



MODULE 9

NOV. 5

Minerals and Bone
health: Calcium
Vitamin D
Osteoporosis

THE SKELETON



WHAT ARE BONES MADE OF?

Composed of:

- 65% mineral crystals
 - Strength and structural support
- 35% collagen
 - Flexibility

Bone mineral density corresponds to bone strength

Bone types:

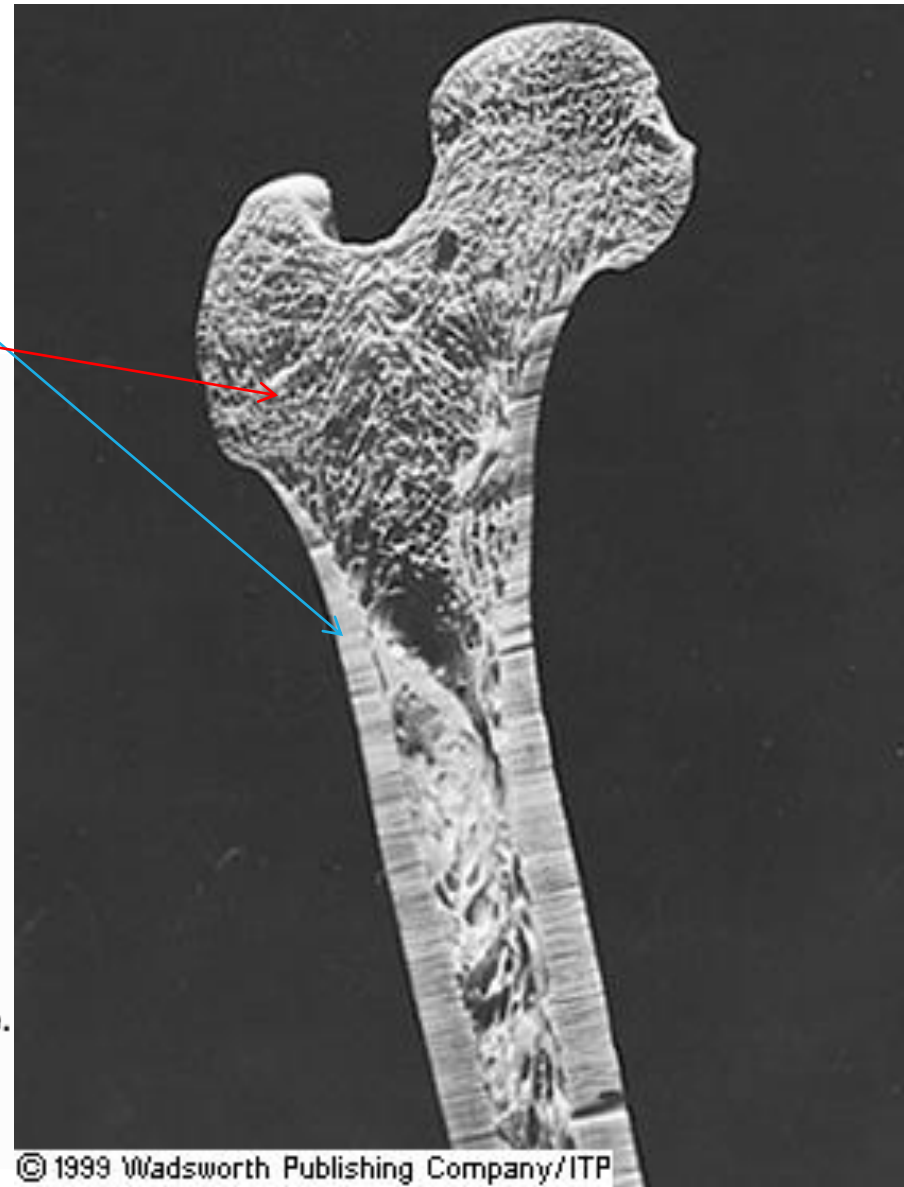
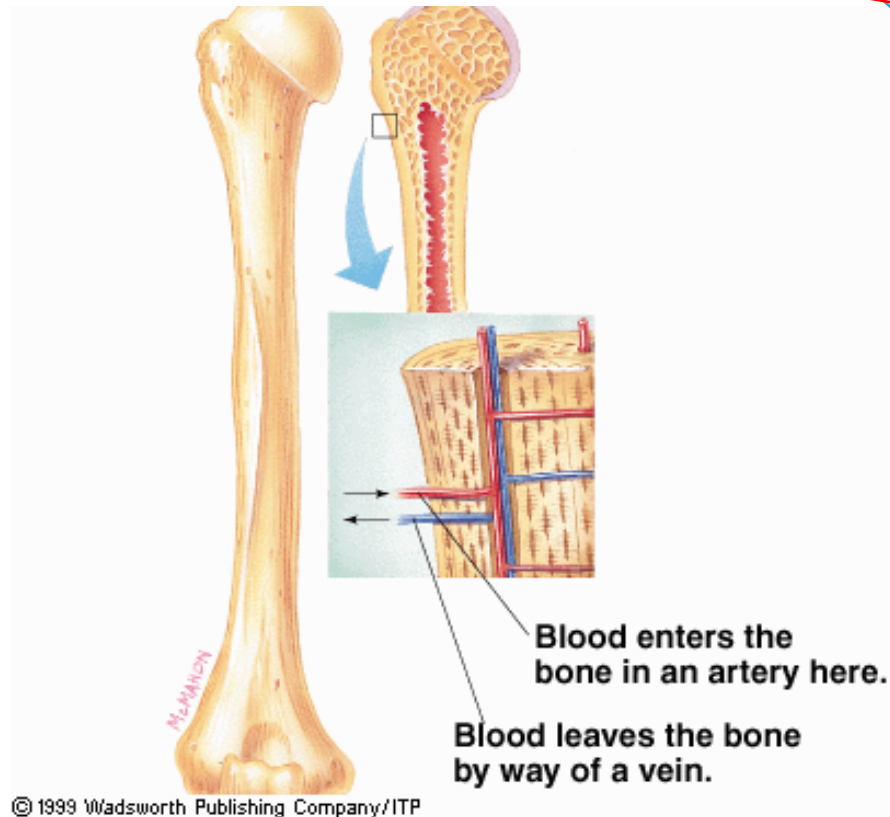
- Cortical
- Trabecular

<https://www.youtube.com/watch?v=inqWoakkiTc>

BONE TYPES

Cortical Bone

Trabecular Bone





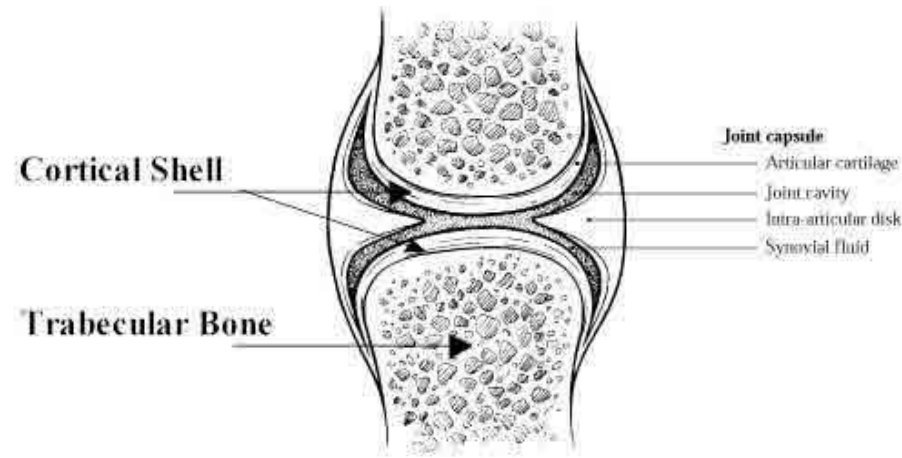
TRUE FALSE

Bones are not
metabolically
active in
adults.

BONE DEVELOPMENT AND DISINTEGRATION

Cortical bone (80% of mineral structure)

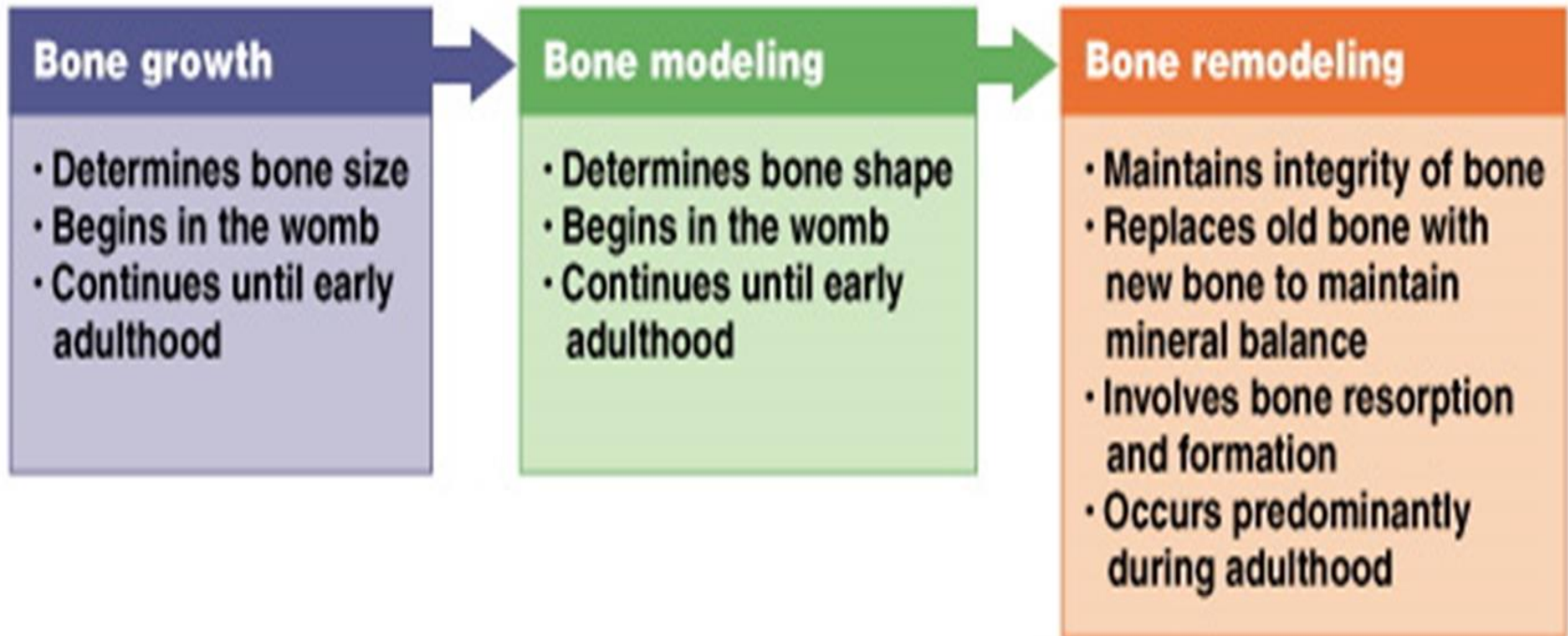
- Hard outer shell
- Gives up calcium to blood
 - Slow and steady rate



Trabecular bone (20% of mineral structure)

- Lacy matrix
- Give up calcium when diet runs short
 - Impacted by day-to-day intake and need for calcium

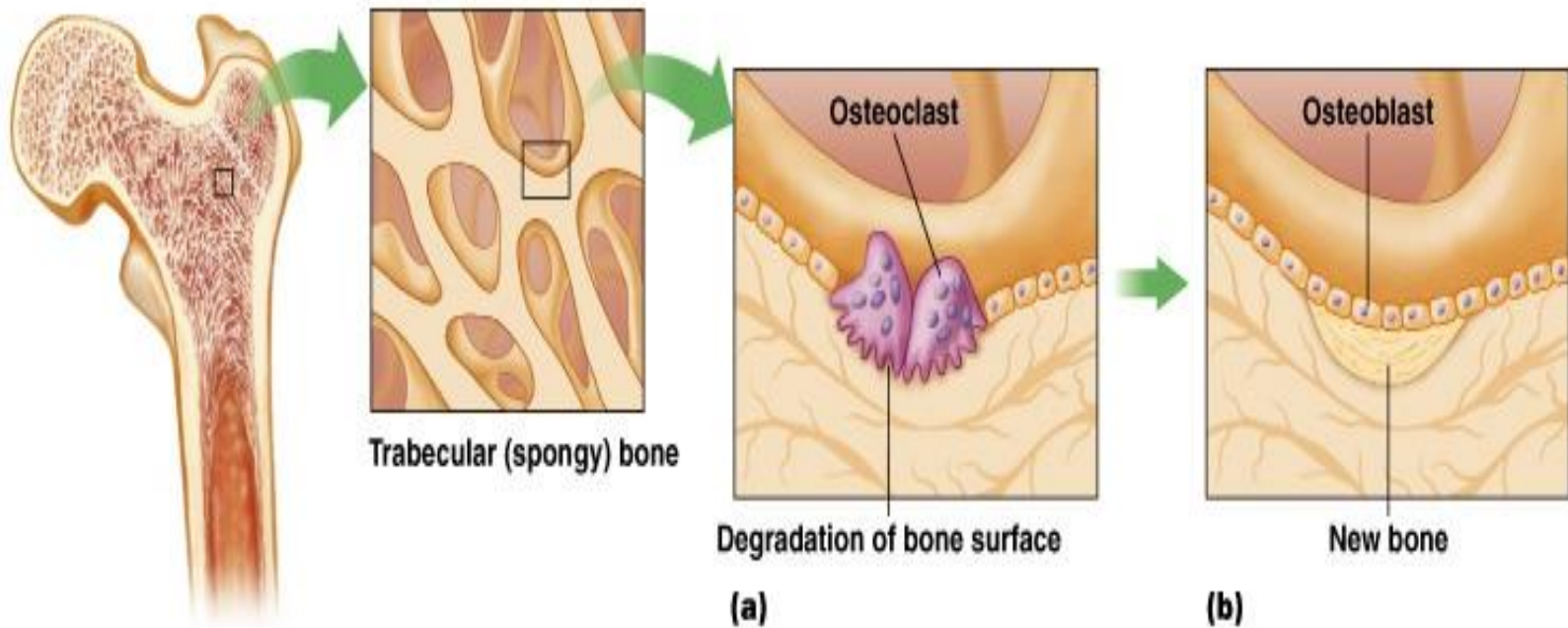
BONE TURNOVER



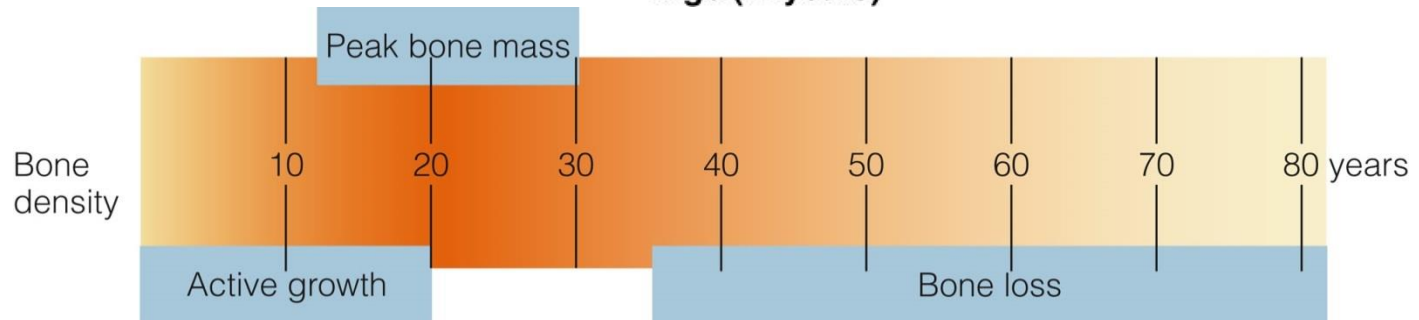
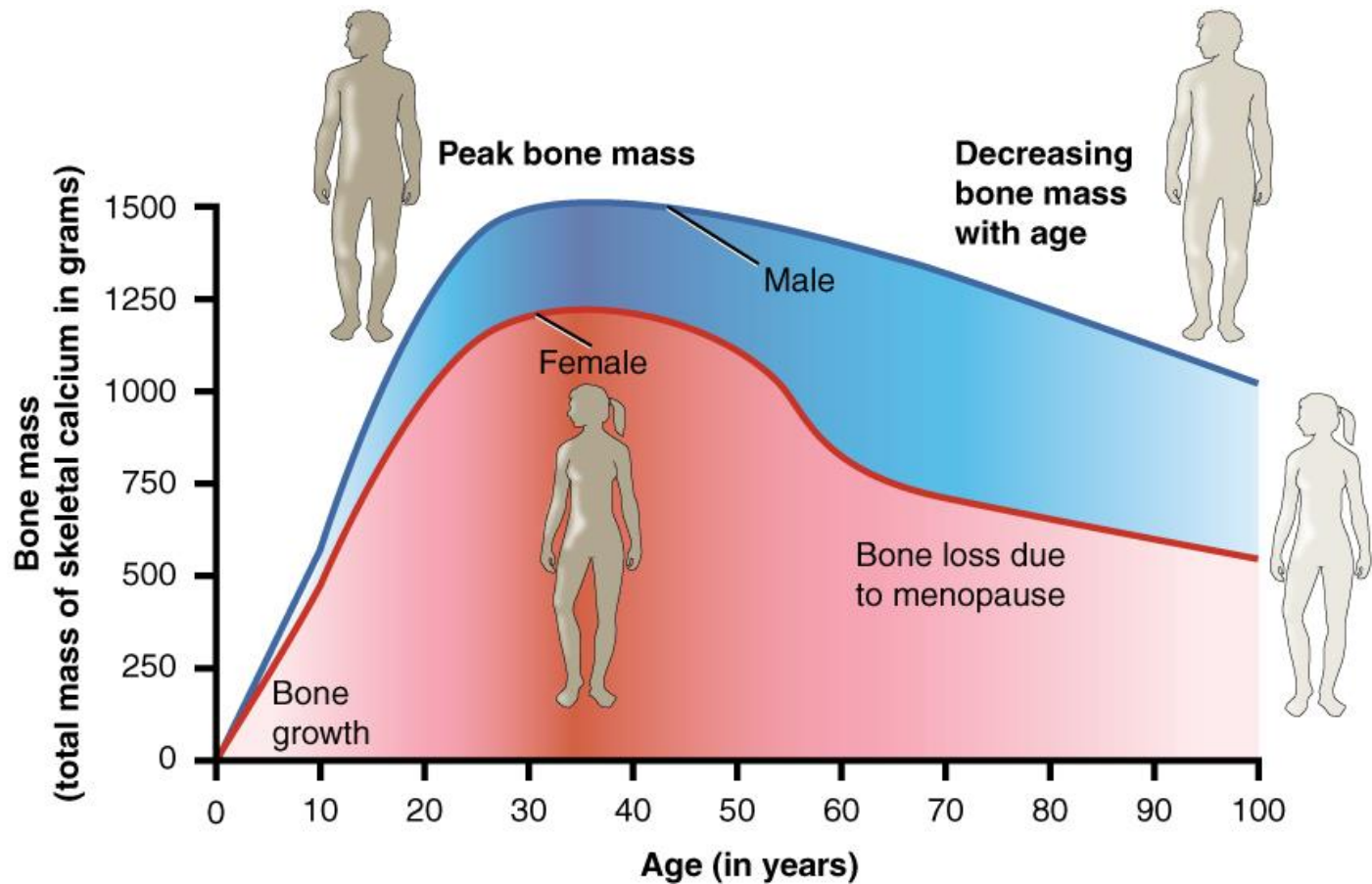
<https://www.youtube.com/watch?v=0dV1Bwe2v6c>

BONE REMODELING:

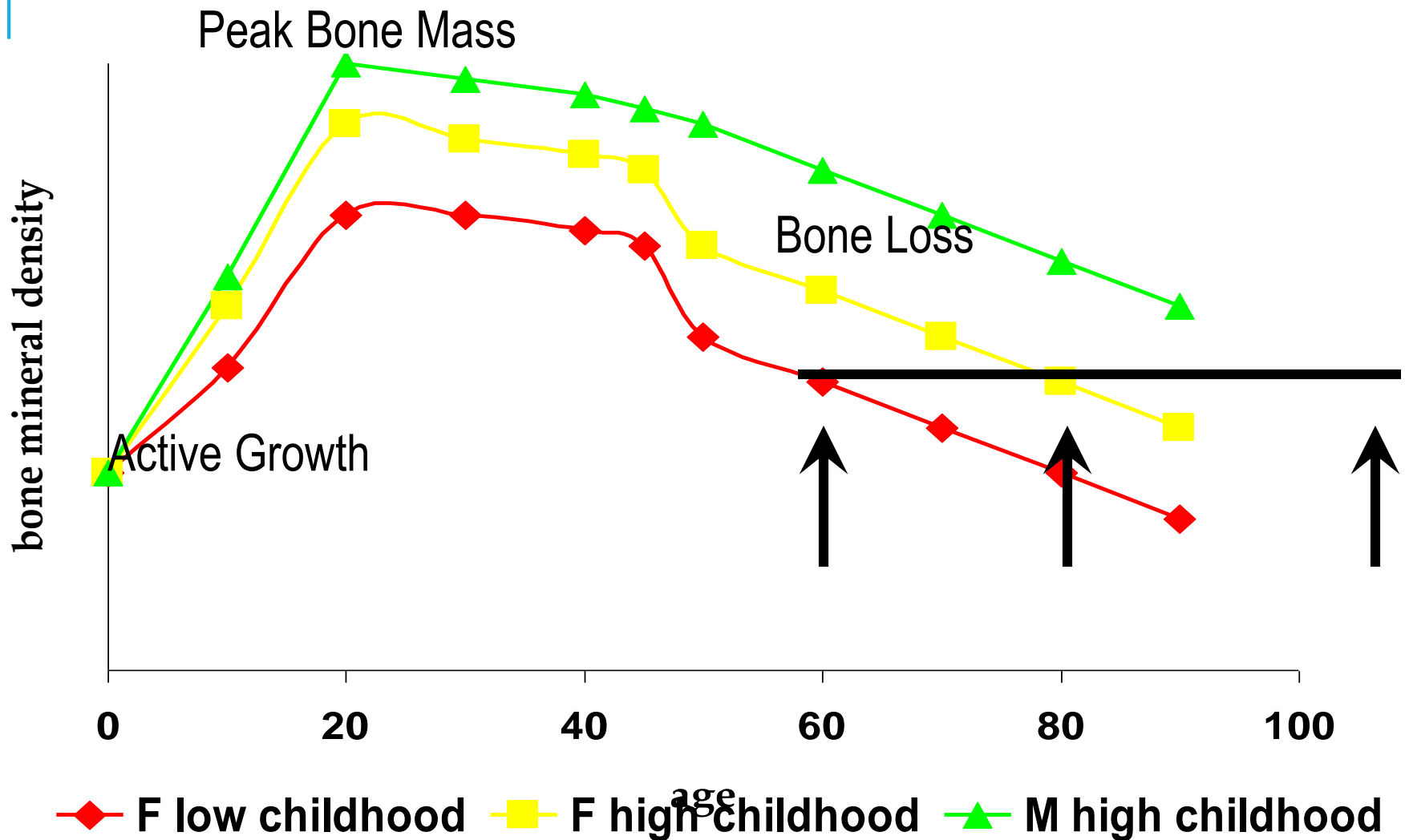
- **Resorption** – surface of bones is broken down
 - Osteoclasts – cells that erode the surface of bones
- **Formation** – of new bone in resorption pit
 - Osteoblasts – cells that produce collagen-containing component of bone



PHASES OF BONE DEVELOPMENT

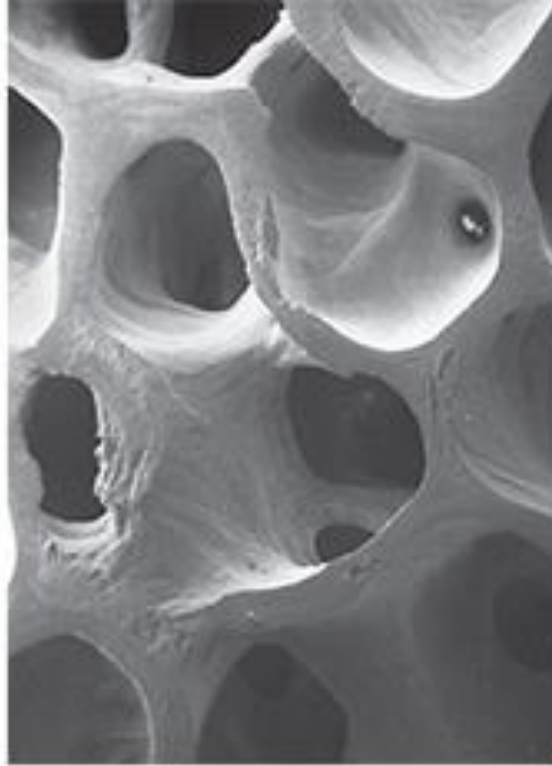


BONE MASS

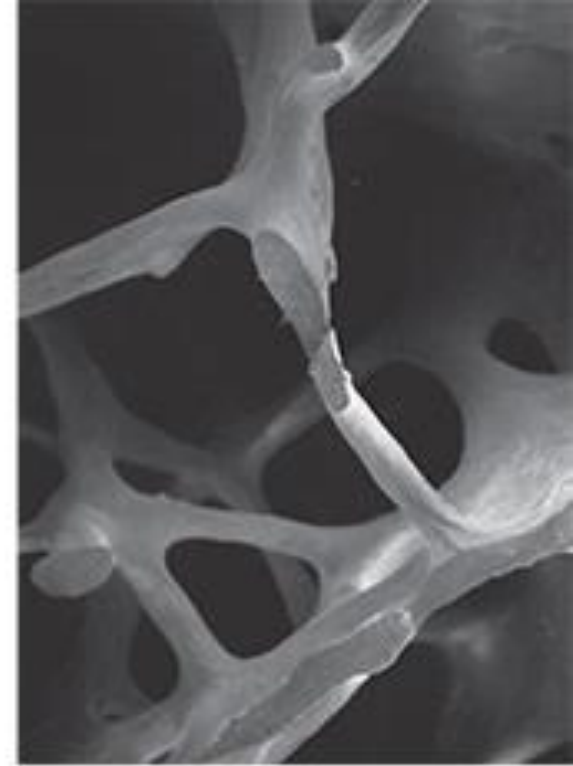




Trabecular bone is the lacy network of bone-containing crystals that fills the interior. Cortical bone is the dense, shell-like bone that forms the exterior shell.



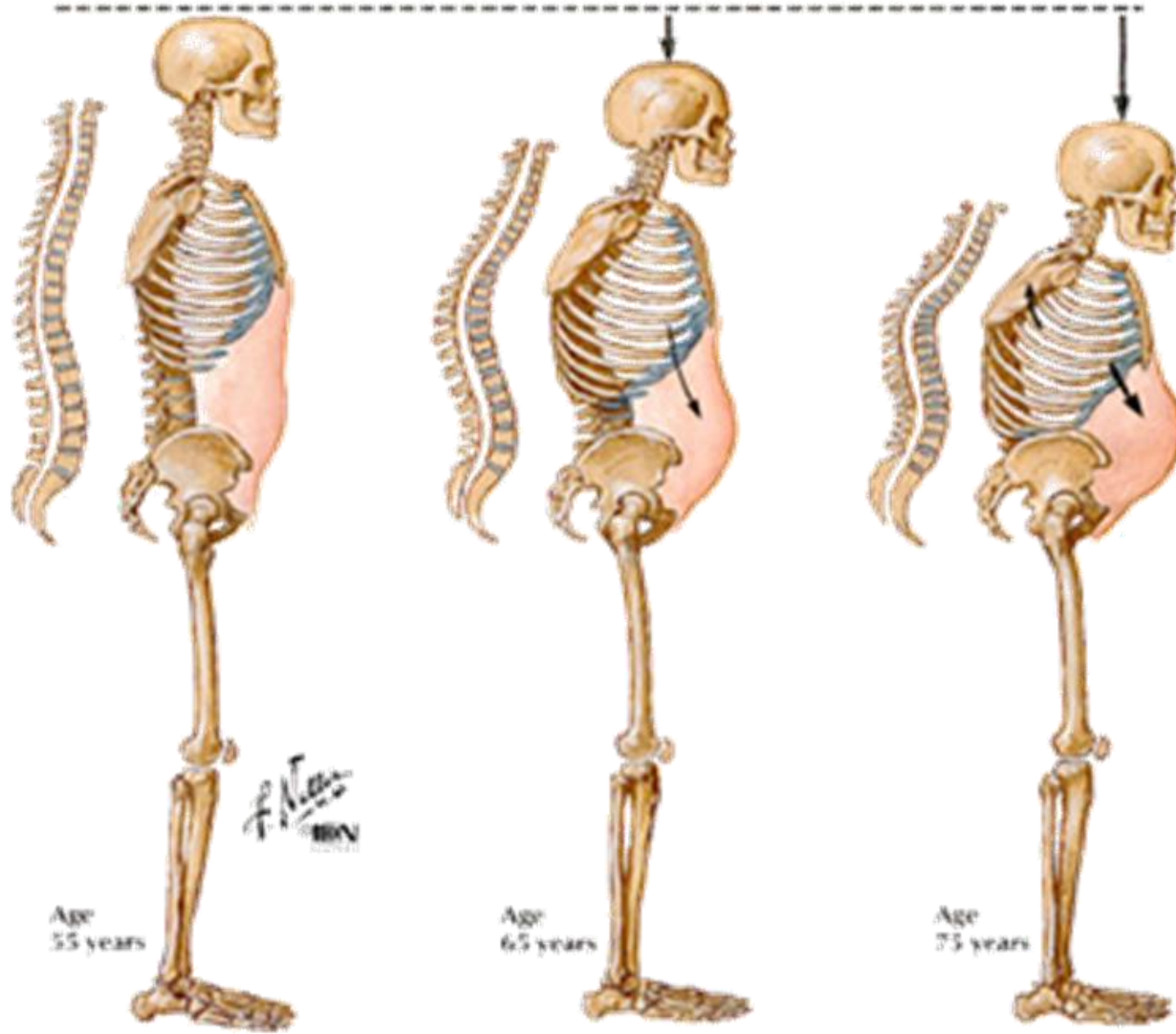
Electron micrograph of healthy trabecular bone.



Electron micrograph of trabecular bone affected by osteoporosis.

HEALTHY AND OSTEOPOROTIC TRABECULAR BONE

Cengage 2019©



OSTEOPOROSIS CANADA



At least **1 IN 3 WOMEN** and **1 IN 5 MEN** will suffer from an osteoporotic fracture during their lifetime



Osteoporosis: "a pediatric disease with geriatric consequences". Peak bone mass is achieved at an early age (16-20 in young women and 20-25 in young men), so **building strong bones during childhood and adolescence can be the best defense against developing osteoporosis later in life.**



2 MILLION CANADIANS are affected by osteoporosis



OVER 80% OF ALL FRACTURES in people 50+ are caused by osteoporosis



ONE IN THREE HIP FRACTURE PATIENTS will re-fracture within one year



Women and men alike **BEGIN TO LOSE BONE IN THEIR MID-30S**



28% OF WOMEN and **37% OF MEN** who suffer a hip fracture will die within one year

OSTEOPOROSIS: CANADIAN STATS

(WWW.OSTEOPOROSIS.CA ACCESSED OCT. 2019)

Prevalence in Canada:

- 1 in 3 women
- 1 in 5 men

Compressed Vertebrae

- Pain, mobility

Acute Care Cost:

- > \$2.3 billion as of 2010
- Plus outpt and LTC: ~\$3.9 billion

Hip Fracture

- Mortality, morbidity

TABLE 12: QUÉBEC: Projected numbers of hip fractures and associated costs to 2035

| YEAR | 2007 | 2010 | 2015 | 2016 | 2020 | 2023 | 2025 | 2030 | 2035 |
|-------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Number of hip fractures | 7,204 | 7,546 | 8,117 | 8,231 | 8,687 | 9,030 | 9,258 | 9,829 | 10,399 |
| Cost in 2010 dollars | \$154,453,760 | \$161,793,403 | \$174,026,140 | \$176,472,688 | \$186,258,878 | \$193,598,521 | \$198,491,616 | \$210,724,354 | \$222,957,092 |

HIP FRACTURES

Lifetime risk of sustaining a hip fracture is

- 75% ♀
- 25% ♂

<https://www.iofbonehealth.org/facts-statistics>

Hip fractures:

- 28% ♀ and 37% ♂ will die within 1 year of their hip fracture
- 50% of survivors are unable to walk unassisted
- 25% of survivors are confined to long-term care in a nursing home

Osteoporosis is a Pediatric Disease

TOWARD PREVENTION: UNDERSTANDING THE CAUSES OF OSTEOPOROSIS

**Bone density
and genes**

- 35%
influence

Environment

- 65%
influence

UNDERSTANDING THE CAUSES OF OSTEOPOROSIS: ENVIRONMENTAL INFLUENCES

Calcium and vitamin D

- Bone strength in later life dependent on bone-building during childhood and adolescence

Estrogen deficiency in women

- Greater bone loss for women during menopause (estrogen production diminishes – 20% bone loss 6-8 yr post menopause)
- Men have greater bone density and smaller losses

UNDERSTANDING THE CAUSES OF OSTEOPOROSIS: ENVIRONMENTAL INFLUENCES

Lack of physical activity

- Active bones are denser
- Weight-bearing exercises are best

Low body weight

Tobacco smoke and alcohol

Dietary Excess

- Protein, sodium, caffeine, soft drinks, vitamin A

Dietary inadequacy

- Ca, Vit D, Protein, vitamin K, folate, vitamin B12, vitamin B6

RISK AND PROTECTIVE FACTORS THAT CORRELATE WITH OSTEOPOROSIS

Table C8–2

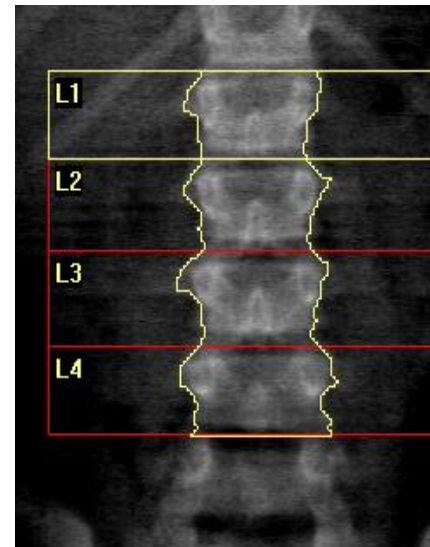
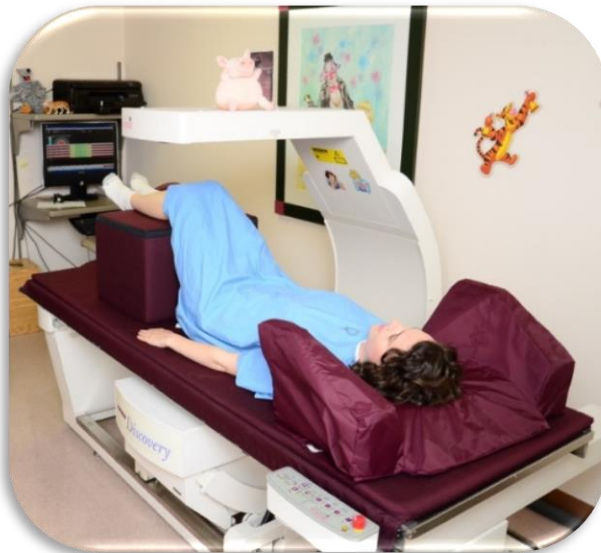
Risk and Protective Factors That Correlate with Osteoporosis

| Risk Factors | Protective Factors |
|--|-------------------------------|
| High Correlation | |
| Advanced age | Black race |
| Alcoholism, heavy drinking | Estrogens, long-term use |
| Chronic steroid use | |
| Female gender | |
| Rheumatoid arthritis | |
| Surgical removal of ovaries or testes | |
| Thinness or weight loss | |
| White race | |
| Moderate Correlation | |
| Chronic thyroid hormone use | Having given birth |
| Cigarette smoking | High body weight |
| Diabetes (insulin dependent, type 1) | High-calcium diet |
| Early menopause | Regular physical activity |
| Excessive antacid use | |
| Family history of osteoporosis | |
| Low-calcium diet | |
| Sedentary lifestyle | |
| Vitamin D deficiency | |
| Probably Important But Not Yet Proven | |
| Alcohol taken in moderation | Adequate vitamin K intake |
| Caffeine intake | |
| High-fibre diet | Low-sodium diet (later years) |
| High blood homocysteine | |
| High-protein diet | |
| Lactose intolerance | |

MEASURING BONE DENSITY

DXA

- Measures the amount of X-rays absorbed by your bones
- 2 distinct X-ray beams
 - one beam is absorbed mainly by soft tissue, the other by bone



LOW BONE MASS

Osteopenia

Bone mineral density 1–2.5 SD below the mean established for a young normal population

(T Score: -1 to -2.5)

Osteoporosis

Bone mineral density > 2.5 SD below the mean established for a young normal population

(T Score: > -2.5)

BONE GROWTH TEAM

Players

- protein - collagen
- minerals - Ca, P, Mg, F

Coaches

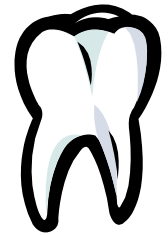
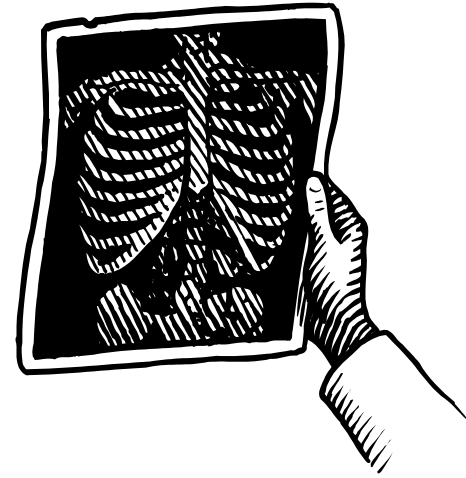
- vitamin D, parathyroid hormone
- calcitonin

Assistants/Scouts

- Vitamins: A, C, K, Bs....

CALCIUM (CA)

- Most abundant mineral in the body
- 99% stored in bones and teeth
 - Part of bone structure (hydroxyapatite)
 - Calcium reserve
 - Maintain bone turnover (building/breaking)

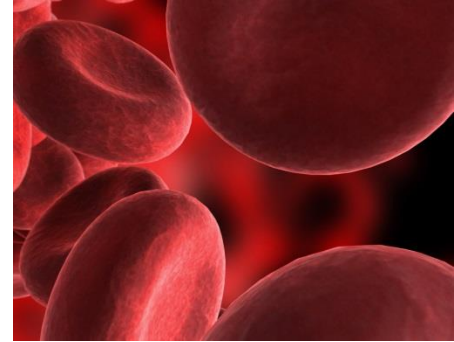


CALCIUM ROLES

Helps maintain normal blood pressure

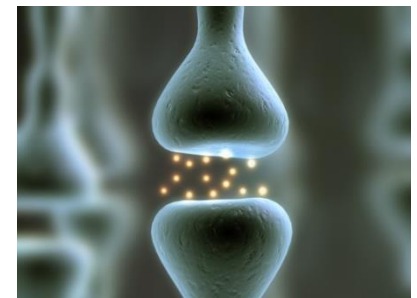
- **Extracellular calcium**

- Participates in blood clotting
 - » Calcium + vitamin K + protein called fibrinogen



- **Intracellular calcium**

- Regulation of muscle contraction
- Transmission of nerve impulses
- Secretion of hormones
- Activation of some enzyme reactions





TRUE OR FALSE

Inadequate
calcium
intake shows
up as low
blood
calcium.

CALCIUM REGULATION

ACUTE

blood Ca *MUST* be maintained

- tetany/rigor

↑↓ blood Ca is a problem of regulation NOT DIET

CHRONIC

- ▶ low dietary Ca - robs the “bone RRSP”

i.e. ↓ bone mineralization

- ▶ stunting in children

- ▶ osteoporosis

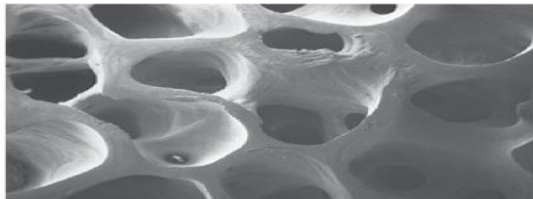
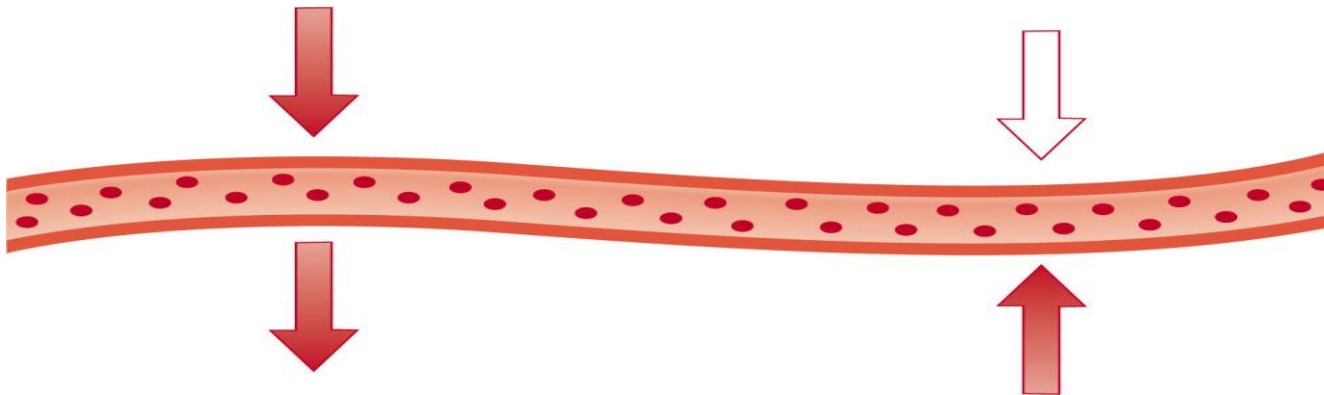
MAINTAINING BLOOD CALCIUM



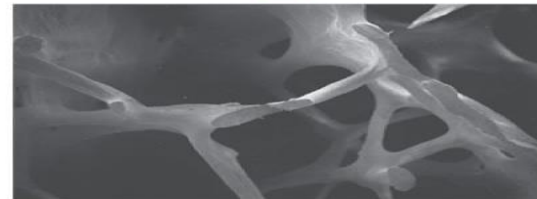
With an adequate intake of calcium-rich food, blood calcium remains normal . . .



With a dietary deficiency, blood calcium still remains normal . . .



. . . and bones deposit calcium. The result is strong, dense bones.



. . . because bones give up calcium to the blood. The result is weak, osteoporotic bones.

CALCIUM ABSORPTION

- Differs during different stages in life
- Growth, pregnancy & lactation
 - Absorb $\approx 50\text{-}60\%$ of dietary calcium
- Maintenance (adulthood)
 - Absorb $\approx 30\%$ of dietary calcium
 - Body adjusts absorption as dietary calcium decreases



CALCIUM ABSORPTION

Increased by:

- anabolic hormones
- gastric acid (meal)
- vitamin D
- low phosphate intake
- lactose (in infants only)

Decreased by:

- aging
- lack of stomach acid
- vitamin D deficiency
- high phosphate intake
- high insoluble fibre diet
- phytates, oxalates
- high protein intake

How much calcium do we need?

Deficiency:

- Stunted growth in children
- Bone loss (osteoporosis)

| Age group | Recommended Dietary Allowance (RDA) per day | Tolerable Upper Intake Level (UL) per day |
|-----------------------|---|---|
| Infants 0-6 months | 200 mg * | 1000 mg |
| Infants 7-12 months | 260 mg * | 1500 mg |
| Children 1-3 years | 700 mg | 2500 mg |
| Children 4-8 years | 1000 mg | 2500 mg |
| Children 9-18 years | 1300 mg | 3000 mg |
| Adults 19-50 years | 1000 mg | 2500 mg |
| Adults 51-70 years | 1000 mg | 2000 mg |
| Men | 1200 mg | 2000 mg |
| Women | | |
| Adults > 70 years | 1200 mg | 2000 mg |
| Pregnancy & Lactation | 1300 mg | 3000 mg |
| 14-18 years | 1000 mg | |
| 19-50 years | | |

* Adequate Intake rather than Recommended Dietary Allowance.

Toxicity:

- Constipation
- Interference with absorption of other minerals
- Increased risk of kidney stones

Eat well. Live well.

Eat a variety of healthy foods each day

Have plenty
of vegetables
and fruits

Eat protein
foods

Make water
your drink
of choice

Choose
whole grain
foods



Discover your food guide at

Canada.ca/FoodGuide

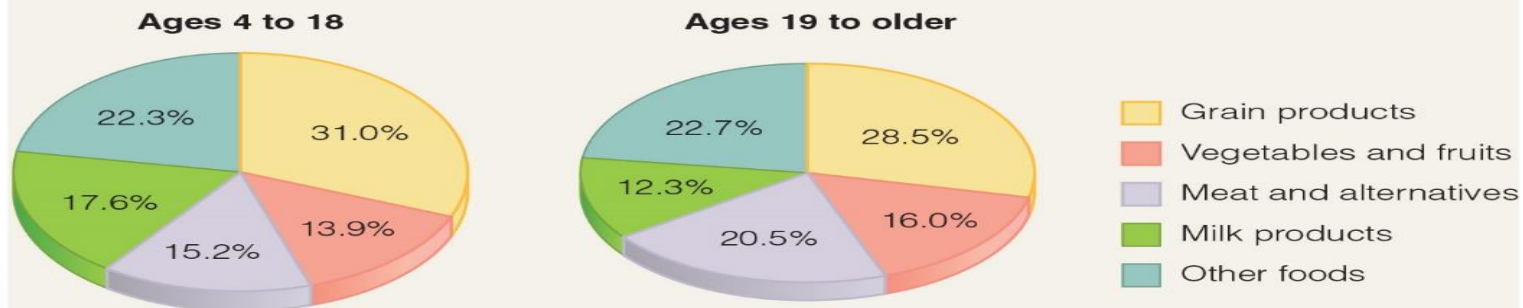
Food Feature: Meeting the Need for Calcium

- Low calcium intake
 - Associated with osteoporosis, high blood pressure, colon cancer, kidney stones, lead poisoning

Figure 8–12

Milk and Alternatives Group Average Intakes^a

On average, in Canada, between 65 and 85 percent of females and between 45 and 85 percent of males 17 years old and older fall far short of meeting the recommendation to obtain a minimum of two cups of milk, yogurt, or cheese each day.

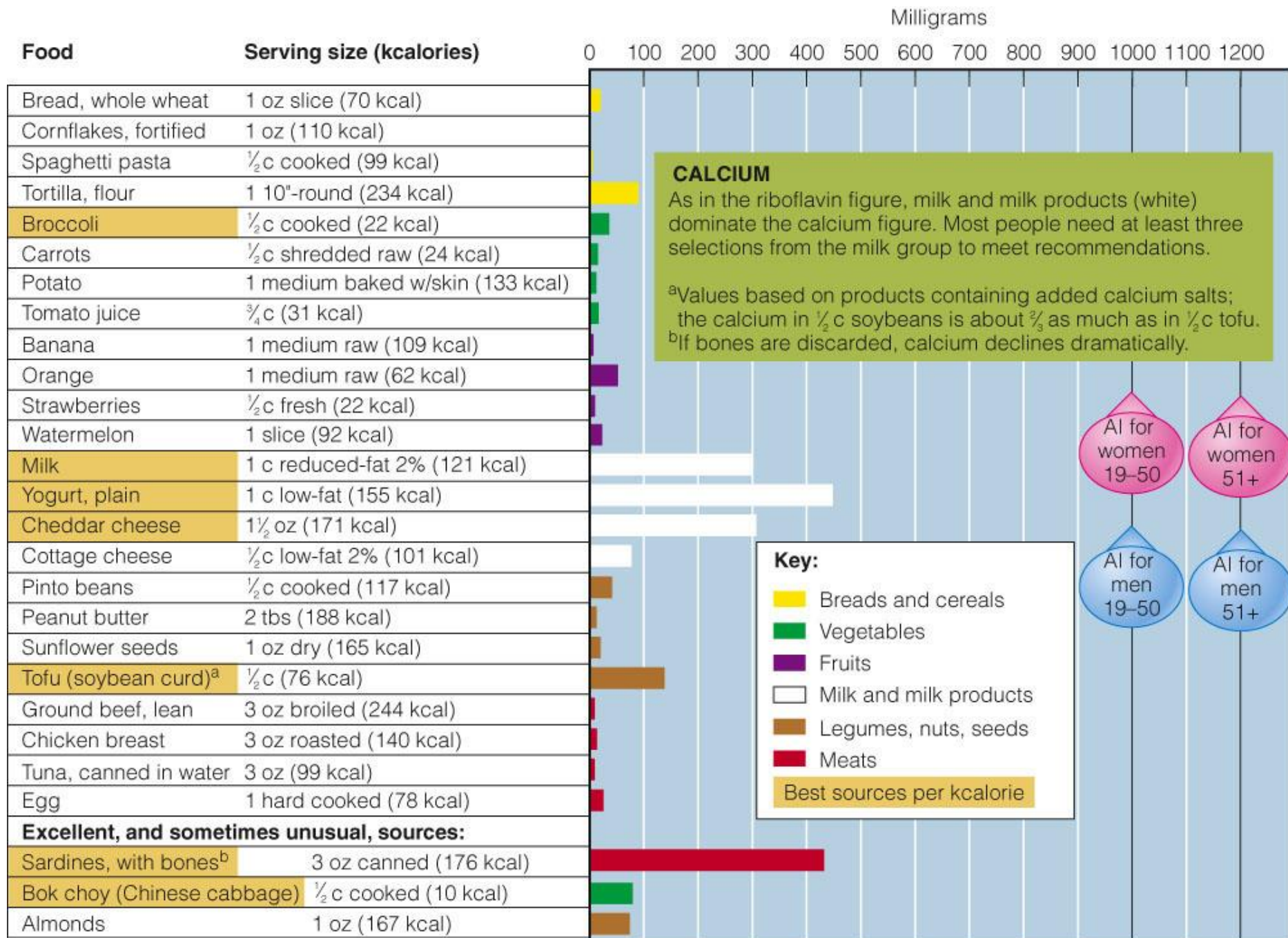


Note: Excludes women who were pregnant or breastfeeding.

^a*Includes all forms of milk, yogurt, cheese, and frozen dairy desserts.*

Source: Findings from the Canadian Community Overview of Canadians' Eating Habits 2004 by Didier Garriguet.

Data Source: 2004 Canadian Community Health Survey: Nutrition.



The presence of calcium within a food does not ensure that the food is a good source of calcium

Bioavailability: degree to which the particular nutrient from a food source can be utilized

- **Insoluble fiber:** binds cations
- **Phytates:** legumes, nuts, and cereals
- **Oxalates:** spinach, beets, celery, eggplant, okra, berries, nuts, tea, cocoa

FOOD FEATURE: MEETING THE NEED FOR CALCIUM

Milk & fortified plant
bev.

Milk and cheese
provide about 50% of
calcium in the
adult diet

Vegetables

Binders in some
vegetables
inhibit calcium
absorption

Figure 8–11

Calcium Absorption from Food Sources



© Cengage Learning

EXAMPLES OF SERVINGS AND BIOAVAILABLE CA

| Food | Portion mg | [Ca] mg | | Abs % |
|---------------------|-----------------|------------|----|--------|
| Milk | 250 mL | 300 | 32 | 90-100 |
| Soy bev. fortified | 250 mL | 300 | 31 | 90-100 |
| Turnip greens | 125 ml (cooked) | 200 | 50 | 100 |
| Broccoli | 375 ml | 100 | 53 | 50 |
| Tofu, firm | 100 g | 190 | 31 | 57 |
| Beans, white kidney | 100 g | 154 | 17 | 26 |

URINARY CALCIUM EXCRETION

Influenced by:

- Calcium intake
- Age
- Caffeine
 - Offset by milk in your coffee
- Dietary sodium
 - Individuals with hypercalciuria should be advised to restrict sodium intakes to minimize urinary calcium excretion
- Dietary protein
 - Excretion of sulphate from sulphur amino acids

CALCIUM SUPPLEMENTS



NEVER to displace Ca intake from diet

Smaller doses absorbed better than large doses

May be useful for people at risk for inadequate Ca intake

- Lactose intolerance
- Milk allergy
- Vegan
- Are there other alternatives?

CALCIUM SUPPLEMENTS



Antacids

- Tums
- Rolaids

Caution: Bone meal, oyster shell, coral, dolomite

- Contaminants – Lead
- Not well absorbed

Calcium citrate, gluconate, malate, carbonate etc.

- well absorbed (~30%)
- Take $\leq 500\text{mg}$ at a time

Multivitamins

- Mineral interactions decrease absorption

Ca Chews

TOO MUCH OF A GOOD THING?

ADULT CALCIUM UL = 2000-2500 MG

Risk of calcification of blood vessels...CVD

Compromised Iron Status (and other minerals) Ca inhibits absorption

Kidney stones

Vitamin D toxicity and increased serum Ca if supplements contain vitamin D

Exposure to contaminants if supplements are from bone meal or dolomite



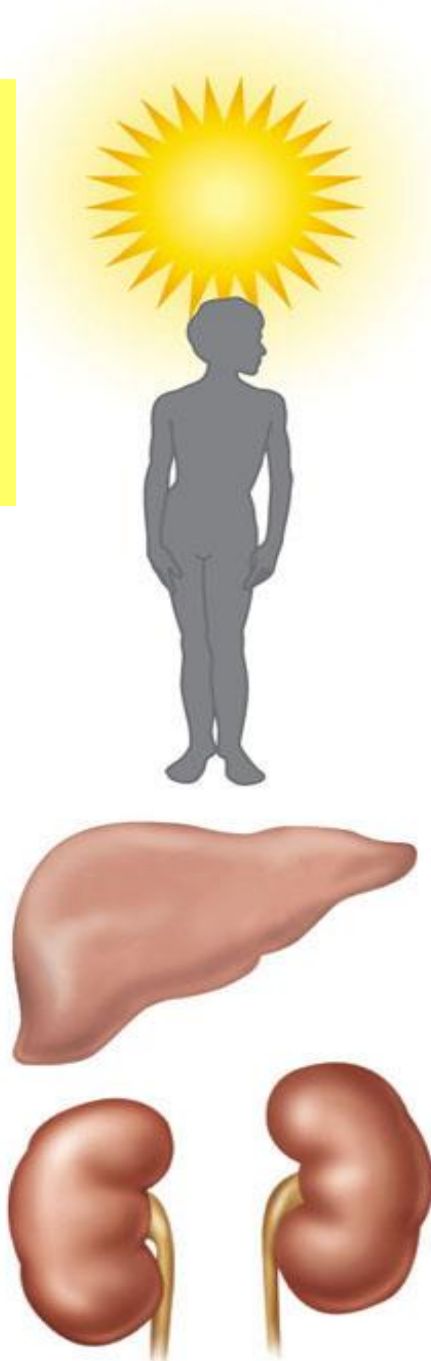
VITAMIN D



TRUE OR FALSE

We can
absorb
Vitamin D
from the sun?

Extreme latitudes ($> 40^{\circ}$ N or $> 40^{\circ}$ S) receive inadequate sun in the winter to make vitamin D



In the skin:

7-dehydrocholesterol
(a precursor made in the liver from cholesterol)

Ultraviolet
light from
the sun

Previtamin D₃

Foods

Vitamin D₃
(an inactive form)

D3 cholecalciferol in
animal foods
(D2 ergocalciferol in
plant foods)

In the liver:

Hydroxylation

25-hydroxy vitamin D₃

calcidiol

In the kidneys:

Hydroxylation

1,25-dihydroxy vitamin D₃
(active form)

calcitriol

VITAMIN D

Functions of vitamin D

- Required for calcium absorption (calbindin)
- Regulates blood calcium levels
- Stimulates osteoclasts
- Necessary for bone calcification
- New functions: immunity and cell differentiation

VITAMIN D ACTIONS

Intestine

- increase Ca absorption from diet





Kidney

- decrease Ca excretion in the urine

Bone

- increase Ca release from bone....but...?

CALCIUM BALANCE

| | | | |
|--|---|---|--|
| Low blood calcium Signals the parathyroid glands to secrete parathyroid hormone into the blood | |  Thyroid gland with parathyroid glands embedded | High blood calcium Signals the thyroid gland to secrete calcitonin |
| Vitamin D Stimulates calcium reabsorption from the kidneys into the blood Enhances calcium absorption in the intestines | Parathyroid hormone Stimulates the activation of vitamin D Stimulates calcium reabsorption from the kidneys into the blood | |  Kidneys |
| | |  Intestines | Limits calcium absorption in the intestines |
| | | |  Bones |
| End results Raised blood calcium Raised blood calcium Parathyroid hormone secretion inhibited | | End results Lower blood calcium Calcitonin secretion inhibited | |

NOTE: Calcitonin plays a major role in defending infants and young children against the dangers of rising blood calcium that can occur when regular feedings of milk deliver large quantities of calcium to a small body. In contrast, calcitonin plays a relatively minor role in adults because their absorption of calcium is less efficient and their bodies are larger, making elevated blood calcium unlikely.

CALCIUM BALANCE?

1. Calcitonin is released when blood calcium is ____.
2. What effect does calcitonin have on vitamin D, and the kidneys?
3. Parathyroid hormone (PTH) _____ vitamin D activation. This enhances calcium _____ in the intestines. Osteoclast cells release _____ into the blood. PTH _____ blood calcium levels.

IS VITAMIN D A

Hormone?

Travels in the blood

Activated in the liver and kidneys

Acts on intestine, kidney, bones...

to increase Ca availability for bone mineralization and remodeling

Vitamin?

It is essential in the diet

- performs a specific function
- absence results in deficiency

We can't synthesize as much as we need

Vitamin is activated to a hormone



TRUE OR FALSE

Vitamin D is
naturally
found in milk.

VITAMIN D: RECOMMENDATIONS AND SOURCES

Recommendations

- Assume no vitamin D synthesis from the sun
- RDA
 - 19-70 yr: 15ug or 600 IU/day
 - > 70 increases to 20ug or 800 IU/day
- New food label DRI: 20 ug

Sun exposure (5–10 min, 3x/week)

- Skin cancer risk increases
- Many factors limit synthesis
- Toxicity unlikely

Few natural food sources

How much vitamin D do we need?

| Age group | Recommended Dietary Allowance (RDA) per day | Tolerable Upper Intake Level (UL) per day |
|--------------------------------|---|---|
| Infants 0-6 months | 400 IU (10 mcg)* | 1000 IU (25 mcg) |
| Infants 7-12 months | 400 IU (10 mcg) * | 1500 IU (38 mcg) |
| Children 1-3 years | 600 IU (15 mcg) | 2500 IU (63 mcg) |
| Children 4-8 years | 600 IU (15 mcg) | 3000 IU (75 mcg) |
| Children and Adults 9-70 years | 600 IU (15 mcg) | 4000 IU (100 mcg) |
| Adults > 70 years | 800 IU (20 mcg) | 4000 IU (100 mcg) |
| Pregnancy & Lactation | 600 IU (15 mcg) | 4000 IU (100 mcg) |

Deficiency:

- Abnormal bone growth (rickets in children; osteomalacia or osteoporosis in adults)
- Malformed teeth
- Muscle spasms

Toxicity:

- Elevated blood calcium
- Calcification of soft tissues
- Excessive thirst
- Headache
- Nausea
- Weakness

* Adequate Intake rather than Recommended Dietary Allowance.

Source: Health Canada, 2019

RDA assume that a person's sun exposure is inadequate.

*revised 2012

Nutrition Facts Valeur nutritive

Per 1 cup (250 mL) / pour 1 tasse (250 mL)

| Amount Teneur | % Daily Value % valeur quotidienne |
|------------------|---------------------------------------|
|------------------|---------------------------------------|

Calories / Calories 160

Fat / Lipides 6 g 9 %

Saturated / saturés 1 g 4 %
+ Trans / trans 0 g

Polyunsaturated / polyinsaturés 2.5 g

Omega-6 / oméga-6 2 g

Omega-3 / oméga-3 0.3 g

Monounsaturated / monoinsaturés 2 g

Cholesterol / Cholestérol 0 mg

Sodium / Sodium 140 mg 6 %

Potassium / Potassium 380 mg 11 %

Carbohydrate / Glucides 20 g 7 %

Fibre / Fibres 1 g 4 %

Sugars / Sucres 19 g

Lactose / Lactose 0 g

Protein / Protéines 7 g

Vitamin A / Vitamine A 10 %

Vitamin C / Vitamine C 0 %

Calcium / Calcium 30 %

Iron / Fer 10 %

Vitamin D / Vitamine D 45 %

Thiamine / Thiamine 8 %

Riboflavin / Riboflavine 25 %

Niacin / Niacine 10 %

Vitamin B6 / Vitamine B6 6 %

Folate / Folate 6 %

Vitamin B12 / Vitamine B12 50 %

Pantothenate / Pantothénate 15 %

Phosphorus / Phosphore 10 %

Magnesium / Magnésium 20 %

Zinc / Zinc 10 %

Valeur nutritive Nutrition Facts

Par portion de 1 tasse (250 mL) /
Per 1 cup (250 mL) serving

| Teneur Amount | % valeur quotidienne % Daily Value |
|------------------|---------------------------------------|
|------------------|---------------------------------------|

Calories / Calories 110 4 %

Lipides / Fat 2.5 g 8 %

saturés / Saturated 1.5 g
+ trans / Trans 0.0 g

Cholestérol / Cholesterol 10 mg 5 %

Sodium / Sodium 120 mg 4 %

Glucides / Carbohydrate 12 g 0 %

Fibres / Fibre 0 g

Sucres / Sugars 12 g

Protéines / Protein 9 g

Vitamine A / Vitamin A 10 %

Vitamine C / Vitamin C 0 %

Calcium / Calcium 30 %

Fer / Iron 0 %

Vitamine D / Vitamin D 45 %

PASTEURISÉ
Ingrédients : Lait partiellement écrémé, palmitate de
vitamine A et vitamine D3.
Contient : Lait

PASTEURIZED
Ingredients: Partly skimmed milk, Vitamin A palmitate
and Vitamin D3.
Contains: Milk

Nutrition Facts Valeur nutritive

Serving Size 1 cup (250 mL)
Portion 1 tasse (250 mL)

| Amount Teneur | % Daily Value % valeur quotidienne |
|------------------|---------------------------------------|
|------------------|---------------------------------------|

Calories / Calories 110

Fat / Lipides 2.5 g 4 %

Saturated / saturés 0.1 g 1 %
+ Trans / trans 0 g

Polyunsaturated / polyinsaturés 0.3 g

Omega-6 / oméga-6 0.3 g

Omega-3 / oméga-3 0 g

Monounsaturated / monoinsaturés 0.6 g

Cholesterol / Cholestérol 0 mg

Sodium / Sodium 80 mg 3 %

Potassium / Potassium 85 mg 2 %

Carbohydrate / Glucides 18 g 6 %

Fibre / Fibres 2 g 8 %

Sugars / Sucres 6 g

Protein / Protéines 4 g

Vitamin A / Vitamine A 10 %

Vitamin C / Vitamine C 0 %

Calcium / Calcium 30 %

Iron / Fer 4 %

Vitamin D / Vitamine D 45 %

Riboflavin / Riboflavine 25 %

Vitamin B12 / Vitamine B12 50 %

Phosphorus / Phosphore 20 %

Magnesium / Magnésium 10 %

Zinc / Zinc 10 %

INGREDIENTS: OAT BASE (FILTERED WATER, GLUTEN-FREE OATS),
SUNFLOWER OIL, GELLAN GUM, SEA SALT, NATURAL FLAVOUR, AMYLASE,
VITAMINS AND MINERALS (TRICALCIUM PHOSPHATE, VITAMIN A PALMITATE,
VITAMIN D2, RIBOFLAVIN, VITAMIN B12, ZINC GLUCONATE).

INGRÉDIENTS : BASE D'AVOINE (EAU FILTRÉE, AVOINE SANS GLUTEN),
HUILE DE TOURNESOL, GOMME GELLANE, SEL MARIN, ARÔME NATUREL,
AMYLASE, VITAMINES ET MINÉRAUX (PHOSPHATE TRICALCIQUE, PALMITATE DE
VITAMINE A, VITAMINE D2, RIBOFLAVINE, VITAMINE B12, GLUCONATE DE ZINC).
PRODUCED IN A FACILITY THAT ALSO PROCESSES TREE NUTS AND SOY.
PRODUIT PRÉPARÉ DANS UNE INSTALLATION QUI TRAITE ÉGALEMENT DES NOIX ET DU SOJA.

Nutrition Facts Valeur nutritive

Per 240 mL / per 240 mL

| Amount Teneur | % Daily Value % valeur quotidienne |
|------------------|---------------------------------------|
|------------------|---------------------------------------|

Calories / Calories 120

Fat / Lipides 4.5g

Saturated / saturés 0.3g
+ Trans / trans 0g

Cholesterol / Cholestérol 0mg

Sodium / Sodium 110mg

Carbohydrate / Glucides 13g

Fibre / Fibres 0g

Sugars / Sucres 12g

Protein / Protéines 8g

Vitamin A / Vitamine A

Vitamin C / Vitamine C

Calcium / Calcium

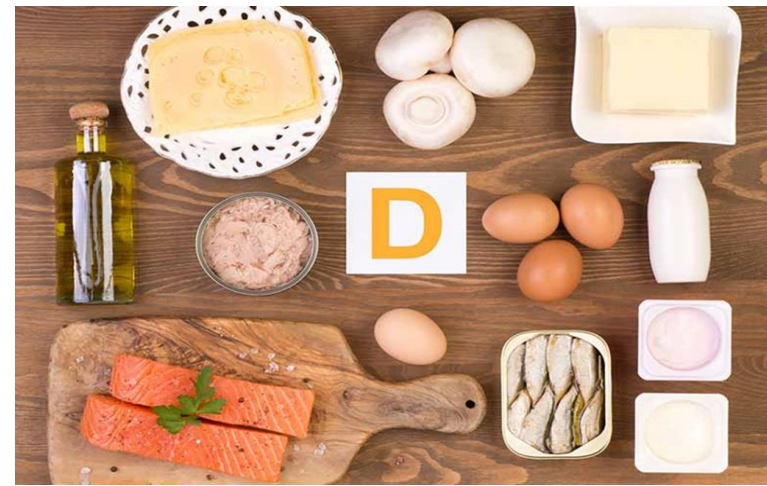
Iron / Fer

INGREDIENTS: Pea Base (Water, Pea Protein), Sugar,
Sunflower Oil, Organic Vanilla Extract, Sea Salt,
Dipotassium Phosphate, Sunflower Lecithin, Natural
Flavours, Organic Guar Gum, Gellan Gum

INGRÉDIENTS : Pâte de Pois
(Eau, Protéine de Pois), Sucre,
Huile de Tournesol, Extrait de
Vanille Biologique, Sel de Mer,
Phosphate Dipotassique, Lécithine
de Tournesol, Arômes Naturels,
Gomme de Guar Biologique,
Gomme Gellane

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VITAMIN D: SOURCES



- **Naturally occurring vitamin D in food:**
 - **Fatty fish** (salmon (3oz = 450 IU), sardines) best sources
 - Some in **egg yolk (40 IU)**, liver (3 oz = 40 IU)
 - Cod liver oil: 1 tablespoon 1,360 IU
- Most vitamin D is obtained from **fortified foods** such as milk, fortified beverages and margarine
- Vegetarians not consuming dairy foods may receive vitamin D from the sun, fortified plant-based milks, juice or supplements

VITAMIN D TOXICITY

What if you consume too much vitamin D?

- Skin synthesis (sun exposure) cannot cause excess vitamin D formation
- Can occur from excess supplements or fish oils
- Results in **hypercalcemia** and calcification of soft tissues, potentially fatal
- UL set at 100 µg/d (4000 IU)

FACTORS THAT REDUCE HOW MUCH VITAMIN D YOUR BODY MAKES INCLUDE:

- Limited sun exposure
 - Sunscreen use Or little skin exposure to sun
 - Living at a high latitude (most of Canada)
 - Staying indoors
 - Cloud cover, smog
- Dark skin: people with darker skin absorb less of the sun's ultraviolet rays
- Age, especially if >65y
- Digestion issues – eg: Crohn's or celiac disease, bariatric surgery
- Liver and kidney disease

<https://www.healthlinkbc.ca/health-topics/za1487>

<https://www.canada.ca/en/health-canada/services/nutrients/vitamin-d.html>

VITAMIN D DEFICIENCY IN CANADA

- Canadians more at risk for vitamin D deficiency than previously thought
- 2013: 32% of Canadians had insufficient vitamin D levels and 10% of Canadians were deficient
- No synthesis in winter
- Reliance on fortification
- Pregnant milk restrictors – decrease birth weight and fetal bone growth
- Sunscreen recommendations....

“-Vitamin D supplements

If you are over 50 years old, Health Canada recommends that you take a daily vitamin D supplement of 400 IU (equivalent to 10 µg).

Speak to your health care provider about taking a vitamin D supplement if you think you are not getting enough of it “

Oct. 2019

SIGNS OF VITAMIN D DEFICIENCY

In adults, vitamin D deficiency **isn't** obvious.
But you **might** have:



Mood Changes



Bone Loss



Muscle Cramps
(or weakness)



Bone & Joint Pain
(especially in your back)



Fatigue



Cleveland Clinic

<https://my.clevelandclinic.org/health/articles/15050-vitamin-d--vitamin-d-deficiency>

VITAMIN D DEFICIENCY

Osteomalacia

Vitamin D deficiency in **adults**, associated with vitamin D intake below 2.5 ug/day

Decreased Ca absorption

Bone matrix is lost so defective mineralization

- ↓ bone remodeling
- **softening** of bone

Bone pain

Hip fracture risk



Unmasking Osteomalacia

Rickets



Vitamin D deficiency in **children** in which growing bones don't mineralize properly.

- softening of bone
- bowed legs
- stunting
- teeth problems

Prevalence decreased due to milk fortification since the 1940s

Re-emerging in exclusively breast fed infants not receiving supplements

MINERALS IN BONE

Phosphorous

- With Ca forms hydroxyapatite mineral of bone
- High intake decreases Ca absorption
- Typical intake is higher than RDA

Magnesium

- Bone structure and regulation of mineralization, vitamin D metabolism
- ATP synthesis
- Blood clotting, muscle contraction (Ca promotes, Mg inhibits), blood pressure regulation

VITAMINS AND BONE

Vitamin K

- Co-enzyme synthesize bone protein
- Deficiency – cannot bind minerals

Vitamin A

- Bone remodeling, osteoclast activity(But reduced BMD with supplements above UL...)

Vitamin C

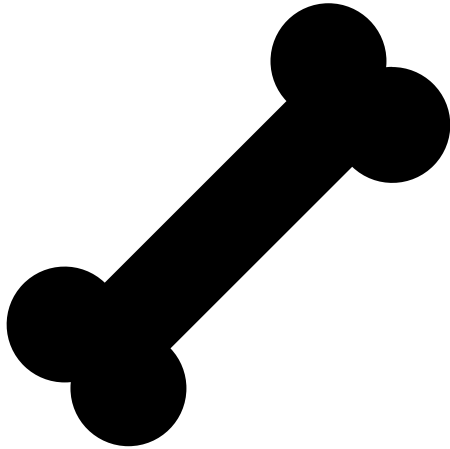
- Cofactor for collagen synthesis (organic matrix)

PREVENTION OF OSTEOPOROSIS

Many investigators view osteoporosis in part as a pediatric disease

To prevent osteoporosis, focus should be placed on maximizing peak bone mass

Insuring that maximal skeletal density has been achieved will prolong the time it takes for bone density to fall below the fracture threshold in response to age-related bone losses



PHYSICAL ACTIVITY AND BONE DENSITY

Most important factor supporting children's bone growth

Lasting benefits for older women

Working muscles pull on bone, causing more trabeculae and bones grow denser

Hormones supporting muscle growth also support bone building

Bones of active people are denser and stronger than sedentary people

Conclusion: weight training improves bone density



OSTEOPOROSIS DIAGNOSIS AND MEDICAL TREATMENT



DEXA scan

Lifestyle plus Drug therapies

Estrogen therapy

- May increases risk for heart disease, breast cancer

OSTEOPOROSIS PREVENTION/TREATMENT

Lifestyle:

Nutrition: Ca, Vit D and.....

Physical activity- including wt training, wt bearing exercise

Quit smoking, decrease alcohol

Treatment:

- Anti-resorptive agents inhibit osteoclasts
 - E.g. Bisphosphonates
 - Hormone replacements (including SERMs eg Raloxifene)
- Anabolic agents to stimulate osteoblasts
 - E.g. PTH

CASE STUDY: LOW VIT. D

Joan is a 90-year-old Caucasian woman who has recently been diagnosed with osteoporosis after a fall that broke her hip. She is 64 inches tall and weighs 115 pounds. Lately, she has been complaining about muscle pain in her legs. She eats a limited diet due to a chronic low appetite. A recent blood test shows Joan's serum vitamin D level is below normal. Her daily diet includes juice or fruit and toast with butter for breakfast, cheese sandwich and fruit for lunch, and salad or a frozen vegetable with meat or poultry for dinner. She dislikes most fish except canned tuna, and she often drinks a glass of fortified milk before going to bed at night. She lives in Quebec City and she spends most days indoors..

What promotes Vit. D deficiency in the elderly?

Of the foods Joan eats, which is the best source of vitamin D?

Because Joan is concerned about skin cancer, she uses a sunscreen when she is outside. At what SPF level will sunscreen start to interfere with vitamin D synthesis?

Joan's low serum vitamin D levels and low dietary vitamin D intake indicate that she is vitamin D deficient. She needs a vitamin D supplement to raise blood vitamin D levels and to lower the risk of falls. Based upon her vitamin D RDA, what supplement dose should she take daily?