



Chapter 12

Nutrition

Nutrients

macronutrients: large
required daily quantities
carbohydrates, lipids, proteins

micronutrients: small required
daily quantities
vitamins, minerals

Also required: water and fiber

Daily Reference Values (DRV):
based on a 2,000 Cal. diet

Sample label for
Macaroni & Cheese

Nutrition Facts			
Serving Size 1 cup (228g) Servings Per Container 2			
Amount Per Serving			
Calories	250	Calories from Fat	110
		% Daily Value*	
Total Fat	12g		18%
Saturated Fat	3g		15%
Trans Fat	3g		
Cholesterol	30mg		10%
Sodium	470mg		20%
Total Carbohydrate	31g		10%
Dietary Fiber	0g		0%
Sugars	5g		
Protein	5g		
Vitamin A			4%
Vitamin C			2%
Calcium			20%
Iron			4%
* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.			
	Calories	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

① Start Here →

② Check Calories

③ Limit these Nutrients

④ Get Enough of these Nutrients

⑤ Footnote

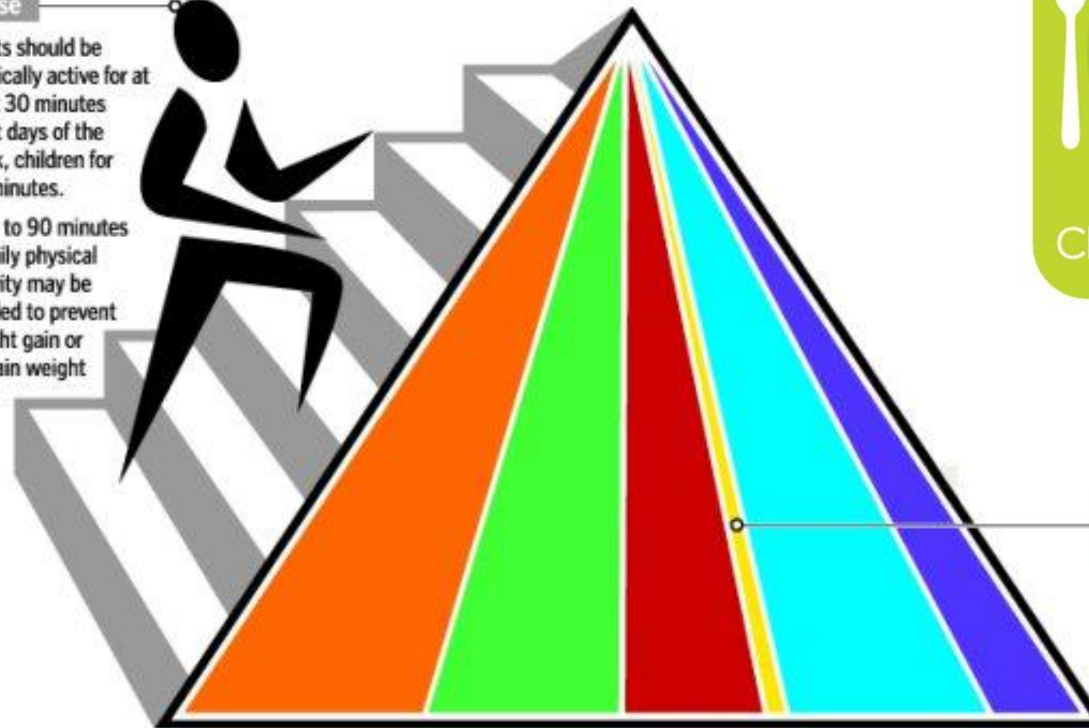
⑥ Quick Guide to % DV

- 5% or less is Low
- 20% or more is High

Food Pyramid

Exercise

- Adults should be physically active for at least 30 minutes most days of the week, children for 60 minutes.
- Sixty to 90 minutes of daily physical activity may be needed to prevent weight gain or sustain weight loss.



Oils

- Most fat should be from fish, nuts and vegetable oils.
- Limit solid fats, such as butter, margarine or lard.
- Keep consumption of saturated fats, trans fats and sodium low.
- Choose foods low in added sugar.

CATEGORY

Grains

Vegetables

Fruits

Milk

Meat and beans

RECOMMENDATION

Half of all grains consumed should be whole grains.

Vary the types of vegetables you eat.

Eat a variety of fruits. Go easy on juices.

Eat low-fat or fat-free dairy products.

Eat lean cuts, seafood and beans. Avoid frying.

DAILY AMOUNT

6 oz.

2.5 cups

2 cups

3 cups

5.5 oz.

Based on a 2,000 calorie diet.

Recommended nutrient intakes at 12-calorie levels can be found on mypyramid.gov.

Calories

Daily caloric intake varies by weight, gender, and level of activity.

basal requirement:
calories needed to maintain a resting body (no activity).

Recommended Daily Calorie Intake				
	Males		Females	
	Activity level*		Activity level*	
Age	Sedentary	Moderate	Sedentary	Moderate
2	1000	1000	1000	1000
3	1000	1400	1000	1200
4-5	1200	1400	1200	1400
6	1400	1600	1200	1400
7	1400	1600	1200	1600
8	1400	1600	1400	1600
9	1600	1800	1400	1600
10	1600	1800	1400	1800
11	1800	2000	1600	1800
12	1800	2200	1600	2000
13	2000	2200	1600	2000
14	2000	2400	1800	2000
15	2200	2600	1800	2000
16-18	2400	2800	1800	2000
19-20	2600	2800	2000	2200
21-25	2400	2800	2000	2200
26-40	2400	2600	1800	2000
41-45	2200	2600	1800	2000
46-50	2200	2400	1800	2000
51-60	2200	2400	1600	1800
61-65	2000	2400	1600	1800
66 and up	2000	2200	1600	1800

Some people need even fewer calories each day such as children and inactive adults. Women need fewer calories than men at all ages.

Body Mass Index (BMI)

obesity: a person with a BMI of 30 or greater.

$$\text{BMI} = \left\{ \frac{\text{WEIGHT (pounds)}}{\text{HEIGHT (inches)}^2} \right\} \times 703$$

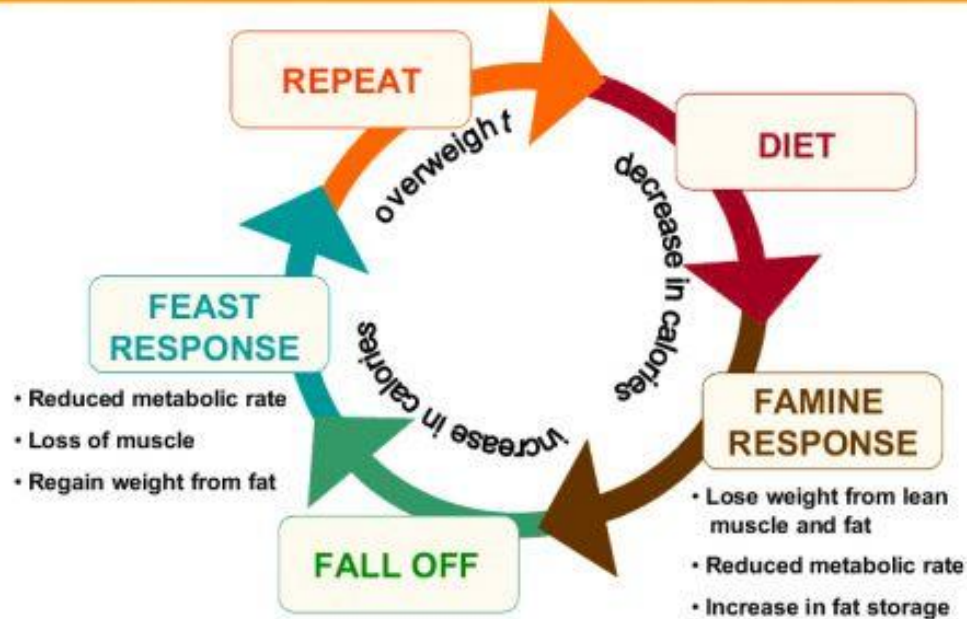
		Weight in Pounds													
		120	130	140	150	160	170	180	190	200	210	220	230	240	250
Height in Feet and Inches	4'6	29	31	34	36	39	41	43	46	48	51	53	56	58	60
	4'8	27	29	31	34	36	38	40	43	45	47	49	52	54	56
	4'10	25	27	29	31	34	36	38	40	42	44	46	48	50	52
	5'0	23	25	27	29	31	33	35	37	39	41	43	45	47	49
	5'2	22	24	26	27	29	31	33	35	37	38	40	42	44	46
	5'4	21	22	24	26	28	29	31	33	34	36	38	40	41	43
	5'6	19	21	23	24	26	27	29	31	32	34	36	37	39	40
	5'8	18	20	21	23	24	26	27	29	30	32	34	35	37	38
	5'10	17	19	20	22	23	24	26	27	29	30	32	33	35	36
	6'0	16	18	19	20	22	23	24	26	27	28	30	31	33	34
	6'2	15	17	18	19	21	22	23	24	26	27	28	30	31	32
	6'4	15	16	17	18	20	21	22	23	24	26	27	28	29	30
	6'6	14	15	16	17	19	20	21	22	23	24	25	27	28	29
	6'8	13	14	15	17	18	19	20	21	22	23	24	25	26	28

Healthy Weight
Overweight
Obese

- BMI does not take into account relative density of muscle versus fat.
- BMI does not take into account physical activity level.

Dieting

THE VICIOUS DIET CYCLE



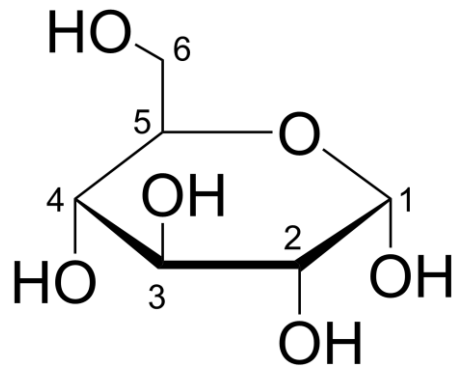
A pound of body fat is approximately equivalent to 3,500 Cal. of energy.

Reducing caloric intake will cause the body to start using up its stores to convert to energy: both fat and proteins (muscle mass).

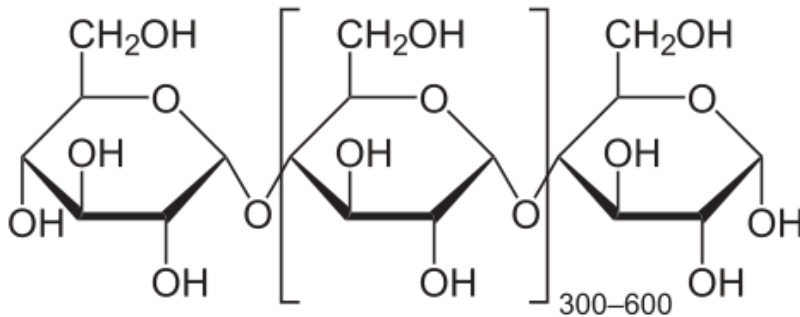
Carbohydrates

Primary source of energy in the body.

simple: mono- or disaccharides



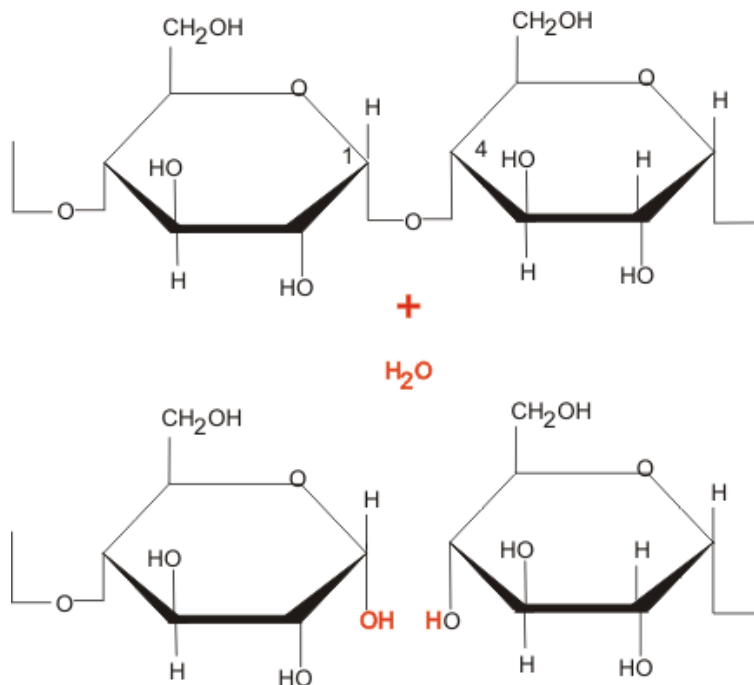
complex: polysaccharides (starch)



Processing Carbohydrates

Recommended: 48% complex carbohydrates and natural sugars, 10% refined sugars (58% total)

Reality: 28% complex carbohydrates and natural sugars, 18% refined (46% total)

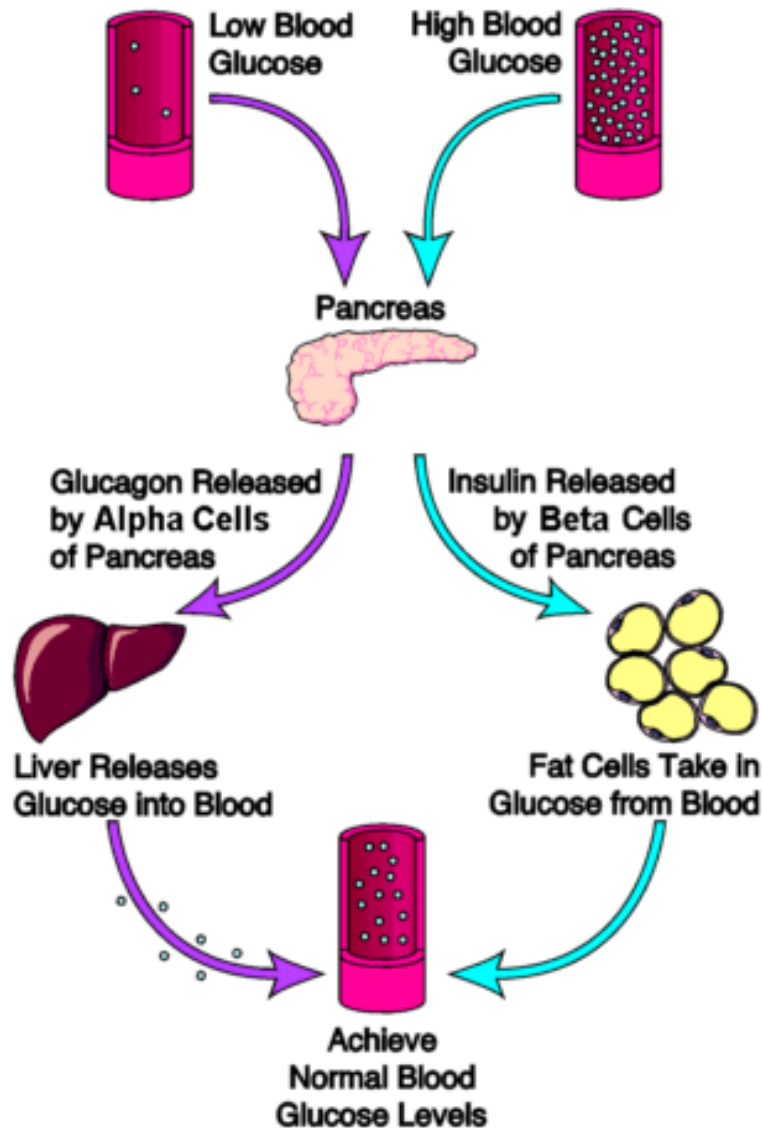


F.B. 2009

Hydrolysis of 1:4 α Linkage

Polysaccharides must be hydrolyzed to monosaccharides to be metabolized.

Blood Glucose Levels



D-glucose is called “blood sugar”.

In healthy humans, almost all glucose is fully metabolized and none appears as waste.

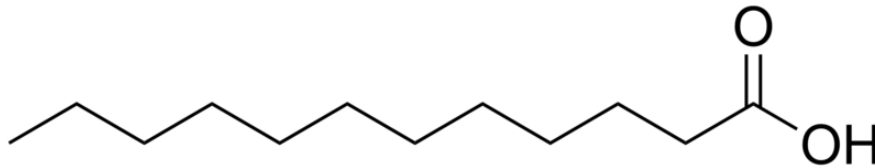
Diabetics cannot fully metabolize all blood glucose.

Recommended Intake:
130 g/day

Lipids

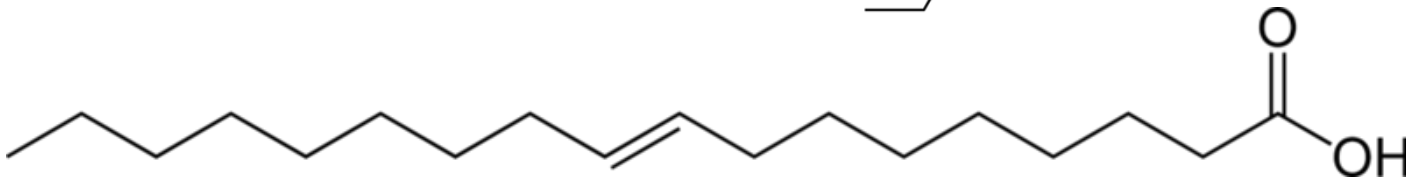
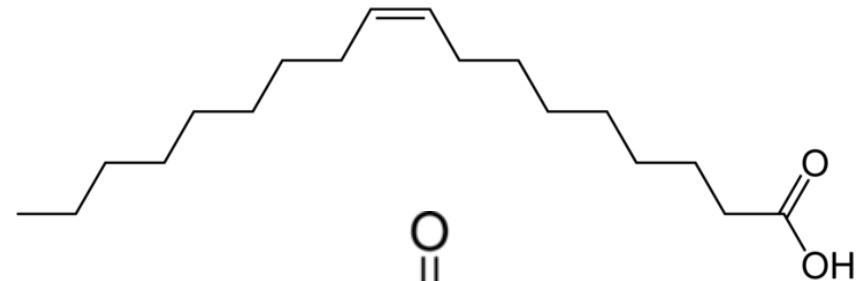
Recommended: 10% saturated, 10% monounsaturated, 10% polyunsaturated (30% total)

Reality: 16% saturated, 19% monounsaturated, 7% polyunsaturated (42% total)



lauric acid: found in coconut oil

oleic acid: found in olives



elaidic acid: found in hydrogenated vegetable oil

Processing Fats

About 95% of dietary lipids are fats and oils (triglycerides); the rest are complex or cholesterol.

Bile increase lipid solubility in aqueous solution before hydrolysis.

Linolenic and linoleic acid, both found in vegetable oils, are essential lipids.



Proteins

Recommended: 12% proteins

Reality: 12% proteins

Essential amino acids cannot be synthesized by the body and must be consumed in the diet.

Age Group	Grams of Protein Needed Each Day
Children ages 1 - 3	13
Children ages 4 - 8	19
Children ages 9 - 13	34
Girls ages 14 - 18	46
Boys ages 14 - 18	52
Women ages 19 - 70+	46
Men ages 19 - 70+	56

Proteins are **not stored** by the body; excess is metabolized as fat instead.

Essential Amino Acids

nonessential amino acids: can be synthesized by the body

essential amino acids: must be consumed through diet; cannot be synthesized by the body.

complete protein: protein source that contains all 10 essential amino acids

Most proteins from meat, fish, eggs, and dairy are “complete”.

Gelatin and most plant proteins are incomplete (low in methionine).

Essential	Nonessential
Isoleucine	Alanine
Leucine	Asparagine
Lysine	Aspartic Acid
Methionine	Cysteine*
Phenylalanine	Glutamic Acid
Threonine	Glutamine*
Tryptophan	Glycine*
Valine	Proline*
	Serine*
	Tyrosine*
	Arginine*
	Histidine*



Vitamins

Table 14. Dietary Reference Intake: Recommended Dietary Allowance and Adequate Intake

	Infants 0-6 mo	Infants 7-12 mo	Children 1-3 y	Children 4-8 y	Males 9-13 y	Males 14-18 y	Females 9-13 y	Females 14-18 y
Vitamin A ($\mu\text{g}/\text{d}$)	400	500	300	400	600	900	600	700
Vitamin C (mg/d)	40	50	15	25	45	75	45	65
Vitamin E (mg/d)	4	5	6	7	11	15	11	15
Vitamin K ($\mu\text{g}/\text{d}$)	2.0	2.5	30	55	60	75	60	75
Thiamin (mg/d)	0.2	0.3	0.5	0.6	0.9	1.2	0.9	1.0
Riboflavin (mg/d)	0.3	0.4	0.5	0.6	0.9	1.3	0.9	1.0
Niacin (mg/d; NE)	2*	4	6	8	12	16	12	14
Vitamin B ₆ (mg/d)	0.1	0.3	0.5	0.6	1.0	1.3	1.0	1.2
Folate ($\mu\text{g}/\text{d}$)	65	80	150	200	300	400	300	400
Vitamin B ₁₂ ($\mu\text{g}/\text{d}$)	0.4	0.5	0.9	1.2	1.8	2.4	1.8	2.4
Pantothenic Acid (mg/d)	1.7	1.8	2	3	4	5	4	5
Biotin ($\mu\text{g}/\text{d}$)	5	6	8	12	20	25	20	25
Copper ($\mu\text{g}/\text{d}$)	200	220	340	440	700	890	700	890
Selenium ($\mu\text{g}/\text{d}$)	15	20	20	30	40	55	40	55
Zinc (mg/d)	2	3	3	5	8	11	8	9

Note: RDAs are in bold type; AIs are in ordinary type.

Source: Health Canada: http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/nutrition/dri_tables-eng.pdf. Reprinted with the permission of the Minister of Public Works and Government Services, Canada, 2008.

*As preformed niacin, not niacin equivalents (NE) for this age group.

Minerals

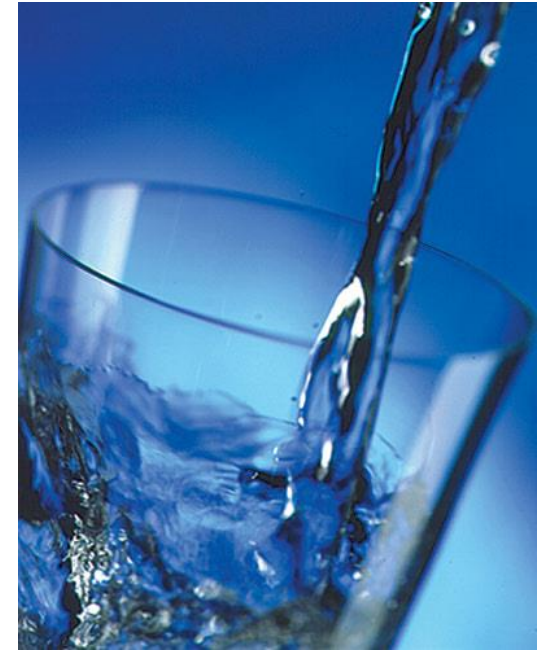
Honey: Minerals (Per 100g)		
		%DV
Calcium	6.0mg	1%
Iron	0.4mg	2%
Magnesium	2.0 mg	0%
Phosphorus	4.0mg	0%
Potassium	52.0mg	1%
Sodium	4.0mg	0%
Zinc	0.2mg	1%
Manganese	0.1mg	4%
Selenium	0.8mcg	1%
Fluoride	7.0 mcg	

Vitamins	
Nutrient	Daily Values
Vitamin C	60 mg
Thiamin	1.5 mg
Riboflavin	1.7 mg
Niacin	20 mg
Pathothenic Acid	10 mg
Vitamin B6	2 mg
Folate	400 mcg
Vitamin B12	6 mcg
Vitamin A	5000 IU
Vitamin E	30 IU
Vitamin K	80 mcg

Minerals	
Nutrient	Daily Values
Calcium	1000 mg
Iodine	150 mcg
Iron	18 mg
Magnesium	400 mg
Phosphorus	1000 mg
Potassium	3500 mg
Sodium	< 2400 mg
Zinc	15 mg
Copper	2 mg
Manganese	2 mg
Selenium	70 mcg

Water

Water makes up 60% of the average person's body weight.



Age (Years)	Total Water Intake (MALES Litres/Day)		Total Water Intake (FEMALES Litres/Day)	
	Least Active Median	Most Active Median	Least Active Median	Most Active Median
8-16	2.11	2.69	1.78	2.29
17-18	2.04	3.35	1.90	2.74
19-30	3.16	3.78	2.60	2.93
31-50	3.54	3.77	2.52	3.16
51-70	3.22	3.42	2.81	3.06
71+	2.54	3.05	2.33	2.75

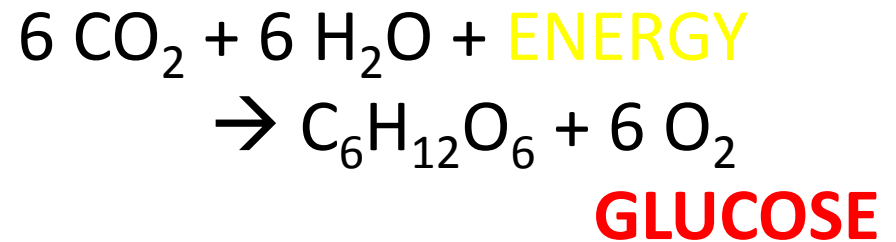
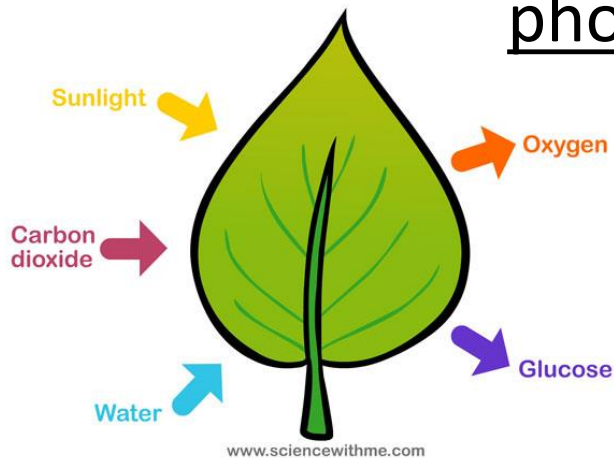
Daily intake is about
1,200-1,500 mL in
addition to water from
food.

Energy

nuclear fusion: $4 \text{ H} \rightarrow \text{He} + \text{ENERGY}$
(e^- capture)

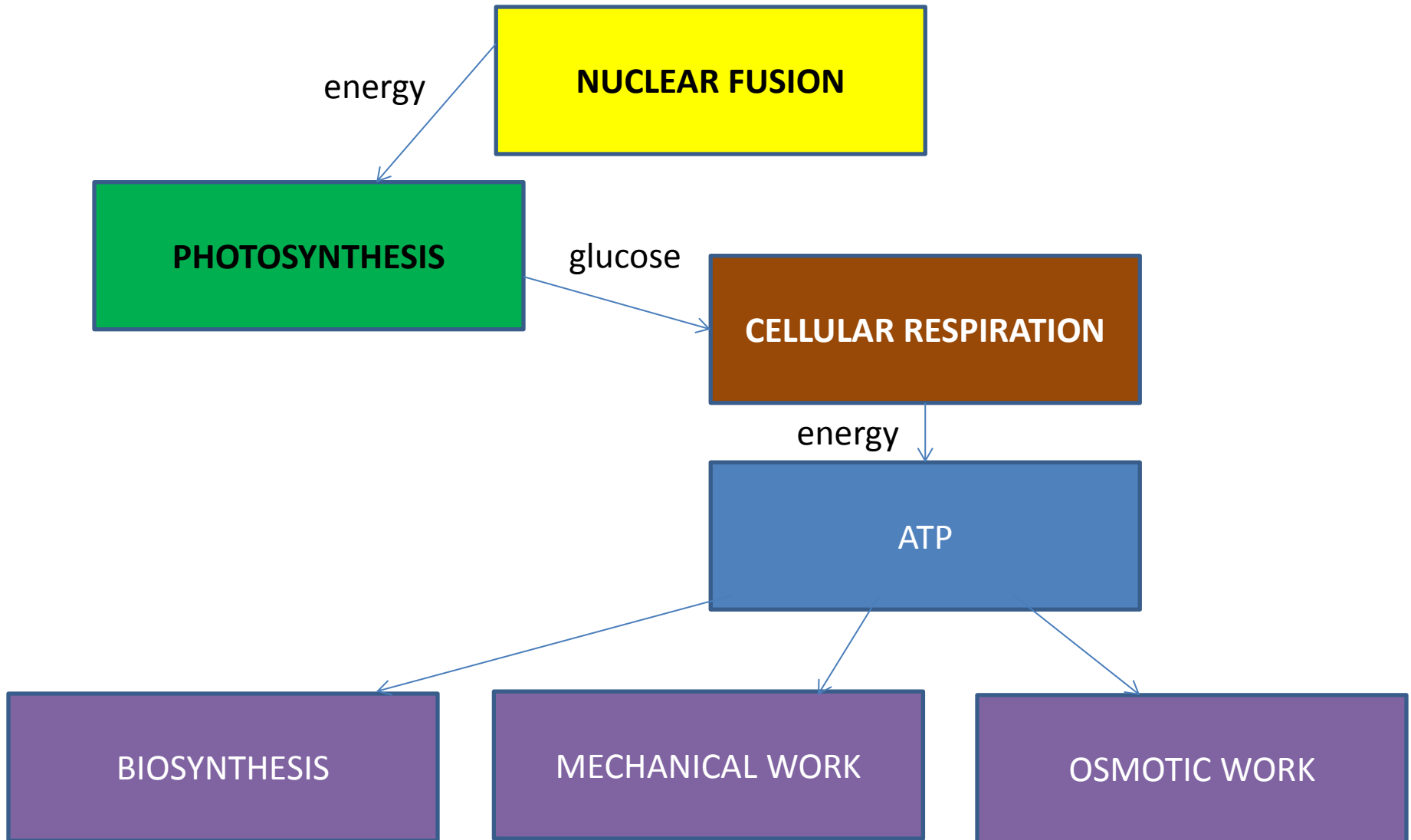


photosynthesis:



cellular respiration: $\text{C}_6\text{H}_{12}\text{O}_6 + \text{O}_2 \rightarrow$
 $6 \text{ CO}_2 + 6 \text{ H}_2\text{O} + \text{energy (ATP)}$

Energy Flow

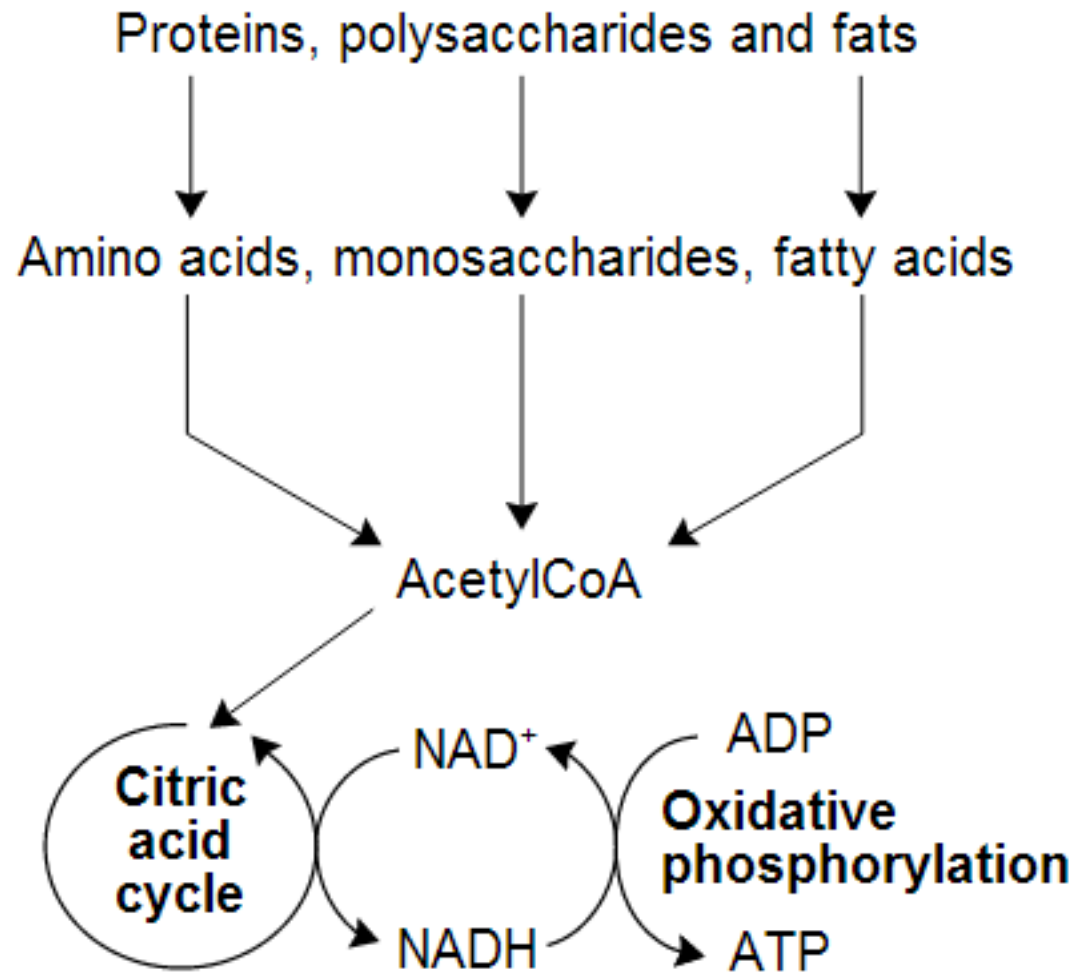


Metabolism

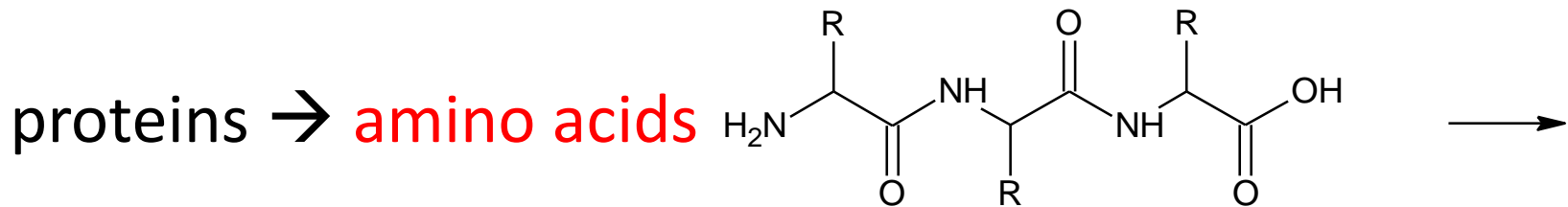
metabolism: all chemical reactions in a living cell

catabolism: breakdown of molecules

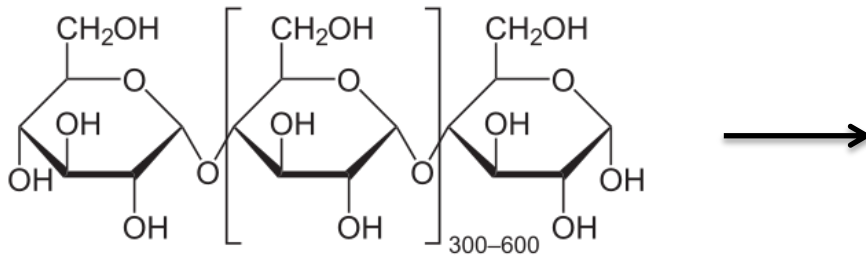
anabolism: build up of molecules



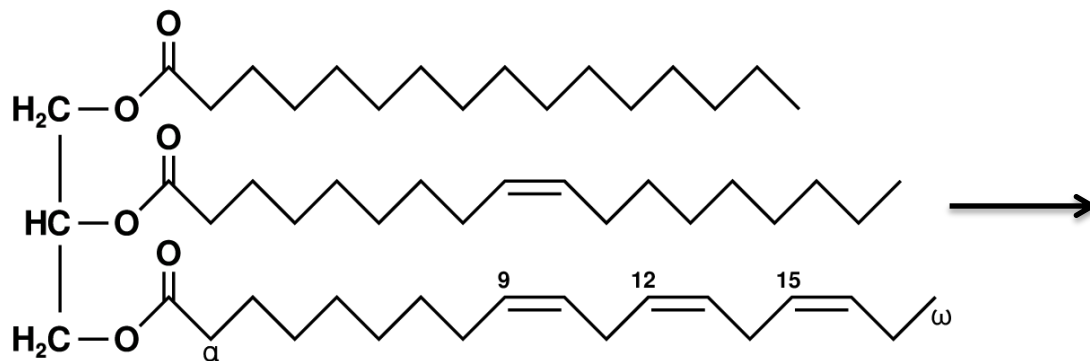
Stage I: Digestion



disaccharides or polysaccharides \rightarrow monosaccharides

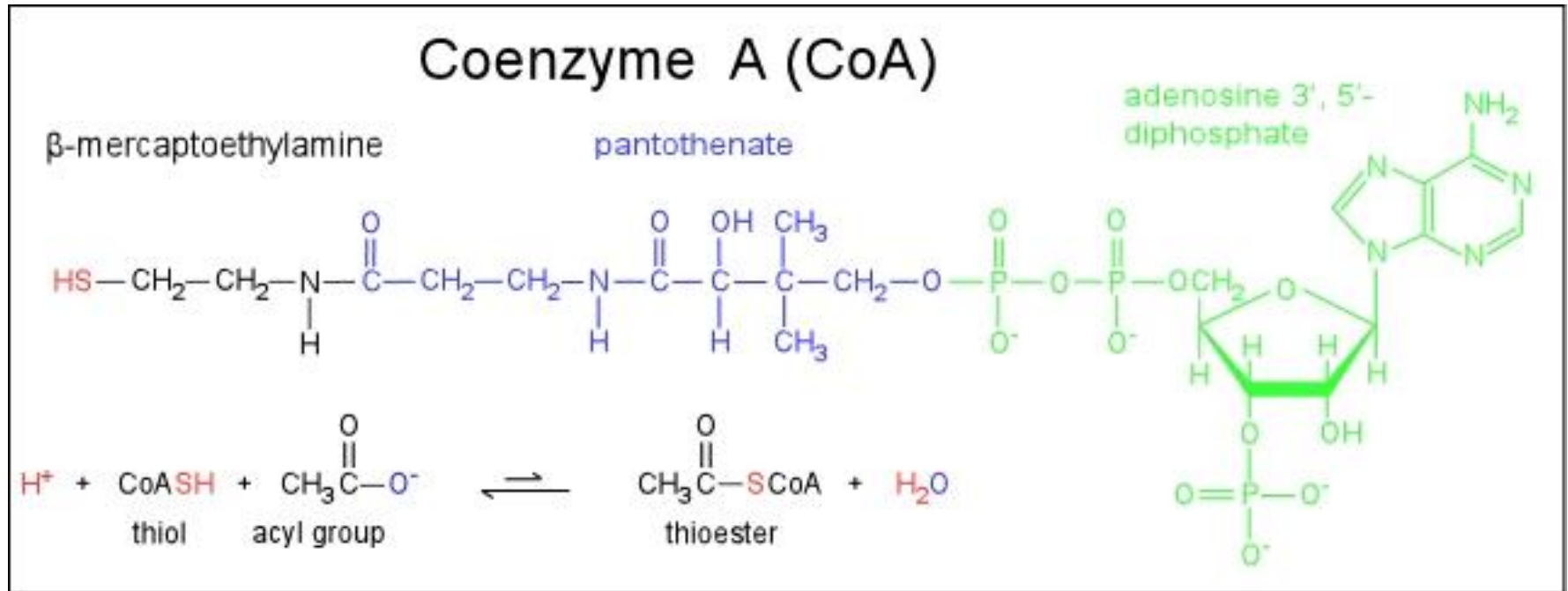


fats and oils \rightarrow fatty acids + glycerol



Stage II: Acetyl CoA

Biomolecules are further degraded into acetyl groups.



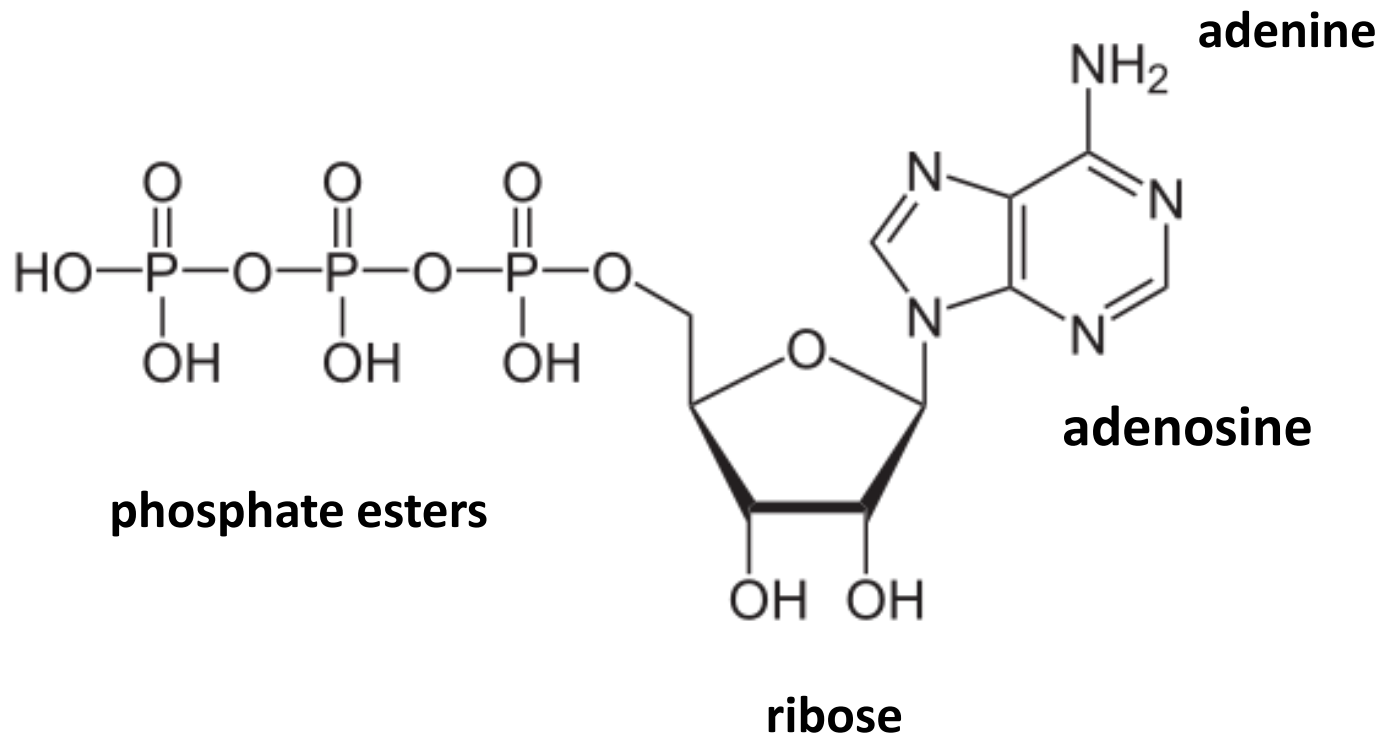
Acetyl CoA is carried into the common catabolic pathway (Citric Acid Cycle, Electron Transport, Oxidative Phosphorylation)

AMP, ADP, ATP

adenosine monophosphate (AMP): one phosphate

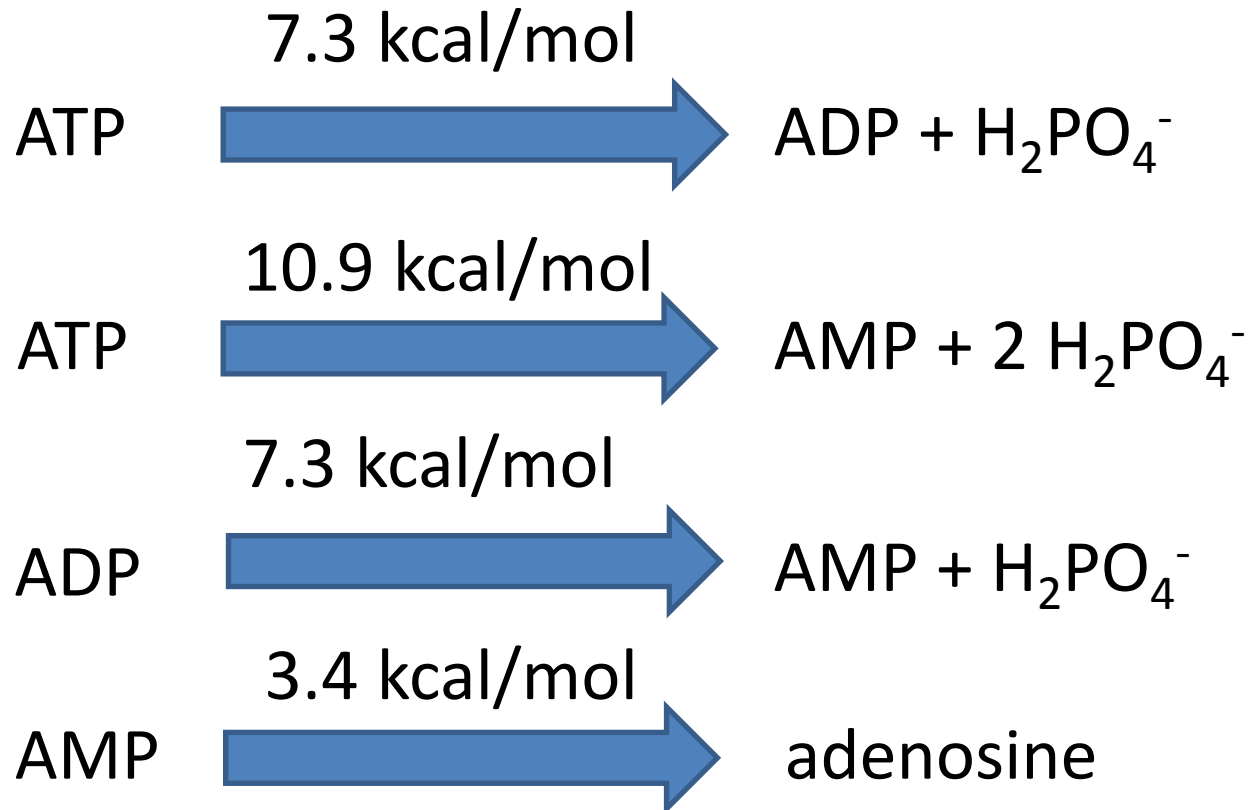
adenosine diphosphate (ADP): two phosphates

adenosine triphosphate (ATP): three phosphates



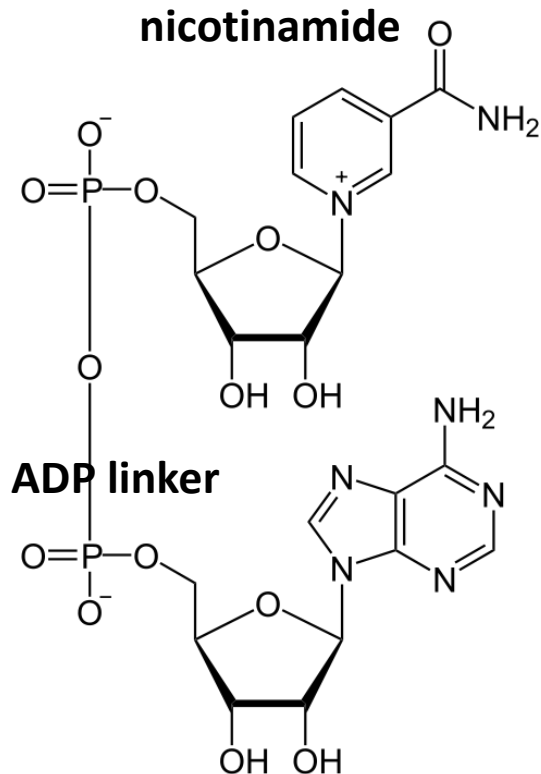
Hydrolysis of AMP, ADP, ATP

A single ATP molecule can be recycled 1000-15000 times per day, as it cannot be stored.

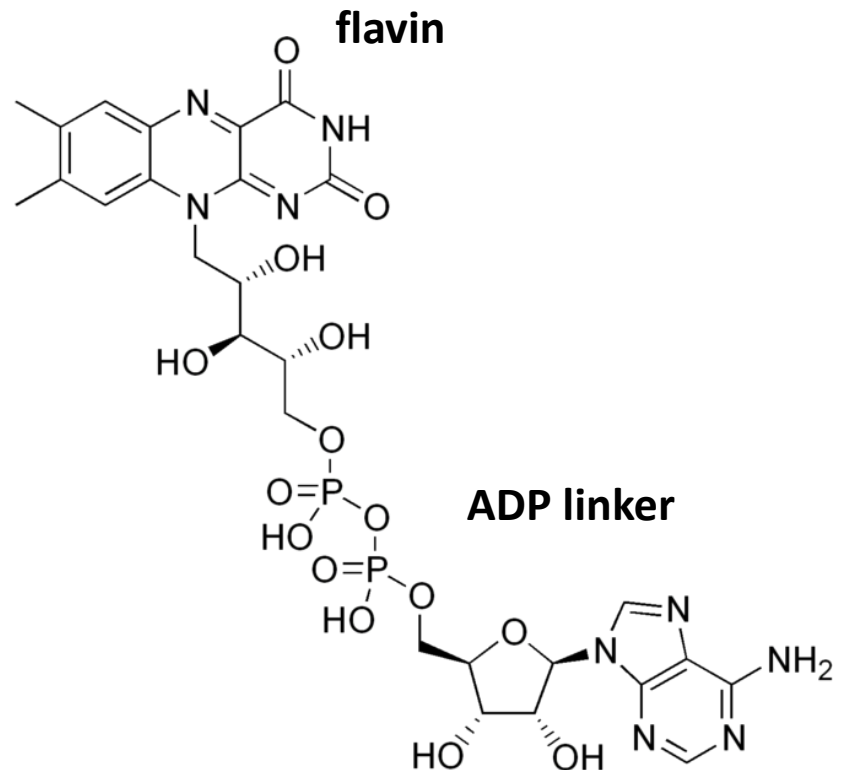


NAD⁺ and FAD

Coenzymes with an ADP core transfer electrons in biological oxidation-reduction (redox) reactions.

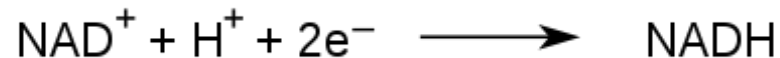
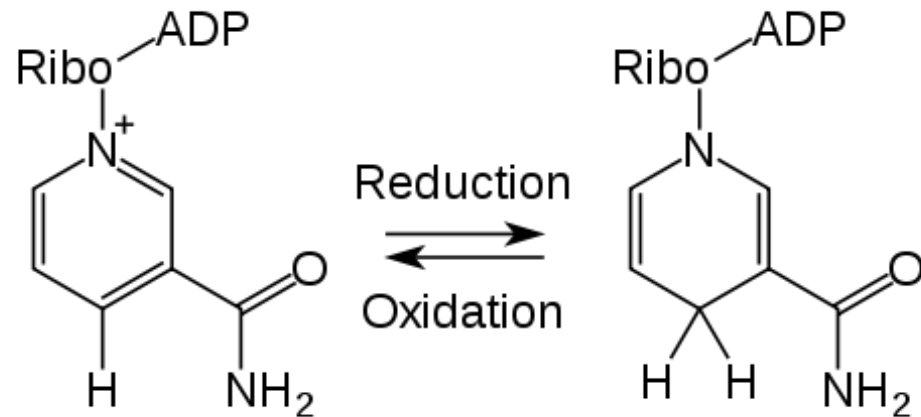


NAD⁺: nicotinamide
adenine dinucleotide

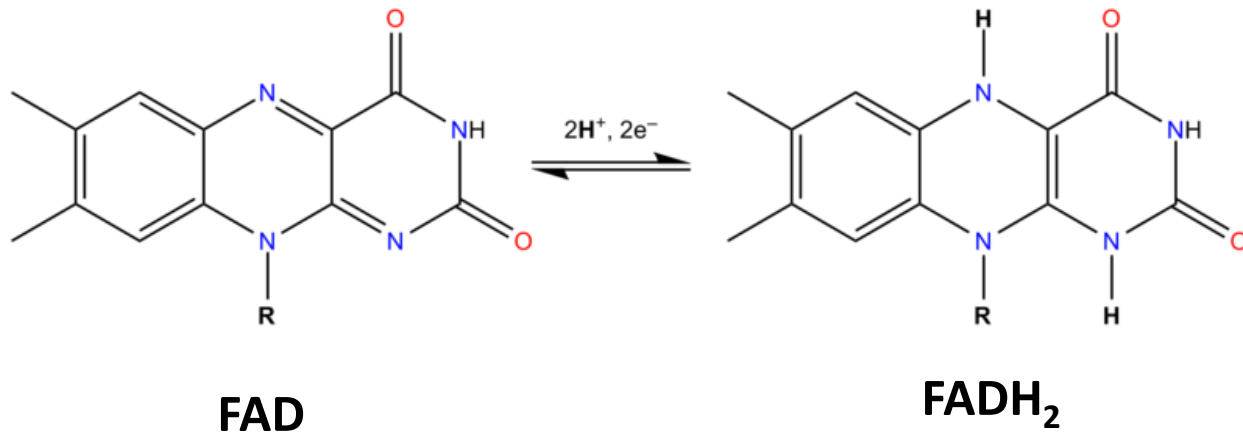


FAD: flavin adenine
dinucleotide

Redox Forms



NAD⁺ and FAD are called “hydrogen ion” and “electron-transporting” molecules.



Redox Activity

