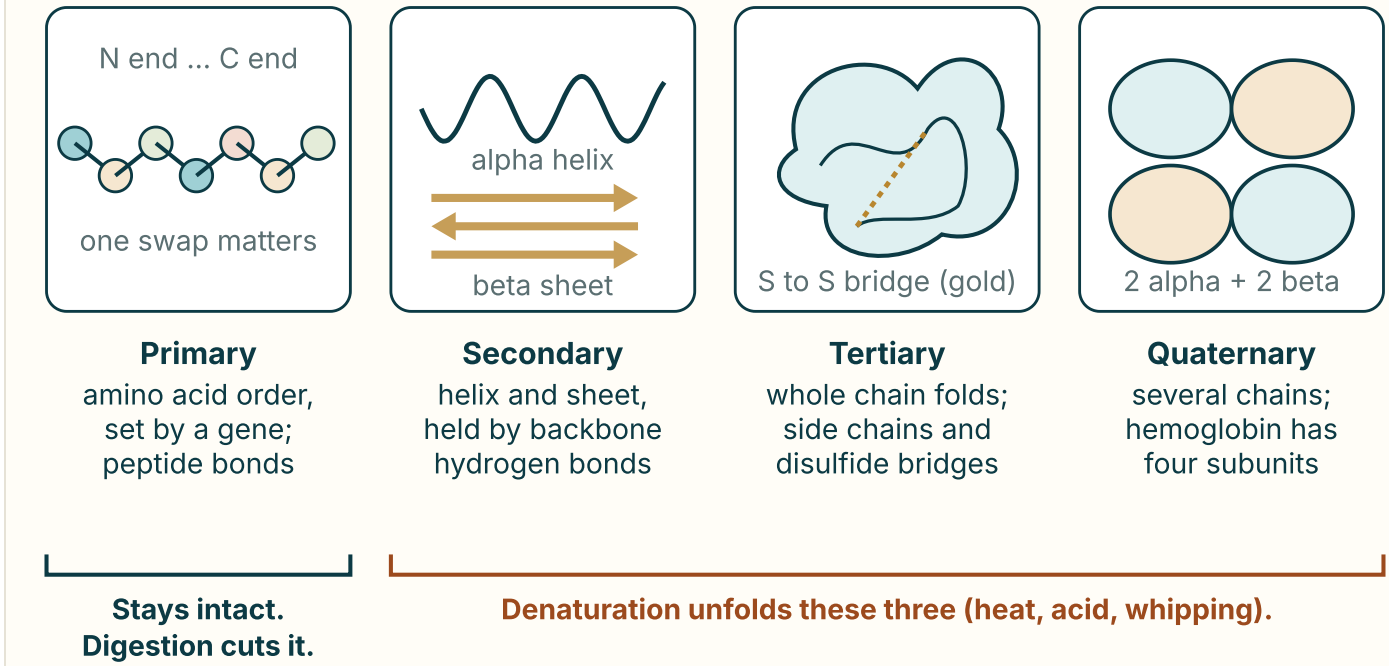
then trypsin (activated by enteropeptidase), chymotrypsin, elastase, carboxypeptidase and brush border peptidases.

Proteins are structure (collagen is most abundant), enzymes, hormones, transporters, antibodies, fluid balance (albumin), buffers and, reluctantly, fuel. RDA 0.8 g/kg for adults (EAR 0.66), 1.1 g/kg in pregnancy and lactation; AMDR 10 to 35%; no UL. Grains are low in lysine and legumes in methionine; complements work across the day.

Nitrogen balance is positive in growth, pregnancy and recovery and negative in illness, burns and poor intake. Adequate carbohydrate is protein sparing. PDCAAS is capped at 1.00; DIAAS measures at the end of the small intestine and is uncapped. Marasmus is wasting without edema; kwashiorkor has edema and a fatty liver, and its cause is unresolved. Concerns that high protein harms healthy kidneys or bones have not held up in current evidence.

LOCK THESE IN

- Nine indispensable amino acids.
- Protein = N × 6.25.
- Denaturation keeps peptide bonds.
- Enteropeptidase activates trypsin.
- RDA 0.8 g/kg; 1.1 g/kg pregnancy and lactation.
- B12, not protein, is the firm vegan planning item.



Shape is function. Denaturation unfolds the upper three levels but leaves the peptide bonds of the primary structure intact.

Chapter 5 numbers

Item	Value
RDA by age	1.05 g/kg (1 to 3); 0.95 (4 to 13); 0.85 (14 to 18); 0.8 adults
AMDR	10 to 35% adults; 10 to 30% ages 4 to 18; 5 to 20% ages 1 to 3
Athletes	1.2 to 2.0 g/kg (guidance)
Over 65	1.0 to 1.2 g/kg (expert suggestion)
Turnover	About 250 to 300 g/day

Worked examples

EXAMPLE 5.1 · PROTEIN FOR ONE PERSON, THREE WAYS

Omari weighs 90 kg. Find his RDA and the athlete range of 1.2 to 2.0 g/kg. A food sample has 12 g of nitrogen; how much protein is that?

STEP 1 · RDA

0.8 × 90 = **72 g/day**.

STEP 2 · ATHLETE RANGE

1.2 × 90 = 108 g; 2.0 × 90 = 180 g, so **108 to 180 g**.

STEP 3 · NITROGEN

12 × 6.25 = **75 g** of protein.

EXAMPLE 5.2 · PROTEIN AS A SHARE OF ENERGY

Keisha eats 70 g of protein on an 1,800 kcal day. What share of energy is protein?

STEP 1 · KCAL

70 × 4 = 280 kcal.

STEP 2 · SHARE

280 ÷ 1,800 = **15.6%**, inside the 10 to 35% AMDR.

TRAPS PEOPLE FALL INTO

- **Denaturation as digestion.** Bonds remain after cooking.
- **Same-meal complements.** The rule was withdrawn.
- **RDA in g/day.** It is per kg of body weight.
- **Kwashiorkor as protein lack alone.** Its cause is unresolved.

Chapter 5 self-test · six items

1. Which amino acid is NOT on the list of nine indispensable ones?

A. Alanine

B. Valine

C. Tryptophan

D. Lysine

A. Alanine Alanine is made by the body. Lysine, valine and tryptophan are indispensable.

2. A single amino acid swap in beta-globin causes which condition?

A. Phenylketonuria (PKU)
B. Kwashiorkor
C. Celiac disease
D. Sickle cell disease

D. Sickle cell disease Valine replaces glutamic acid at position six, changing hemoglobin's behavior.

3. What is the main protein that holds water in the blood by osmotic pull?

A. Collagen
B. Pepsin
C. Albumin
D. Keratin

C. Albumin Albumin stays in capillaries and keeps fluid in the bloodstream.

4. What does the PDCAAS correct a food's amino acid score for?

A. Fat content
B. Digestibility
C. Fiber grams
D. Water content

B. Digestibility PDCAAS adjusts the amino acid pattern score for how well the protein is digested, capped at 1.00.

5. Which protein source is complete and plant-based?

A. Soy
B. Peanuts
C. Wheat
D. Rice

A. Soy Soy and quinoa supply all nine indispensable amino acids in good proportions.

6. A 50 kg teenager aged 15 needs how much protein by the RDA?

A. About 47.5 g/day
B. About 55 g/day
C. About 42.5 g/day
D. About 40 g/day

C. About 42.5 g/day Ages 14 to 18 have an RDA of 0.85 g/kg: 0.85 × 50 = 42.5 g.

CHAPTER 6

Vitamins

Read it in full: **Chapter 6 in the textbook**. Practice it in the lab: **Vitamin Stores & Safety: Fat- vs Water-Soluble** and **Collagen and Scurvy: When Vitamin C Runs Out**.

What to know

Vitamins are organic, needed in mg or µg, and give 0 kcal. Fat-soluble A, D, E and K need fat and bile, are stored and can become toxic. Water-soluble B vitamins and C turn over fast, except B12, which the liver stores for years.

A: rhodopsin and epithelium; deficiency causes night blindness and xerophthalmia; preformed A over 3,000 µg is teratogenic; 1 µg RAE = 12 µg dietary beta-carotene. D: liver then kidney activation; RDA 15 µg (600 IU) to 70, 20 µg (800 IU) after; 1 µg = 40 IU; rickets and

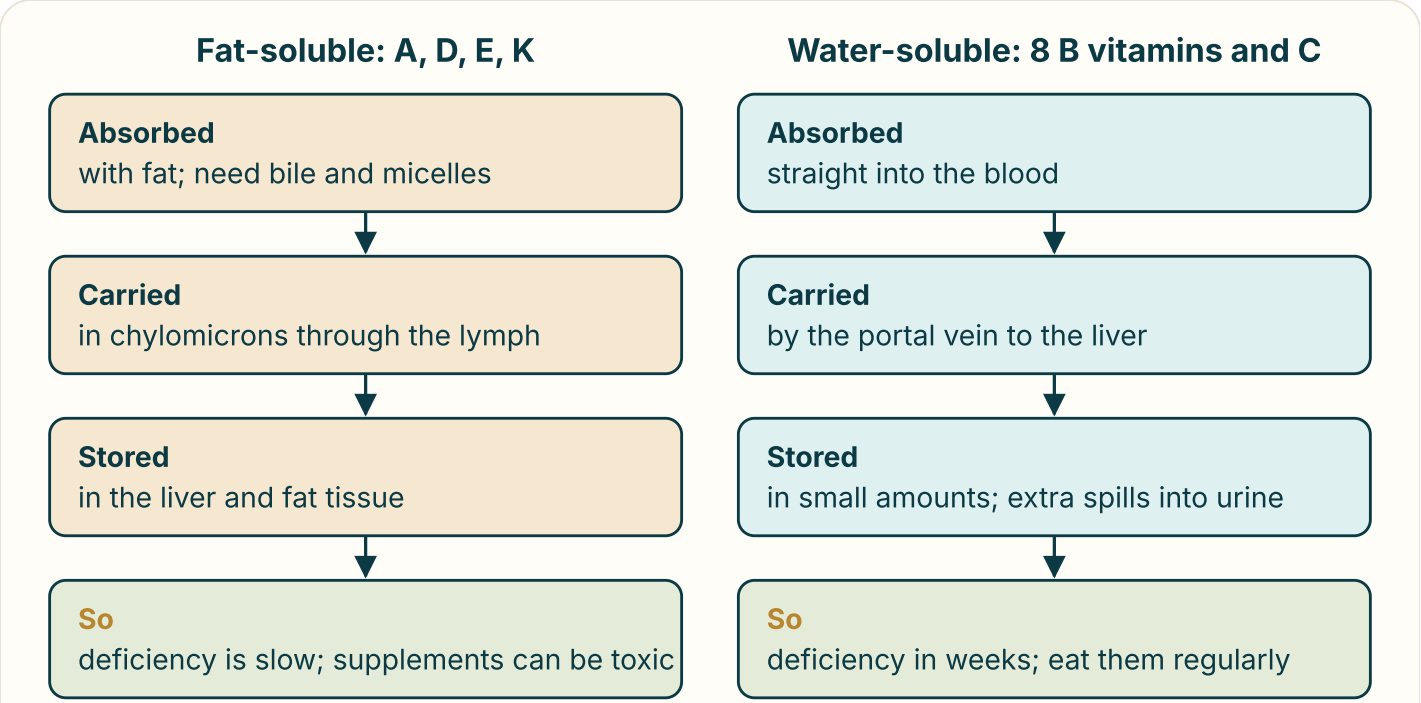
osteomalacia. E: membrane antioxidant, RDA 15 mg. K: clotting factors, AI 120 and 90 µg, dose at birth.

B vitamins are coenzymes: thiamin (beriberi, Wernicke-Korsakoff), riboflavin (cheilitis), niacin (pellagra; 60 mg tryptophan = 1 mg NE), B6 (UL 100 mg), folate (600 µg DFE in pregnancy; neural tube defects) and B12 (2.4 µg; intrinsic factor; animal foods only). Vitamin C hydroxylates collagen and boosts nonheme iron: RDA 90 men, 75 women, +35 for smoking; scurvy if absent.

Bioavailability shifts with the food matrix, fat, chemical form and interactions: chopped and gently cooked carrots release more carotenoid, and folic acid is absorbed better than food folate, hence DFE. Boiling and draining loses the most vitamin C, thiamin and folate; light degrades riboflavin; baking soda destroys thiamin and C. Strong supplement uses: folic acid before pregnancy, vitamin K at birth, vitamin D for breastfed infants, B12 for vegans and many older adults.

LOCK THESE IN

- Fat-soluble stored; water-soluble regular.
- Preformed A UL 3,000 µg.
- D: 1 µg = 40 IU.
- Thiamin, niacin, C, D, A deficiency pairs.
- Folic acid before pregnancy prevents NTDs.
- Folic acid can mask B12 deficiency.



Solubility sets the rules. How a vitamin is absorbed, carried and stored predicts how fast deficiency appears and whether excess builds up.

Chapter 6 numbers

Vitamin	Adult value
A	RDA 900 / 700 µg RAE; UL 3,000 µg preformed
D	RDA 15 µg (600 IU); 20 µg over 70; UL 100 µg
Folate	RDA 400 µg DFE; 600 pregnancy; UL 1,000 µg folic acid
B12	RDA 2.4 µg
C	RDA 90 / 75 mg; UL 2,000 mg

Worked examples

EXAMPLE 6.1 · TWO UNIT CONVERSIONS

Convert a 1,000 IU vitamin D supplement into micrograms, and 2,400 µg of dietary beta-carotene into RAE.

STEP 1 · VITAMIN D

1,000 ÷ 40 = **25 µg**, above the 15 µg RDA and well under the 100 µg UL.

STEP 2 · BETA-CAROTENE

2,400 ÷ 12 = **200 µg RAE**.

THE UL

The vitamin A UL counts preformed retinol only, so the 200 µg RAE from beta-carotene does not count toward it.

EXAMPLE 6.2 · NIACIN EQUIVALENTS

A day supplies 8 mg of niacin and 480 mg of tryptophan. Compare the total with the adult men's RDA.

STEP 1 · TRYPTOPHAN

480 ÷ 60 = 8 mg NE.

STEP 2 · TOTAL

8 + 8 = **16 mg NE**, exactly the men's RDA of 16 mg NE.

TRAPS PEOPLE FALL INTO

- **"Extra water-soluble vitamins just wash out."** B6, niacin and folic acid have ULs.
- **Mixing IU and µg.** 1 µg D = 40 IU.
- **Unfortified plant B12.** Not reliable.
- **Supplements as pre-approved.** They are not.

Chapter 6 self-test · six items

1. Which vitamin forms rhodopsin for vision in dim light?

A. Vitamin D

B. Vitamin K

C. Vitamin A

D. Vitamin E

C. Vitamin A Retinal bound to opsin forms rhodopsin in rod cells.

2. A 75-year-old asks for the vitamin D RDA. What is it?

A. 20 µg (800 IU)
B. 15 µg (600 IU)
C. 10 µg (400 IU)
D. 100 µg (4,000 IU)

A. 20 µg (800 IU) Adults over 70 need 800 IU. 600 IU is for ages 1 to 70, and 4,000 IU is the UL.

3. Which vitamin is a coenzyme as NAD^+ and $NADP^+$?

A. Folate
B. Niacin
C. Thiamin
D. Riboflavin

B. Niacin Niacin becomes NAD^+ and $NADP^+$. Thiamin becomes TPP, riboflavin FAD and FMN.

4. Which deficiency is classically linked to a diet of polished white rice?

A. Vitamin C, causing scurvy
B. Vitamin D, causing rickets
C. Niacin, causing pellagra
D. Thiamin, causing beriberi

D. Thiamin, causing beriberi Milling strips the thiamin-rich bran.

5. Which cooking change best keeps vitamin C in vegetables?

A. Steaming instead of boiling
B. Boiling longer in more water
C. Adding baking soda to the pot
D. Draining and discarding the liquid

A. Steaming instead of boiling Vitamin C leaches into water and breaks down with heat; steaming limits both.

6. Why can vitamin C help a person eating mostly beans and grains?

A. It replaces the need for vitamin B12
B. It supplies energy at 4 kcal per gram
C. It blocks phytate from entering cells
D. It raises nonheme iron absorption

D. It raises nonheme iron absorption Vitamin C reduces ferric to ferrous iron, which is absorbed more easily.

CHAPTER 7

Minerals and Water

Read it in full: **Chapter 7 in the textbook**. Practice it in the lab: **The Major Minerals** and **The Sodium-Potassium Balance**.

What to know

Minerals are elements, give 0 kcal, survive heat but leach into water. Major minerals are over 100 mg a day: calcium (RDA 1,000; 1,200 women 51+ and men 71+; 1,300 ages 9 to 18), phosphorus (700), magnesium (400 to 420 men, 310 to 320 women), and sodium, potassium and chloride with AIs. Sodium AI 1,500 mg, CDRR 2,300 mg; potassium AI 3,400 mg men, 2,600 mg women.

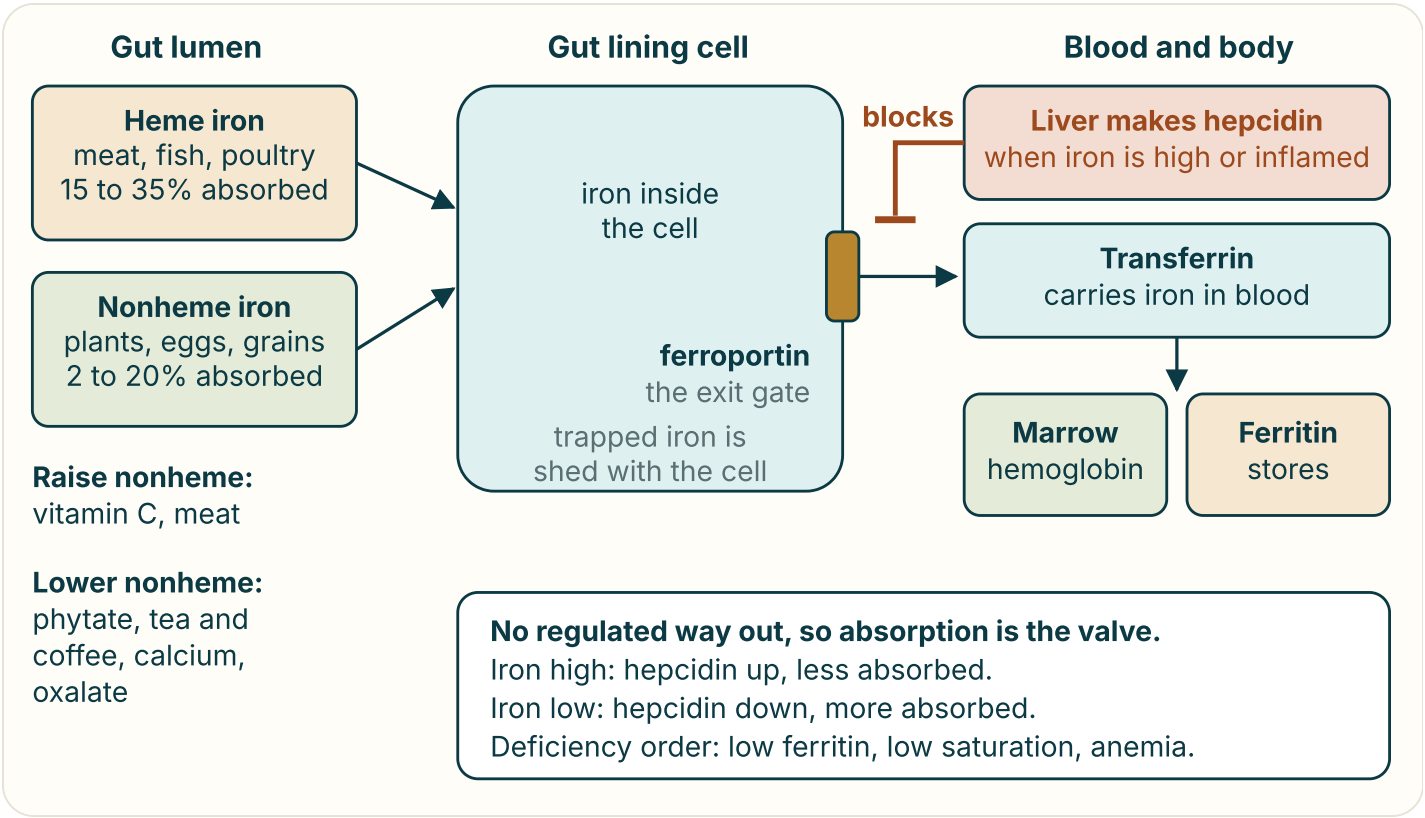
Trace minerals sit close to their ULs: iron (8, 18, 27 mg; UL 45), zinc (11 and 8 mg; UL 40), iodine (150 µg; UL 1,100), selenium (55 µg; UL 400) and fluoride (AI 4 and 3 mg; UL 10). Phytate and oxalate reduce absorption; vitamin C helps nonheme iron. Heme iron is 15 to 35% absorbed, nonheme 2 to 20%. Hepcidin controls iron at absorption; stages run from low ferritin to microcytic anemia.

Water is 50 to 70% of body weight, two thirds inside cells. AI 3.7 L men and 2.7 L women, from food and drinks. ADH defends concentration; aldosterone defends volume. Lowering sodium lowers blood pressure (strong); raising potassium helps too (moderate). One teaspoon of salt is about 2,300 mg sodium, and about 70% of sodium comes from packaged and restaurant food.

Iron deficiency anemia is microcytic and hypochromic; B12 and folate deficiency are macrocytic. Ferritin is an acute-phase reactant, so inflammation can hide empty stores. Two Brazil nuts can exceed a day's selenium, and the amount varies with soil. Exercise-associated hyponatremia shows that hydration is a balance, not a maximum. Potassium salt substitutes can be unsafe with kidney disease or some blood pressure medicines.

LOCK THESE IN

- Major over 100 mg/day; trace less.
- Calcium 1,000 / 1,200 / 1,300 mg.
- Heme 15 to 35%; nonheme 2 to 20%.
- Hepcidin up, iron absorption down.
- Water AI 3.7 L men, 2.7 L women.
- Salt is about 40% sodium.



Absorption is the valve. With no regulated way to excrete iron, hepcidin closes the ferroportin gate when iron is plentiful.

Chapter 7 numbers

Mineral	Adult value
Iron	8 mg men; 18 mg women 19 to 50; 27 mg pregnancy; UL 45
Zinc	11 mg men; 8 mg women; UL 40
Iodine	150 µg; 220 pregnancy; 290 lactation; UL 1,100
Selenium	55 µg; UL 400
Sodium	AI 1,500 mg; CDRR 2,300 mg

Worked examples

EXAMPLE 7.1 · SALT INTO SODIUM

A recipe uses 3 g of salt for one serving. How much sodium is that, and what share of the CDRR?

STEP 1 · SALT TO SODIUM

Salt is about 40% sodium: 3,000 mg × 0.40 = **1,200 mg**.

STEP 2 · SHARE

1,200 ÷ 2,300 = **52%** of the CDRR in one serving.

CHECK

A full teaspoon of salt is about 2,300 mg sodium, so 3 g is about half a teaspoon.

EXAMPLE 7.2 · IRON ABSORBED FROM A MIXED MEAL

A meal has 3 mg heme iron (25% absorbed) and 12 mg nonheme iron (5% absorbed). How much iron is absorbed?

STEP 1 · HEME

3 × 0.25 = 0.75 mg.

STEP 2 · NONHEME

12 × 0.05 = 0.60 mg.

STEP 3 · TOTAL

0.75 + 0.60 = **1.35 mg** of the 15 mg on paper.

LEVER

Adding vitamin C to the meal would raise the nonheme share.

TRAPS PEOPLE FALL INTO

- **Cooking destroys minerals.** Water leaches them; heat does not destroy them.
- **Spinach for calcium.** Oxalate blocks it.
- **Normal hemoglobin rules out low iron.** Stores fall first.
- **Eight glasses as a DRI.** It is not one.

Chapter 7 self-test · six items

1. Which mineral is about 99% stored in bone and teeth?

A. Iodine
B. Calcium
C. Sodium
D. Iron

B. Calcium About 99% of body calcium is hydroxyapatite in bone and teeth.

2. Which mineral works mainly as part of thyroid hormone?

A. Iodine
B. Zinc
C. Selenium
D. Fluoride

A. Iodine Iodine is built into thyroid hormone. Selenium helps activate it, but iodine is the core.

3. Which statement about the iron UL fits the chapter?

A. No iron UL has been set at all
B. It is 8 mg/day for adult men only
C. It is 18 mg/day for adult women
D. It is 45 mg/day for adults

D. It is 45 mg/day for adults The adult iron UL is 45 mg/day. 18 and 8 mg are RDAs.

4. What is the main job of aldosterone in fluid balance?

A. Triggering thirst when blood thickens
B. Releasing iron from liver stores
C. Holding sodium so water follows
D. Pumping water directly into cells

C. Holding sodium so water follows Aldosterone makes the kidney retain sodium, and water follows by osmosis. ADH and thirst defend concentration.

5. A vegetarian woman aged 25 asks how much iron she needs. About how much?

A. About 45 mg/day
B. About 8 mg/day
C. About 18 mg/day
D. About 32 mg/day

D. About 32 mg/day The standard RDA of 18 mg times about 1.8 for diets without meat, poultry or fish gives about 32 mg.

6. Where does most sodium in the US diet come from?

A. Salt added in home cooking
B. The salt shaker at the table
C. Packaged and restaurant foods
D. Naturally salty fresh produce

C. Packaged and restaurant foods About 70% of sodium is already in food before it reaches the table.

CHAPTER 8

Energy Balance and Weight

Read it in full: **Chapter 8 in the textbook**. Practice it in the lab: **The Energy Balance Scale** and **Appetite Hormones & the Defended Weight**.

What to know

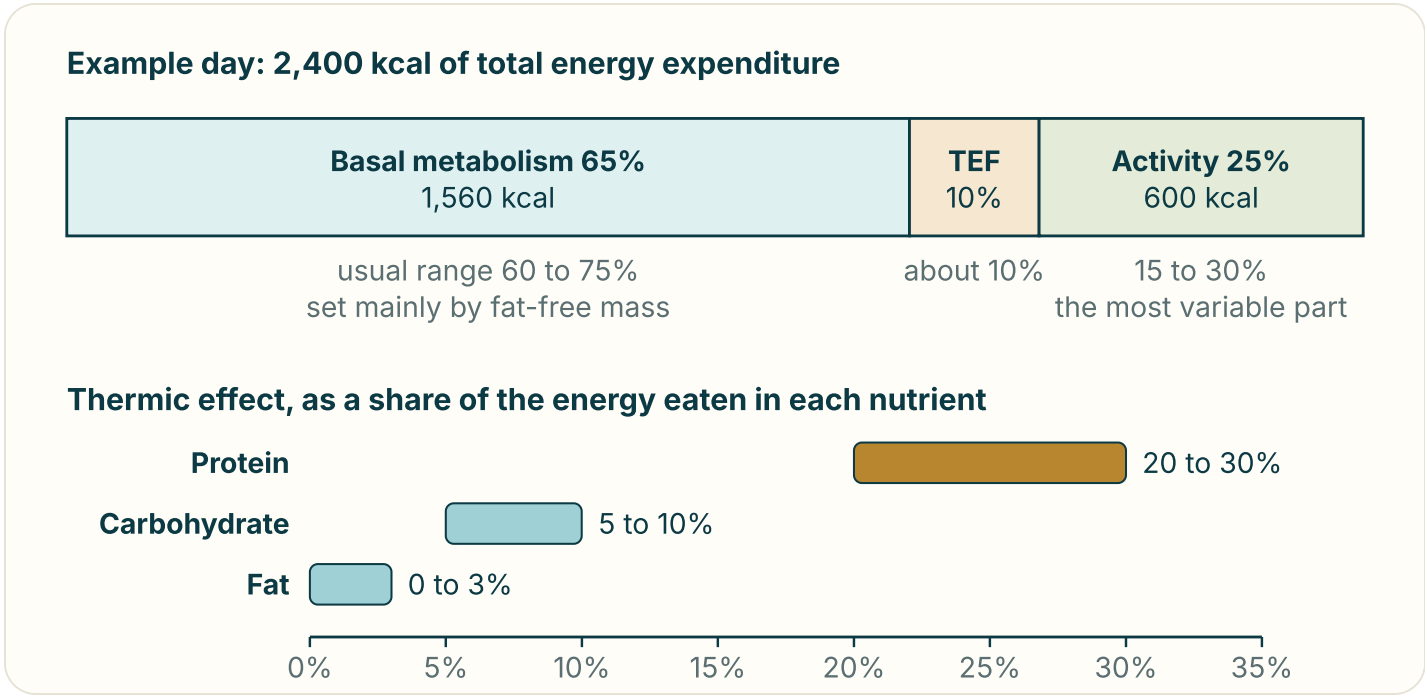
Energy balance compares intake and expenditure over time, and the two sides adjust to each other, so the static 3,500 kcal per pound rule overpredicts long-term loss. Energy has an EER, not an RDA. Pregnancy adds about 340 then 452 kcal; lactation 330 then 400.

TEE = basal metabolism (60 to 75%, driven by fat-free mass) + thermic effect of food (about 10%; protein 20 to 30%) + activity (15 to 30%, most variable, includes NEAT). TEE is about RMR × PAL. BMI = kg ÷ m^2; adult bands 18.5, 25, 30; children use percentiles (5th, 85th, 95th). Waist over 102 cm (men) or 88 cm (women) of European descent, or waist-to-height above 0.5, signals central fat.

Ghrelin raises hunger; CCK, GLP-1, PYY, insulin and leptin restrain it. Common obesity involves leptin resistance. The body defends weight loss more than gain. Health behaviors help whether or not weight changes; 5 to 10% loss improves markers; the DPP cut diabetes 58%. Adherence, not macronutrient ratio, predicts results.

Hunger is the body's drive; appetite is the psychological desire; satiation ends a meal; satiety delays the next. MC4R mutations are the most common single-gene cause of severe obesity but explain few cases. In a small, rigorous inpatient trial, people ate about 500 kcal more a day on an ultra-processed menu. Fad diets fail for physical and structural reasons, not personal weakness, and medical treatments belong with a clinician.

> **LOCK THESE IN**
>
> - EER, not RDA, for energy.
> - Basal 60 to 75%; TEF 10%; activity 15 to 30%.
> - BMI = kg ÷ m^2.
> - Children use BMI-for-age percentiles.
> - Ghrelin up; leptin reports fat stores.
> - Adherence beats composition.



Three parts of energy out. Basal metabolism is the largest share, activity the most variable, and protein has the highest thermic effect.

Chapter 8 numbers

Item	Value
PAL	1.0 to 1.39 sedentary; 1.4 to 1.59 low; 1.6 to 1.89 active; 1.9 to 2.5 very
TEF by macronutrient	Protein 20 to 30%; carb 5 to 10%; fat 0 to 3%
Asian BMI cut points	23.0 and 27.5
Essential fat	3 to 5% men; 8 to 12% women
Heritability of BMI	About 40 to 70%

Worked examples

EXAMPLE 8.1 · BMI AND TEE

Daniel weighs 85 kg at 1.80 m. His RMR is 1,600 kcal and his PAL is 1.6. Find his BMI and TEE.

STEP 1 · BMI

$1.80^2 = 3.24$; $85 \div 3.24 =$ **26.2**, a screening band of 25.0 to 29.9.

STEP 2 · TEE

1,600 × 1.6 = **2,560 kcal/day**.

READ IT WELL

BMI cannot see muscle or fat location; a waist measure adds that. TEE is a starting estimate.

EXAMPLE 8.2 · WAIST-TO-HEIGHT RATIO

Sven is 175 cm tall with a 95 cm waist. Find his waist-to-height ratio.

STEP 1 · DIVIDE

95 ÷ 175 = **0.54**.

STEP 2 · READ IT

Above the simple 0.5 guide, which points to central fat that BMI alone would not show.

TRAPS PEOPLE FALL INTO

- **3,500 kcal per pound forever.** Expenditure adapts.
- **Muscle burns hundreds of kcal.** About 6 kcal per pound per day.
- **Adult BMI bands for children.** Use percentiles.
- **Regain as weak will.** Biology defends lost weight.

Chapter 8 self-test · six items

1. What is the strongest predictor of a person's BMR?

A. Protein intake

B. Hours of sleep

C. Body fat percent

D. Fat-free mass

D. Fat-free mass Fat-free mass explains most of the difference in BMR between people.

2. Which part of activity energy includes fidgeting, standing and walking to the bus?

A. BMR
B. NEAT
C. RMR
D. TEF

B. NEAT Non-exercise activity thermogenesis is all movement outside deliberate exercise, and it falls during restriction.

3. A 12-year-old is at the 90th BMI-for-age percentile. Which band fits?

A. Overweight
B. Healthy range
C. Obesity
D. Underweight

A. Overweight The 85th to below the 95th percentile is the overweight band for ages 2 to 19.

4. Which hormone from fat tissue reports long-term energy stores?

A. GLP-1
B. CCK
C. Leptin
D. Ghrelin

C. Leptin Leptin is secreted roughly in proportion to fat mass.

5. Why do fad diets show dramatic loss in week one?

A. Protein needs drop to almost zero
B. Glycogen and its water are lost
C. Fat cells shrink permanently at once
D. Resting metabolism doubles quickly

B. Glycogen and its water are lost Each gram of glycogen holds about 3 g of water, and both return just as fast.

6. Which behavior is the best predictor of keeping lost weight off?

A. Regular physical activity
B. A low-carbohydrate ratio
C. Taking a detox cleanse
D. Eating only before 6 pm

A. Regular physical activity Activity of about 150 to 300 minutes a week best predicts maintenance.

CHAPTER 9

Nutrition and Physical Activity

Read it in full: **Chapter 9 in the textbook**. Practice it in the lab: **Glycogen and the Wall** and **Protein: The Claims vs the Evidence**.

What to know

The phosphagen system covers about 10 seconds of all-out effort, anaerobic glycolysis about 10 seconds to 2 minutes, and the oxidative system everything longer. Fat dominates at rest and easy effort; carbohydrate takes over as intensity rises. Muscle glycogen (300 to 500 g) limits hard efforts past about 90 minutes.

Daily carbohydrate runs 3 to 12 g/kg by training load. Loading is 10 to 12 g/kg for 36 to 48 hours with a taper, for events of 90 minutes or more. During exercise, 30 to 60 g/hour for 1 to 2.5 hours,

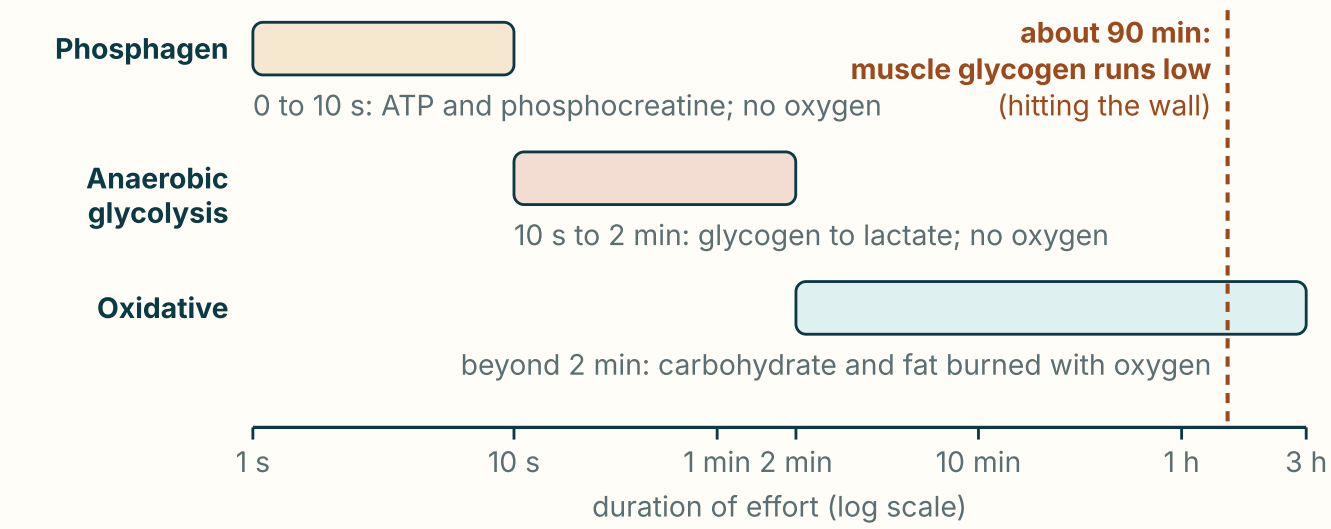
up to 90 g/hour beyond that with glucose plus fructose. Protein for active people is 1.2 to 2.0 g/kg, about 20 to 40 g per meal; the 30 minute window is a myth.

Over 2% body mass lost harms performance; rehydrate with 1.25 to 1.5 L per kg lost. Exercise-associated hyponatremia (sodium below 135 mmol/L) comes from overdrinking and worsens with more water; drink to thirst. Strong aids: creatine, caffeine, beta-alanine, sodium bicarbonate and nitrate. Low energy availability harms bone, hormones and immunity in every body.

Glycogen holds water, so loading adds 1 to 2 kg. Practice race fueling in training because the gut must adapt. Leucine at about 2 to 3 g per meal triggers a full synthesis response in younger adults. Sweat sodium varies several-fold, which is why blanket electrolyte rules make little sense. Supplements are regulated more like foods and have been found with undeclared stimulants and anabolic agents; third-party lot testing reduces that risk.

LOCK THESE IN

- Phosphagen, glycolysis, oxidative.
- Glycogen limits efforts past 90 min.
- 3 to 12 g/kg carbohydrate.
- 30 to 60, up to 90 g/h during long events.
- 1.2 to 2.0 g/kg protein for training.
- EAH: weight up, sodium down.



Duration picks the system. All three systems run at once; the bars show which leads. Note the log scale on the time axis.

Chapter 9 numbers

Item	Value
Liver glycogen	80 to 110 g
Muscle glycogen	300 to 500 g
Sweat	0.5 to 2.0 L/h; sodium 20 to 80 mmol/L
Per-meal protein	0.25 to 0.3 g/kg
Refuel fast	1.0 to 1.2 g/kg/h for 4 h if next session within 8 h

Worked examples

EXAMPLE 9.1 · SWEAT LOSS IN A SMALLER ATHLETE

Ana weighs 55 kg and loses 1.2 kg during a hot practice. Is she past the 2% line, and how much should she drink afterward?

STEP 1 · PERCENT

1.2 ÷ 55 = 0.022, so **2.2%**, just past the 2% line.

STEP 2 · REHYDRATE

1.2 × 1.25 = 1.5 L; 1.2 × 1.5 = 1.8 L, so **1.5 to 1.8 L** with sodium.

EXAMPLE 9.2 · CARBOHYDRATE LOADING

A 70 kg marathoner loads for 36 to 48 hours. What daily carbohydrate range applies?

STEP 1 · MULTIPLY

10 to 12 g/kg: 70 × 10 = 700 g; 70 × 12 = 840 g.

RESULT

700 to 840 g/day with a taper; expect 1 to 2 kg of water weight.

TRAPS PEOPLE FALL INTO

- **Fat as the limiting fuel.** Glycogen is.
- **Loading for short events.** No benefit.
- **A 30 minute protein window.** The window is hours.
- **Water for every collapse.** It worsens hyponatremia.

Chapter 9 self-test · six items

1. A 400 m sprint lasting about 50 seconds relies most on which system?

A. Anaerobic glycolysis

B. The phosphagen system

C. Ketone body oxidation

D. Oxidative fat burning

A. Anaerobic glycolysis Efforts of about 10 seconds to 2 minutes rely mainly on anaerobic glycolysis.

2. About how much carbohydrate per hour is advised for a 2-hour ride?

A. 150 to 200 g/hour
B. 90 to 120 g/hour
C. 30 to 60 g/hour
D. 0 to 10 g/hour

C. 30 to 60 g/hour For about 1 to 2.5 hours, 30 to 60 g per hour improves endurance.

3. Which statement about BCAAs fits the chapter?

A. They have strong evidence for endurance
B. They are the most studied supplement
C. They replace the need for carbohydrate
D. They are inferior to complete protein

D. They are inferior to complete protein BCAAs lack credible evidence; complete protein is a better amino acid source.

4. Which aid works as a buffer inside muscle cells after weeks of loading?

A. Beet nitrate
B. Beta-alanine
C. Caffeine
D. Creatine

B. Beta-alanine Beta-alanine raises muscle carnosine, an intracellular buffer.

5. Why does underfueling harm athletes even if they look well?

A. Muscle glycogen grows too large to use
B. Blood sodium rises above the safe range
C. Protein needs drop and muscle is spared
D. Bone, hormones and immunity are cut back

D. Bone, hormones and immunity are cut back Low energy availability suppresses bone turnover, reproductive hormones and immunity.

6. What best signals hyponatremia rather than dehydration during a long race?

A. Body weight fell by about 3 percent
B. Body weight went up during the event
C. The runner felt strong, early thirst
D. Urine became darker and more scant

B. Body weight went up during the event Weight gain points to overdrinking and diluted sodium.

CHAPTER 10

Nutrition Through the Lifespan

Read it in full: **Chapter 10 in the textbook**. Practice it in the lab: **Growth and Appetite: Reading the Slope** and **Nutrient Density in Later Life**.

What to know

Pregnancy adds 0, 340 and 452 kcal by trimester, but nutrient needs rise more: folate 600 µg DFE (plus 400 µg folic acid before conception), iron 27 mg, iodine 220 µg, protein 1.1 g/kg; calcium stays at 1,000 mg for adults. Weight gain by pre-pregnancy BMI: 28 to 40, 25 to 35, 15 to 25, 11 to 20 lb. Avoid teratogens, Listeria-prone foods and high-mercury fish; most fish are encouraged.

Lactation adds about 330 then 400 kcal; iron falls to 9 mg while vitamin A (1,300 µg) and iodine (290 µg) peak. Human milk has about 65 to 70 kcal per 100 mL with about half its energy from

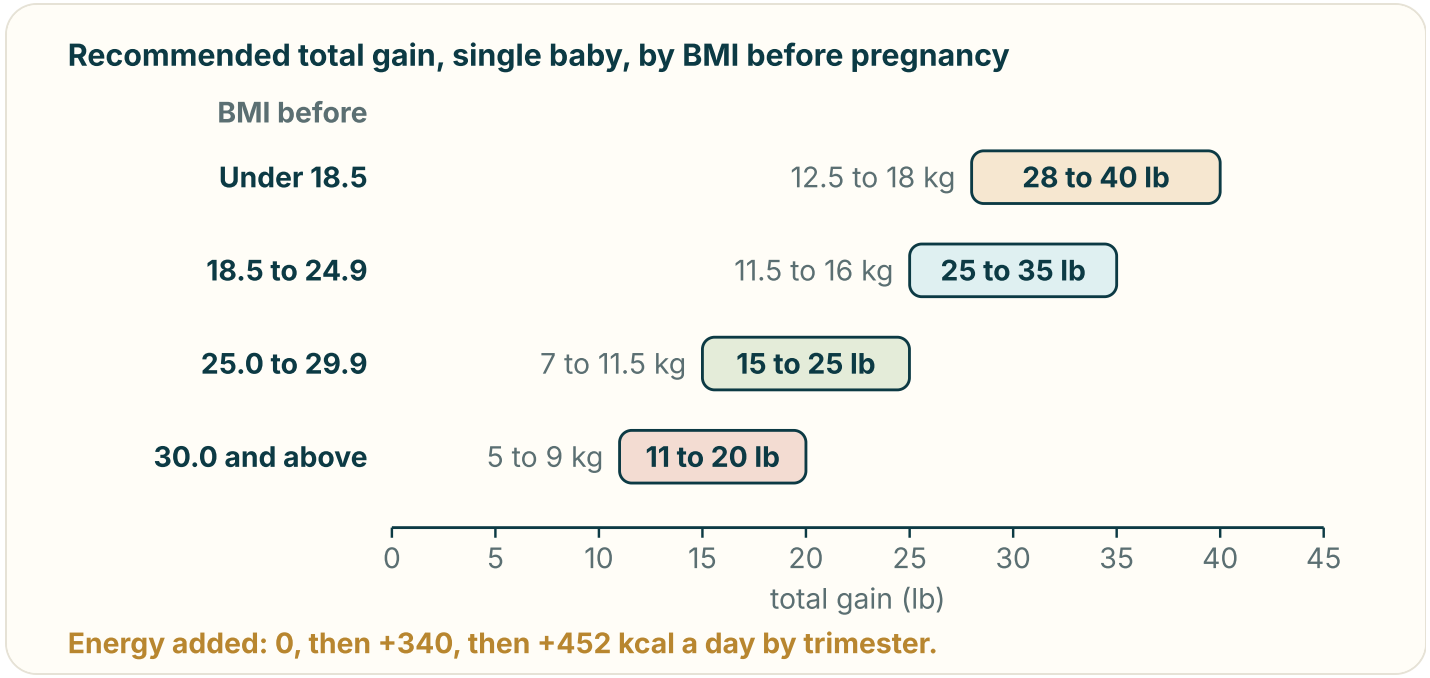
fat; HMOs feed gut bacteria. Infants get vitamin K at birth and vitamin D 400 IU if breastfed. Formula must never be diluted. Solids start about 6 months, no honey before 12 months, and allergens go in during the first year.

Toddler appetite drops with slower growth; judge intake over a week and use the division of responsibility. Too much cow's milk drives iron deficiency. Teens need calcium 1,300 mg (about 90% of peak bone by 18 to 20) and iron 11 mg (boys) or 15 mg (girls); weight-neutral talk is better supported. Older adults need fewer calories but the same or more nutrients: vitamin D 800 IU over 70, calcium 1,200 mg, B12 from fortified sources after 50, scheduled fluids.

Human milk is low in vitamin D but its iron is highly bioavailable, and colostrum is rich in secretory IgA. Formula is a safe, complete alternative when mixed exactly; specialty formulas are for medical needs. Children's intake swings meal to meal but is steady over a week; track the child's own growth curve on WHO (to age 2) and CDC (2 to 20) charts. About 10 to 30% of older adults have atrophic gastritis, and unintentional weight loss is a red flag.

LOCK THESE IN

- Pregnancy: 0, +340, +452 kcal.
- Folate 600 µg DFE; iron 27 mg.
- Lactation iron 9 mg.
- Vitamin D 400 IU for breastfed infants.
- Teen calcium 1,300 mg.
- B12 source changes after 50, not the amount.



Gain is indexed to BMI. The higher the BMI before pregnancy, the lower the recommended range. These are outcome-based ranges, not a scorecard.

Chapter 10 numbers

Stage	Value
Infancy energy	About 100 kcal/kg falling to 80
Toddler iron	7 mg (1 to 3)
Teen iron	11 mg boys; 15 mg girls
Older adult protein	1.0 to 1.2 g/kg suggested
Caffeine in pregnancy	Under about 200 mg/day

Worked examples

EXAMPLE 10.1 · THE LACTATION ENERGY MATH

A parent exports about 500 kcal a day in milk during the first six months. Fat stored in pregnancy is expected to cover about 170 kcal a day. What is the added energy need?

STEP 1 · SUBTRACT

500 − 170 = **330 kcal/day**.

STEP 2 · LATER MONTHS

After six months no offset is assumed, and the added need is about 400 kcal/day.

COMPARE

The third trimester adds about 452, so lactation sits in the same range.

EXAMPLE 10.2 · PROTEIN IN PREGNANCY

Nia weighs 70 kg. Compare her protein RDA before and during pregnancy.

STEP 1 · BEFORE

0.8 × 70 = 56 g/day.

STEP 2 · DURING

1.1 × 70 = **77 g/day**, 21 g more.

TRAPS PEOPLE FALL INTO

- **Eating for two.** Energy rises modestly.
- **Delaying allergens.** LEAP reversed that advice.
- **Clean your plate.** It overrides fullness signals.
- **Weight loss in older adults as success.** Unintentional loss is a warning sign.

Chapter 10 self-test · six items

1. A woman with a pre-pregnancy BMI of 31 asks about weight gain. Which range applies?

A. 25 to 35 lb

B. 11 to 20 lb

C. 28 to 40 lb

D. 15 to 25 lb

B. 11 to 20 lb A BMI of 30 or more maps to 11 to 20 lb for a singleton pregnancy.

2. Which fish is advised against in pregnancy because of mercury?

A. Swordfish
B. Salmon
C. Cod
D. Sardines

A. Swordfish Shark, swordfish, king mackerel, tilefish and bigeye tuna are high in methylmercury.

3. Why do iron-rich foods matter so much when a breastfed infant starts solids?

A. Iron is needed to digest the first solid foods
B. Infants cannot absorb iron after 12 months
C. Breast milk has no iron of any kind in it
D. Birth iron stores last only about 4 to 6 months

D. Birth iron stores last only about 4 to 6 months Term infants are born with iron stores that last about 4 to 6 months, and milk alone stops covering needs around then.

4. A toddler refuses broccoli three times. What does the chapter suggest?

A. Reward each bite with a dessert
B. Stop serving it to them for good
C. Keep offering it without pressure
D. Require two bites before playtime

C. Keep offering it without pressure Acceptance often takes 8 to 15 or more neutral exposures; pressure and rewards reduce liking.

5. Why is calcium highest at ages 9 to 18?

A. Teens absorb almost no calcium
B. Teen bones begin losing mineral
C. Teens need calcium for energy
D. Most peak bone mass is built then

D. Most peak bone mass is built then About 90% of peak bone mass is in place by about 18 to 20.

6. Why should older adults be offered fluids on a schedule?

A. Their water AI is far higher
B. Their thirst response is blunted
C. Their food contains no water
D. Their kidneys store extra water

B. Their thirst response is blunted Water needs do not fall, but thirst becomes less reliable with age.

CHAPTER 11

Food Safety

Read it in full: **Chapter 11 in the textbook**. Practice it in the lab: **Find the Contamination** and **Who Is Most at Risk**.

What to know

Intoxication from a preformed toxin starts fast (Staph aureus, emetic B. cereus); infection takes hours to days. Norovirus causes the most illness; Salmonella the most bacterial hospitalizations and deaths; STEC risks HUS in young children; Listeria grows in the fridge; botulism causes descending paralysis. Oral rehydration pairs sodium and glucose.

Danger zone: 40 to 140°F (USDA) or 41 to 135°F (Food Code). Two hours cumulative, one hour above 90°F. Cook poultry to 165°F, ground meat 160°F, whole cuts 145°F plus a 3 minute rest,

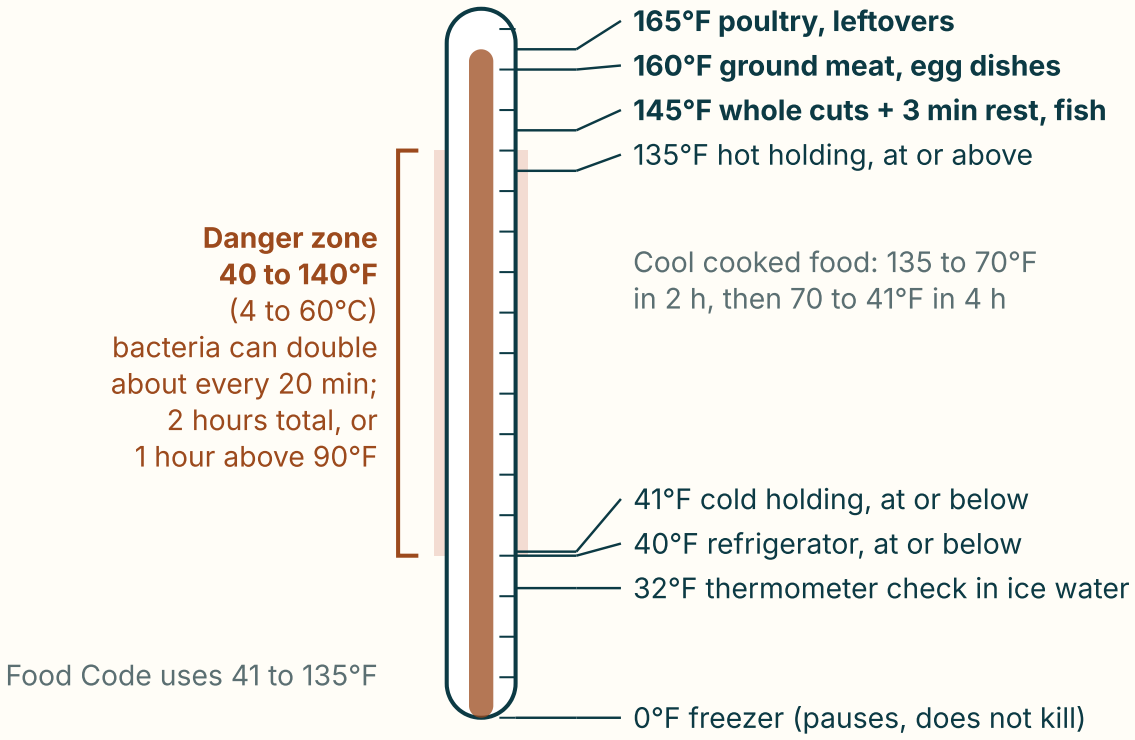
fish 145°F, leftovers 165°F. Cool 135 to 70°F in 2 hours and 70 to 41°F in 4 more.

Clean, separate, cook, chill. Wash hands 20 seconds with soap. Do not wash raw poultry; wash produce under running water only. Higher-risk groups: pregnancy, under five, 65 and older, immunocompromised. The ADI is the NOAEL divided by 100. Hazard is not risk, and relative is not absolute.

Most cases resolve on their own; the danger is fluid and electrolyte loss. Freezing suspends most bacteria rather than killing them. Cooking reduces pathogens, chilling stops survivors from multiplying, and holding only preserves what was achieved. Pasteurization does not meaningfully lower milk's nutrition. In pregnancy, choose low-mercury fish rather than avoiding fish. Processing includes protective steps such as freezing, canning and fortification.

LOCK THESE IN

- Fast onset with vomiting means toxin.
- Danger zone and the two-hour rule.
- 165, 160, 145, 165°F.
- Two-stage cooling.
- Clean, separate, cook, chill.
- ADI = NOAEL ÷ 100.



Keep food out of the zone. Cooking is the kill step, but only a thermometer confirms it. Holding keeps safety; it does not create it.

Chapter 11 numbers

Item	Value
Fridge and freezer	40°F or below; 0°F
Hot and cold holding	135°F or above; 41°F or below
Pasteurization	161°F for 15 s
Leftovers	3 to 4 days
Hand sanitizer	60% alcohol or more; weak on norovirus

Worked examples

EXAMPLE 11.1 · ADDING UP THE DANGER ZONE

Lasagna cools on the counter for 50 minutes, rides 40 minutes to a potluck on a mild day, and sits 45 minutes before serving. Is it within the two-hour rule?

STEP 1 · ADD

50 + 40 + 45 = 135 minutes.

STEP 2 · COMPARE

The limit is 120 minutes on a mild day, so it is **over**.

ACT

Throw it out. Reheating cannot remove a heat-stable toxin.

EXAMPLE 11.2 · A TWO-STAGE COOLING CHECK

Soup leaves the stove at 135°F at 1:00 pm, reaches 70°F at 2:45 pm and 41°F at 6:30 pm. Did it pass?

STEP 1 · STAGE 1

1:00 to 2:45 is 1 h 45 min, under 2 h. **Passed.**

STEP 2 · STAGE 2

Total time 1:00 to 6:30 is 5.5 h, under 6 h. **Passed.**

TRAPS PEOPLE FALL INTO

- **Reheating as a fix.** Staph toxin survives.
- **Color as doneness.** Use a thermometer.
- **Washing raw chicken.** It spreads bacteria.
- **Group 1 as equal danger.** It shows certainty, not size.

Chapter 11 self-test · six items

1. Which pathogen can grow at refrigerator temperature?

A. Campylobacter jejuni
B. Staphylococcus aureus
C. Clostridium perfringens
D. Listeria monocytogenes

D. Listeria monocytogenes Listeria multiplies at 4°C, which is why refrigerated ready-to-eat foods carry special risk.

2. Symptoms begin 3 weeks after a meal, with jaundice. Which agent fits?

A. Norovirus (GII)
B. Hepatitis A virus
C. Bacillus cereus
D. Staphylococcus aureus

B. Hepatitis A virus Hepatitis A incubates 15 to 50 days and causes jaundice.

3. What safe minimum temperature applies to a whole pork chop?

A. 165°F plus a 3 minute rest
B. 160°F with no rest needed
C. 145°F plus a 3 minute rest
D. 135°F held for 15 minutes

C. 145°F plus a 3 minute rest Whole cuts need 145°F and a 3 minute rest. Ground meats need 160°F.

4. Which thawing method is NOT safe?

A. Leaving it on the counter
B. In the refrigerator
C. In the microwave, then cooking
D. In cold running water

A. Leaving it on the counter On the counter, the outer layer warms into the danger zone long before the center thaws.

5. Why are adults over 65 at higher risk from foodborne illness?

A. They eat more raw sprouts than others
B. Weaker immunity and less stomach acid
C. They need more calories from protein
D. Their fridges run colder than average

B. Weaker immunity and less stomach acid Aging immunity, reduced gastric acid, slower gut motility and more illness raise risk.

6. Who sets pesticide tolerances on crops in the US?

A. The WHO
B. The USDA-FSIS
C. The EPA
D. The CDC

C. The EPA The EPA sets tolerances; the FDA and USDA enforce them in monitoring programs.

CHAPTER 12

Diet and Chronic Disease

Read it in full: **Chapter 12 in the textbook**. Practice it in the lab: **How Strong Is the Evidence?** and **Building & Losing Bone Across a Lifetime**.

What to know

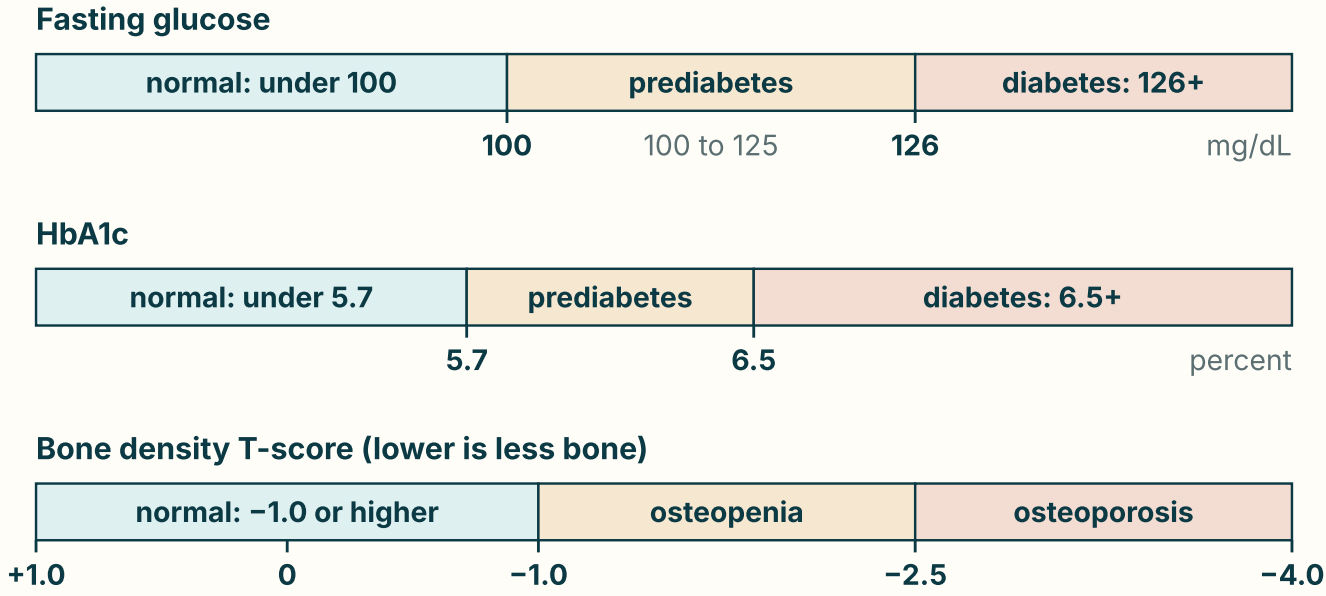
LDL is causal in atherosclerosis; HDL is a marker. Saturated and trans fats raise LDL; unsaturated fats lower it when they replace saturated fat. Lowering sodium lowers blood pressure (AI 1,500 mg, CDRR 2,300 mg); potassium AI 3,400 and 2,600 mg.

Type 2 diabetes is insulin resistance plus failing beta cells. Prediabetes: fasting glucose 100 to 125 mg/dL or HbA1c 5.7 to 6.4%. Carbohydrate quality tracks risk; the DPP cut new cases 58% (metformin 31%). IARC Group 1 (processed meat, alcohol) shows certainty, not size; processed meat adds about 18% relative risk per 50 g/day.

Peak bone mass comes by the late twenties. Calcium 1,000, 1,200 or 1,300 mg; vitamin D 600 IU to 70, 800 IU after. Osteoporosis is less bone; osteomalacia is poorly mineralized bone. Mediterranean (PREDIMED, about 30% fewer events), DASH (about −5.5 mmHg, about −11 if hypertensive) and plant-based patterns share base foods; single-nutrient pills keep failing.

Dietary cholesterol has a modest, variable effect on LDL, so the 300 mg cap was dropped in 2015. Excess body fatness is judged to raise risk of at least a dozen cancers. Fiber-rich foods are linked to lower colorectal cancer risk, but short fiber-pill trials were null. About 30% of milk calcium is absorbed; spinach's oxalate blocks its calcium; very high sodium modestly raises urinary calcium. Adherence, cost and culture matter more than picking the "best" pattern.

> **LOCK THESE IN**
>
> - LDL causal; HDL a marker.
> - Substitution decides fat effects.
> - Prediabetes cut points.
> - DPP 58%.
> - Group 1 = certainty.
> - Osteoporosis versus osteomalacia.



Osteoporosis is less bone, normally mineralized. Osteomalacia is too little mineral.

Know the cut points. The same three bands repeat: normal, an in-between warning zone, and disease.

Chapter 12 numbers

Item	Value
Diabetes cut point	Fasting 126 mg/dL or HbA1c 6.5%
T-scores	Osteoporosis −2.5 or lower; osteopenia −1.0 to −2.5
Calcium UL	2,500 mg (19 to 50); 2,000 mg (51+)
Vitamin D UL	4,000 IU
DASH	About −5.5 mmHg systolic

Worked examples

EXAMPLE 12.1 · RELATIVE TO ABSOLUTE

A headline says an exposure raises a disease risk by 30%. The baseline risk is 2%. What is the new risk?

STEP 1 · APPLY

2% × 1.30 = **2.6%**.

STEP 2 · CHANGE

2.6 − 2.0 = **0.6 percentage points**.

ASK

Was it a cohort or a trial, and what replaced the exposure? A relative number alone hides the size.

EXAMPLE 12.2 · CALCIUM FROM MILK

Three cups of milk at about 300 mg each are drunk by a 45-year-old woman. How close is she to her RDA?

STEP 1 · TOTAL

3 × 300 = 900 mg.

STEP 2 · COMPARE

Her RDA (women 19 to 50) is 1,000 mg, so she needs about **100 mg** more from other foods.

TRAPS PEOPLE FALL INTO

- **Ignoring the replacement.** Swaps decide the outcome.
- **Fiber pills as fiber foods.** Short pill trials were null.
- **Osteoporosis as low mineral content.** It is less bone that is normally mineralized.
- **One "best" diet.** The successful patterns overlap.

Chapter 12 self-test · six items

1. Which fat raises LDL and also lowers HDL?

A. Canola cooking oil

B. Industrial trans fat

C. Extra-virgin olive oil

D. Fish oil capsules

B. Industrial trans fat Trans fat from partial hydrogenation does both, which is why it was removed from the US food supply.

2. An HbA1c of 6.1% falls into which category?

A. Normal
B. Diabetes
C. Prediabetes
D. Hypoglycemia

C. Prediabetes Prediabetes is HbA1c 5.7 to 6.4%; diabetes starts at 6.5%.

3. Why does alcohol carry cancer risk with no safe threshold identified?

A. It is converted to processed meat nitrites
B. It raises LDL more than saturated fat does
C. It blocks all vitamin absorption in the gut
D. Its breakdown product acetaldehyde harms DNA

D. Its breakdown product acetaldehyde harms DNA Ethanol becomes acetaldehyde, a carcinogen, and alcohol is causal for several cancer sites.

4. What is the vitamin D RDA for a 40-year-old?

A. 600 IU (15 µg)
B. 4,000 IU (100 µg)
C. 800 IU (20 µg)
D. 400 IU (10 µg)

A. 600 IU (15 µg) Ages 1 to 70 have an RDA of 600 IU; 800 IU applies over 70, and 4,000 IU is the UL.

5. Which trial design gave DASH its strength?

A. It tested a set of single-nutrient supplements
B. All food was provided and weight held steady
C. It followed vegetarians for several decades
D. It asked people to recall their usual meals

B. All food was provided and weight held steady DASH was a controlled feeding trial, the strongest design available for diet.

6. Why have single-nutrient supplement trials often failed?

A. Nutrients have no effect outside of food labels
B. Supplements are never absorbed by the gut
C. The trials always used doses that were too low
D. Foods act as a matrix with interacting nutrients

D. Foods act as a matrix with interacting nutrients The food matrix, interactions, substitution and correlated intakes explain why patterns succeed where pills fail.

CHAPTER 13

Assessment and Diet Planning

Read it in full: **Chapter 13 in the textbook**. Practice it in the lab: **The ABCDs of Assessment** and **Spot the Pseudoscience**.

What to know

Screening flags; assessment triangulates the ABCD domains. BMI cannot diagnose a person; albumin reflects inflammation. Recalls suffer memory error, records reactivity, FFQs coarse quantities. Energy is underreported by about 10 to 30% against doubly labeled water, as measurement error.

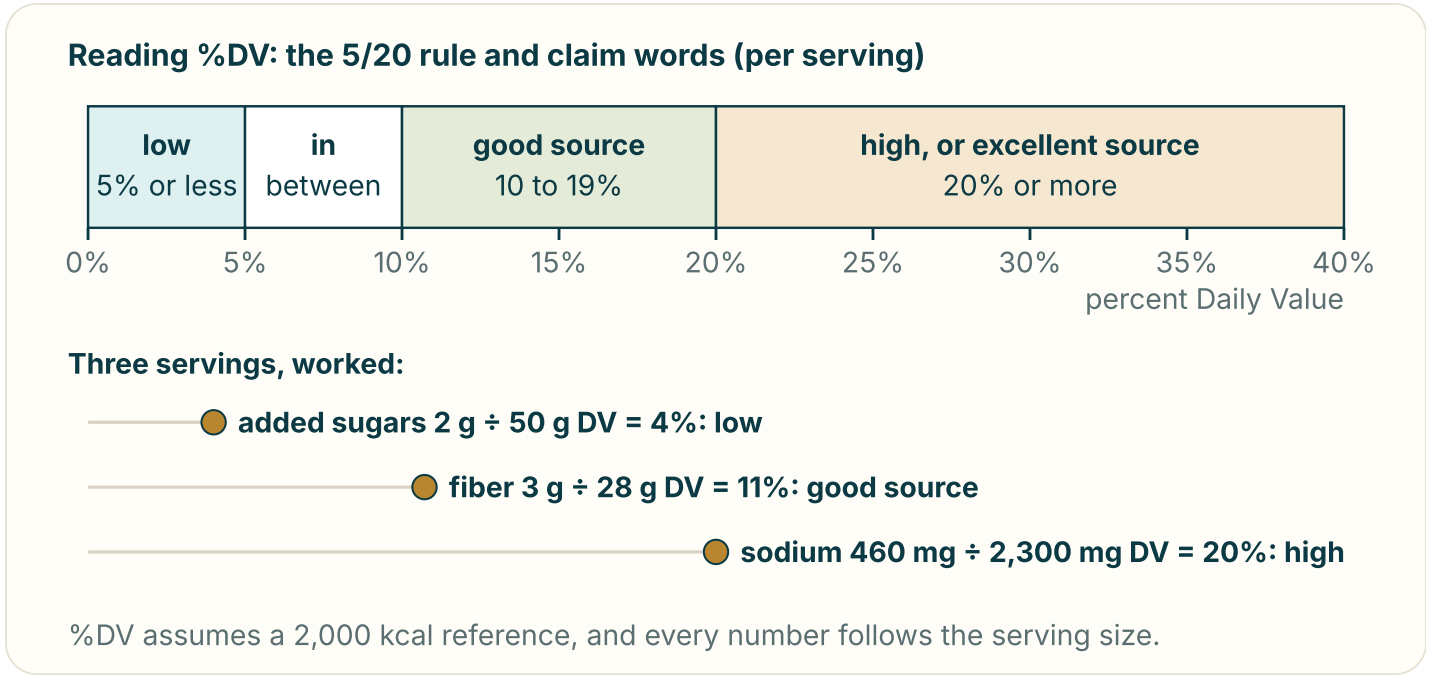
Every label number follows the serving size; %DV assumes 2,000 kcal. 5% DV is low and 20% is high; "good source" is 10 to 19%. DVs: sodium 2,300 mg, fiber 28 g, added sugars 50 g, potassium 4,700 mg, vitamin D 20 µg, iron 18 mg, calcium 1,300 mg. Ingredients run by weight. Structure/function claims need no premarket authorization.

Plan with the right DRI: RDA for a person, EAR for groups, UL as a ceiling. Draft with food groups, then check energy, shortfall nutrients (fiber, calcium, iron, vitamin D, potassium), ceilings and feasibility. Judge claims by design, absolute effect size, endpoints and conflicts of interest; watch for detox, cure-all and "clean versus toxic" language.

Food composition databases add uncertainty, and app entries are often unverified. Health claims need authorization; qualified health claims must disclose weak evidence. Nutrition limits trials (no blinding to food, long outcomes, no true placebo diet), so strong conclusions often come from convergence across designs. Strong examples: folic acid and neural tube defects, iodine in pregnancy, vitamin D and rickets, replacing saturated with unsaturated fat. Preliminary: most microbiome, meal-timing and genotype-diet claims.

LOCK THESE IN

- ABCD, never one domain.
- Underreporting 10 to 30%.
- 5/20 rule.
- Serving size governs the label.
- RDA for one, EAR for groups.
- Compared to what?



5% low, 20% high. Divide the amount per serving by the Daily Value to get %DV, then read it against the scale.

Chapter 13 numbers

Item	Value
Added sugars DV	50 g
Fiber DV	28 g
Low sodium claim	140 mg or less per serving
Allergens	Nine, including sesame since 2023
FFQ size	About 100 to 150 foods

Worked examples

EXAMPLE 13.1 · ADDED SUGARS ON A LABEL

A container of flavored yogurt drink lists 3 servings, 180 kcal and 9 g added sugars per serving. Find the %DV per serving and for the whole container.

STEP 1 · PER SERVING

9 ÷ 50 = **18% DV**, close to high.

STEP 2 · WHOLE CONTAINER

9 × 3 = 27 g; 27 ÷ 50 = **54% DV**, and 180 × 3 = 540 kcal.

HABIT

Check servings per container before reading anything else.

EXAMPLE 13.2 · IRON %DV FOR TWO PEOPLE

A bread serving has 2.7 mg of iron. Find its %DV and its share of a man's RDA.

STEP 1 · %DV

2.7 ÷ 18 = **15% DV**, a good source.

STEP 2 · THE MAN

2.7 ÷ 8 = **34%** of his RDA.

WHY THEY DIFFER

The iron DV is pegged to women 19 to 50.

TRAPS PEOPLE FALL INTO

- **One recall as usual intake.** Repeat on several days.
- **%DV fits everyone the same.** It is one reference.
- **Supplements as verified.** The panel is the maker's declaration.
- **Credentials settle it.** Evidence does.

Chapter 13 self-test · six items

1. Which marker best reflects iron stores in a person without inflammation?

A. Prealbumin

B. Serum albumin

C. Serum ferritin

D. Hemoglobin

C. Serum ferritin Ferritin falls first as stores drain; hemoglobin falls only later.

2. Which method can rank many people's long-run intake cheaply in a large study?

A. A food frequency questionnaire
B. A weighed 7-day food record
C. A single 24-hour recall
D. Direct observation of meals

A. A food frequency questionnaire FFQs capture long-run patterns and rank people, though they are poor at absolute amounts.

3. A serving has 25% DV for calcium. How does the 5/20 rule read it?

A. Neither low nor high
B. High in calcium
C. A good source only
D. Low in calcium

B. High in calcium 20% DV or more is high. A good source is 10 to 19%.

4. Which nutrient became a required line on the 2016 Nutrition Facts panel?

A. Vitamin E
B. Vitamin A
C. Vitamin C
D. Vitamin D

D. Vitamin D Vitamin D and potassium became required; vitamins A and C became optional.

5. Which title is a protected credential with defined training and an exam?

A. Wellness coach
B. Nutritionist (unregulated)
C. Registered dietitian (RD)
D. Certified food blogger

C. Registered dietitian (RD) RD and RDN are protected credentials. "Nutritionist" is often unregulated.

6. A product promises to "detox" the body but names no toxin. Why is that a red flag?

A. Detox claims are always FDA approved
B. Toxins are only found in processed food
C. Detox products work best with fasting
D. The liver and kidneys already do this

D. The liver and kidneys already do this Real claims name the substance and the mechanism; the body clears waste continuously.

CHAPTER 14

Food Security and Sustainability

Read it in full: **Chapter 14 in the textbook**. Practice it in the lab: **Forms of Malnutrition** and **What Actually Helps**.

What to know

Food security rests on availability, access, utilization and stability. The US continuum runs high, marginal, low and very low; the last two are food insecure (about one in eight households). Food insecurity is about income, time and access, and its health effects are real; the two-question Hunger Vital Sign screens for it.

Stunting (height-for-age below −2 SD) marks chronic deprivation; wasting (weight-for-height below −2 SD) marks acute risk; SAM is weight-for-height below −3, MUAC below 115 mm or

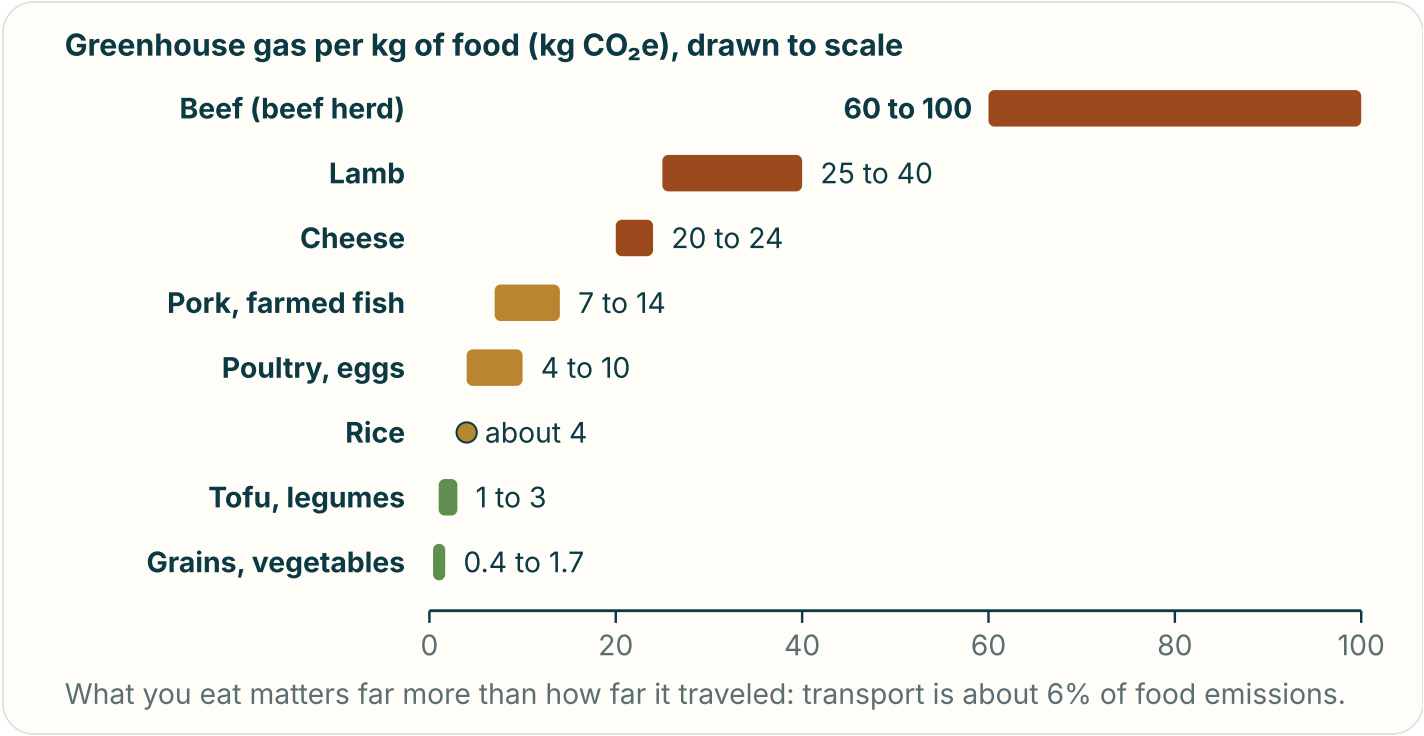
bilateral edema. The first 1,000 days are a critical window. Hidden hunger centers on iron, vitamin A, iodine, zinc and folate.

About 13% of food is lost before retail and 19% wasted after. Food type matters far more than food miles (transport about 6%): beef about 60 to 100 kg CO_2e per kg versus legumes about 1 to 3. SNAP, WIC, school meals and fortification (iodized salt, folic acid, vitamin D milk, enriched flour) work by changing the environment.

Malnutrition includes undernutrition, micronutrient deficiency and diet-related chronic disease, and many places carry a double burden. Refeeding after severe malnutrition can shift phosphate, potassium and magnesium dangerously, so it is supervised. Ready-to-use therapeutic food uses fat to pack about 500 kcal into 92 g. Ultra-processed food links are strong observationally but mechanistically unresolved. The EAT-Lancet diet is a global model, not a personal prescription.

LOCK THESE IN

- Four dimensions.
- Low and very low are insecure.
- Stunting chronic; wasting acute.
- First 1,000 days.
- Food type over food miles.
- Fortification needs no behavior change.



Food type beats food miles. Ruminant meat and cheese sit far above plant proteins, grains and vegetables on the same scale.

Chapter 14 numbers

Item	Value
US food insecurity	About 1 in 8 households
Global	About 2.3 billion insecure
Children	About 150 million stunted; 45 million wasted
Food system	About half of habitable land; 70% of freshwater withdrawals
Folic acid fortification	NTDs down about 25 to 35%

Worked examples

EXAMPLE 14.1 · A WEEKLY FOOTPRINT SWAP

A family eats 0.3 kg of beef at two dinners a week. They swap both for 0.3 kg of lentils. Using about 80 and 2 kg CO_2e per kg, what is the weekly saving?

STEP 1 · BEEF

$2 \times 0.3 \times 80 = 48$ kg CO_2e.

STEP 2 · LENTILS

$2 \times 0.3 \times 2 = 1.2$ kg CO_2e.

STEP 3 · SAVING

$48 - 1.2 =$ **46.8 kg CO_2e a week**.

FRAMING

This is a ratio choice, not a forbidden food; cost, culture and preference still matter.

EXAMPLE 14.2 · PLACING HOUSEHOLDS ON THE CONTINUUM

Household A worries food will run out but eats normally. Household B buys cheaper, less varied food. Household C skips meals at month end. Classify each.

STEP 1 · A

Marginal food security, counted as **food secure**.

STEP 2 · B

Low food security, **food insecure**.

STEP 3 · C

Very low food security, **food insecure**.

TRAPS PEOPLE FALL INTO

- **Food insecurity as hunger only.** It is a continuum.
- **Food miles first.** Food type dominates.
- **Processing as all harmful.** Freezing and fortifying help.
- **Education as the main lever.** Income and environment usually bind.

Chapter 14 self-test · six items

1. A family has money and a store nearby but no working stove or safe water. Which dimension fails?

A. Stability
B. Access
C. Availability
D. Utilization

D. Utilization Utilization covers whether the body can use food: safety, clean water, cooking and health.

2. Which household is counted as food secure?

A. One with worry but a normal diet
B. One with reduced variety of food
C. One that cuts meal size to stretch food
D. One that skips meals some months

A. One with worry but a normal diet Marginal food security (anxiety, normal intake) is counted as food secure.

3. Which measure marks an acute deficit with the highest near-term death risk?

A. Stunting
B. Overweight
C. Wasting
D. Underweight

C. Wasting Wasting is low weight-for-height and reflects recent loss.

4. Why was pellagra common in some maize-based diets?

A. Maize lacks almost all forms of carbohydrate
B. Its niacin is bound unless treated with alkali
C. Maize contains too much thiamin to absorb
D. Maize blocks iodine uptake by the thyroid

B. Its niacin is bound unless treated with alkali Nixtamalization releases bound niacin; untreated maize diets led to pellagra.

5. Which share of food emissions comes from transport, per the chapter?

A. About 6 percent
B. About 30 percent
C. About 50 percent
D. About 75 percent

A. About 6 percent Transport is a minor term; food type dominates footprints.

6. Which intervention changed iodine status without anyone changing habits?

A. Cooking classes
B. Salt iodization
C. Diet apps
D. Calorie labels

B. Salt iodization Iodized salt reaches people through the food supply and sharply reduced goiter.

Cram sheet

Every number in the course, sorted by topic. Cover the right column and rebuild each row. If a row will not come back, go to that chapter's exam guide.

Energy and macronutrients

Item	Value	Note
Energy factors	Carb 4, protein 4, fat 9, alcohol 7 kcal/g; fiber about 2	1 kcal = 4.184 kJ
AMDRs, adults	Carb 45 to 65%; fat 20 to 35%; protein 10 to 35%	Fat 30 to 40% ages 1 to 3; 25 to 35% ages 4 to 18
Carbohydrate	RDA 130 g; 175 pregnancy; 210 lactation	Added sugars under 10%
Fiber AI	14 g per 1,000 kcal: 38 g men, 25 g women (19 to 50); 30 and 21 g after 50	28 g pregnancy; DV 28 g
Fat	Saturated under 10%; trans as low as possible	Linoleic AI 17/12 g; ALA AI 1.6/1.1 g
Protein	RDA 0.8 g/kg; 1.1 g/kg pregnancy and lactation	EAR 0.66 g/kg; athletes 1.2 to 2.0 g/kg
Expenditure	Basal 60 to 75%; TEF about 10%; activity 15 to 30%	TEE = RMR × PAL
Pregnancy and lactation energy	0, +340, +452; then +330, +400 kcal	Energy has an EER, not an RDA

Equations

Name	Equation	Units
Food energy	4(carb) + 4(protein) + 9(fat) + 7(alcohol)	kcal
Percent of calories	g × kcal/g ÷ total kcal × 100	percent
Grams from a percent	total kcal × fraction ÷ kcal/g	g
Glycemic load	GI × g available carb ÷ 100	no unit
Protein from nitrogen	N × 6.25	g
BMI	kg ÷ m^2; or lb ÷ in^2 × 703	kg/m^2
Vitamin A	1 µg RAE = 12 µg dietary beta-carotene	µg RAE
Vitamin D	1 µg = 40 IU	IU or µg
Niacin	60 mg tryptophan = 1 mg NE	mg NE
Salt to sodium	sodium = salt × 0.40	mg
ADI	NOAEL ÷ 100	mg/kg/day

Key vitamins (adults)

Vitamin	Role and sources	RDA or AI; UL
A	Vision, epithelium; liver, dairy fat, orange and green produce	900/700 µg RAE; UL 3,000 µg preformed
D	Calcium absorption; sun, oily fish, fortified milk	600 IU to 70, 800 IU after; UL 4,000 IU
E	Membrane antioxidant; oils, nuts, seeds	15 mg; UL 1,000 mg supplemental
K	Clotting factors; leafy greens	AI 120/90 µg; no UL
Thiamin	TPP; whole and enriched grains	1.2/1.1 mg
Niacin	NAD^+; enriched grains, tryptophan	16/14 mg NE; UL 35 mg supplemental
B6	PLP; varied foods	1.3 mg (19 to 50); UL 100 mg
Folate	DNA synthesis; greens, legumes, fortified flour	400 µg DFE; 600 pregnancy; UL 1,000 µg folic acid
B12	DNA and nerves; animal and fortified foods	2.4 µg; fortified sources after 50
C	Collagen, iron absorption; peppers, citrus, broccoli	90/75 mg; +35 smoking; UL 2,000 mg

Key minerals and water (adults)

Mineral	Role and sources	RDA or AI; UL
Calcium	Bone; dairy, fortified drinks, calcium-set tofu, kale	1,000 mg; 1,200 women 51+ and all 71+; 1,300 ages 9 to 18
Magnesium	Enzyme cofactor; nuts, seeds, legumes	400/420 men; 310/320 women; UL 350 mg supplements
Sodium	Fluid volume; packaged and restaurant food	AI 1,500 mg; CDRR 2,300 mg
Potassium	Inside-cell cation; potatoes, beans, bananas	AI 3,400 men; 2,600 women
Iron	Hemoglobin; meat (heme), beans and fortified grains	8 men; 18 women 19 to 50; 27 pregnancy; 9 lactation; UL 45
Zinc	Enzymes, immunity; meat, shellfish, legumes	11/8 mg; UL 40
Iodine	Thyroid hormone; iodized salt, seafood	150 µg; 220 pregnancy; 290 lactation; UL 1,100
Selenium	Antioxidant enzymes; Brazil nuts, seafood	55 µg; UL 400
Fluoride	Enamel; fluoridated water	AI 4/3 mg; UL 10
Water	Solvent, transport, temperature	AI 3.7 L men; 2.7 L women

Deficiency syndromes to recognize

Nutrient	Syndrome	Features
Vitamin C	Scurvy	Bleeding gums, perifollicular hemorrhage, corkscrew hairs, poor healing
Vitamin A	Xerophthalmia	Night blindness, Bitot spots, then blindness
Thiamin	Beriberi; Wernicke-Korsakoff	Neuropathy or heart failure; confusion, ataxia, eye signs
Niacin	Pellagra	Dermatitis, diarrhea, dementia, death
Vitamin D	Rickets; osteomalacia	Bowed legs; bone pain and weakness
Folate and B12	Megaloblastic anemia	Large cells; B12 adds nerve damage
Iron	Iron deficiency anemia	Small pale cells, fatigue, spoon nails
Iodine	Goiter; congenital hypothyroidism	Enlarged thyroid; fetal brain harm
Vitamin K	Bleeding	Newborn VKDB without the birth dose

How strong is the evidence?

Tier	Examples from the course
Strong	Deficiency diseases; folic acid and NTDs; sodium and blood pressure; LDL causal; replacing saturated with unsaturated fat; free sugars and dental caries; DASH; DPP; LEAP; fortification
Moderate	Potassium and blood pressure; fish in the diet; higher protein and fiber for satiety; WIC outcomes
Preliminary or mixed	Most microbiome claims; GI as a standalone tool; ultra-processed mechanism; omega-6 to omega-3 ratio; regenerative grazing offsets; produce prescriptions
Weak or negative	Routine multivitamins for disease; high-dose vitamin E; beta-carotene in smokers (harm); detoxes; BCAAs; specific macronutrient ratios for weight

Label rules and Daily Values

Item	Value
5/20 rule	5% DV or less low; 20% DV or more high
Claims	Good source 10 to 19% DV; excellent source 20%+; low sodium 140 mg or less
DVs	Sodium 2,300 mg; fiber 28 g; added sugars 50 g; saturated fat 20 g; total fat 78 g
DVs, micronutrients	Vitamin D 20 µg; calcium 1,300 mg; iron 18 mg; potassium 4,700 mg
Other rules	Ingredients by weight; nine allergens incl. sesame; serving size governs every number

Food safety temperatures (book values)

Item	Value
Danger zone	40 to 140°F USDA; 41 to 135°F Food Code
Time	2 h cumulative; 1 h above 90°F
Cook to	Poultry 165; ground meat 160; whole cuts 145 + 3 min; fish 145; eggs 160; leftovers 165 (°F)
Cooling	135 to 70°F in 2 h; 70 to 41°F in 4 h
Holding and storage	Hot 135°F+; cold 41°F or below; fridge 40°F; freezer 0°F

Lifespan, activity and public health

Item	Value
Gestational gain	28 to 40; 25 to 35; 15 to 25; 11 to 20 lb by BMI band
Infants	Vitamin K at birth; vitamin D 400 IU if breastfed; solids about 6 months; no honey before 12 months
Activity	Carb 3 to 12 g/kg/day; 30 to 60 up to 90 g/h; loss over 2% hurts; EAH sodium below 135 mmol/L
Chronic disease	Prediabetes 100 to 125 mg/dL or 5.7 to 6.4%; DPP 58%; processed meat about 18% per 50 g/day
Food security	About 1 in 8 US households; stunting and wasting below −2 SD; SAM below −3 or MUAC below 115 mm
Food system	About 13% lost plus 19% wasted; transport about 6% of emissions

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