

Our Changing Metabolic Needs As we Age

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Definition of Metabolism and its parts

What is Metabolism?

The sum of controlled chemical reactions that occur within a cell (microbial cell)

- **Metabolism is composed of Catabolism and Anabolism**
- **Catabolism (breakdown)**
Provides energy and building blocks for anabolism and other cellular functions
- **Anabolism (biosynthesis)**
Uses energy and building blocks to build larger molecules, macromolecules, and cell structures

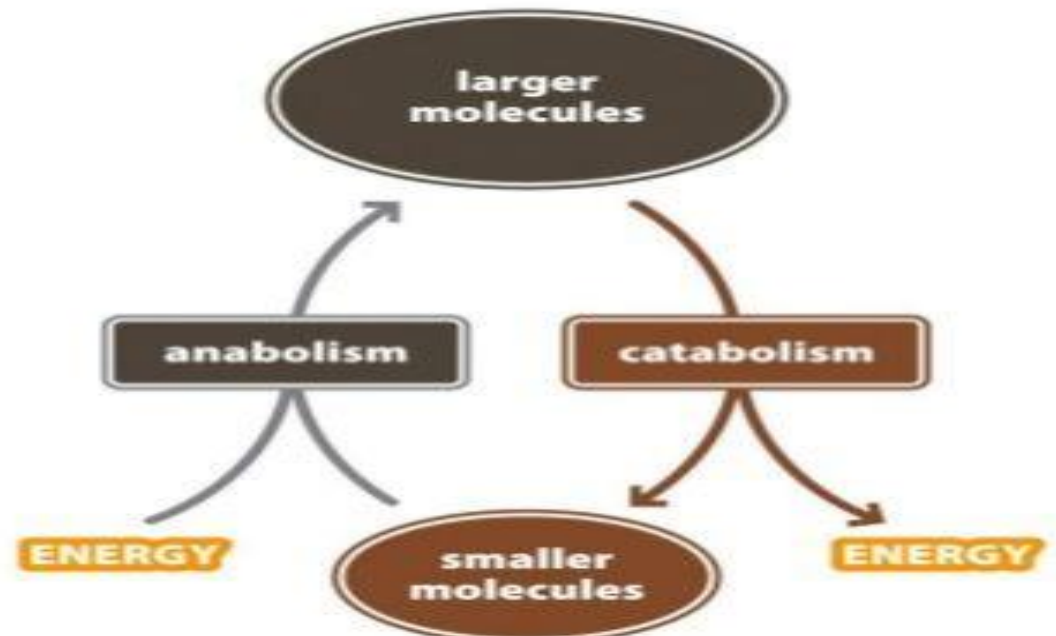
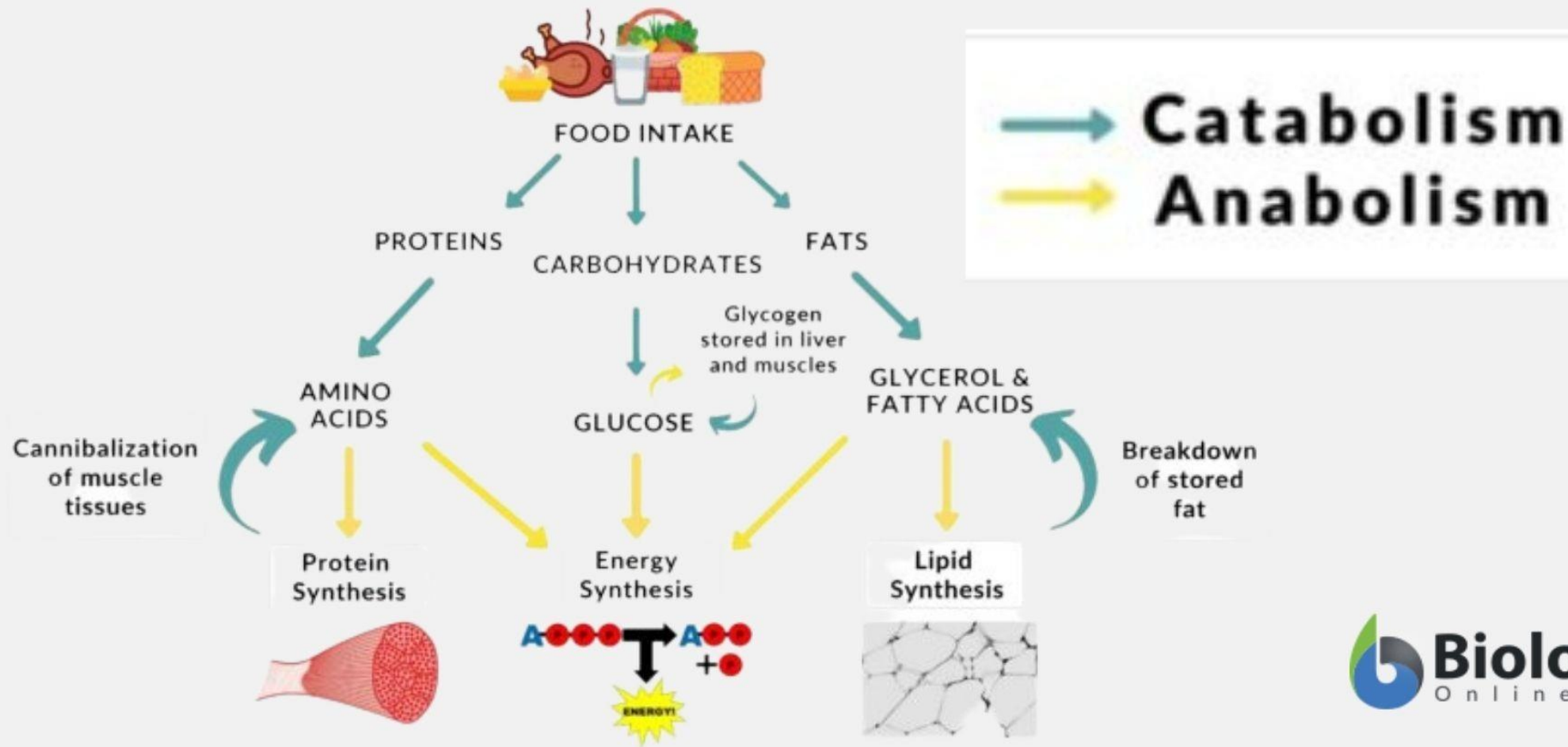


Figure 3.1 Microbiology: A Clinical Approach (© Garland Science)

Metabolism



Metabolism: why it is important?

- **Metabolism** is the biochemical process of combining nutrients with oxygen to release the energy our bodies need to function.
- Your resting **metabolic** rate (RMR) is the number of calories your body burns to maintain vital body functions such as heart rate, brain function and breathing.
- In the context of aging (structurally and physiologically), metabolism is one of several areas that experience change.
- All systems experience change as we age: musculoskeletal, cardiovascular, skin, respiratory, renal, gastrointestinal, endocrine, reproductive, neurological, sensory, and immunological.

Age-Related Physiological Changes

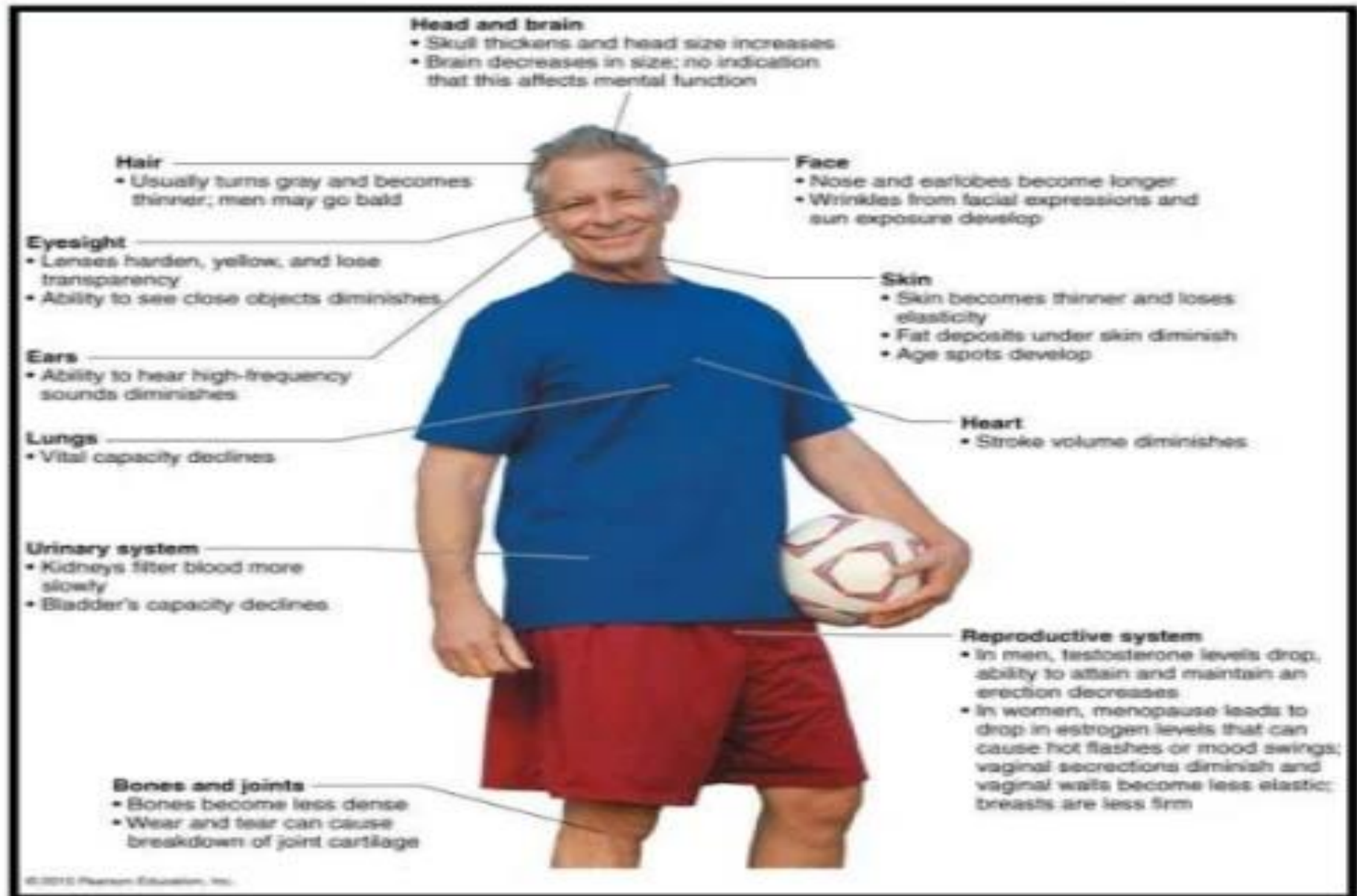
Three Groups of Physiological Changes

- 1) Changes in autonomic functions and cellular homeostasis e.g. temperature, blood volumes and Endocrine changes
- 2) Reduction in organic mass e.g. brain, liver, kidneys, bones and muscles
- 3) Reduction in organic functional reserve e.g. lungs and heart

Systems Affected

- Cardiovascular system
- Respiratory System
- Genitourinary System
- Gastrointestinal System
- Endocrine System
- Skin and Musculoskeletal System
- Nervous System
- Body temperature regulation
- Immune System
- Psychological Changes

NORMAL CHANGES DURING AGEING



What are the biggest factors affecting Metabolism as we move passed middle age?

- **Age**(some sources say over 55 and others over 60)
- **Illness like Diabetes**, and other autoimmune illnesses
- **Thyroid disease**: underactive thyroid
- **Diminished activity**(assuming food consumption stays constant)
- **Height**(Metabolism increases with increase height, weight, surface area)
- **Loss of muscle mass** (loss means fewer calories burned)
- **Even changes in NEAT**(non-exercise activity thermogenesis)
- **Poor sleep hygiene**(connected to hormonal/metabolic changes)

Physiological Aging Changes

SENSORY

- ↓ salivation
- ↓ taste buds for sweet & salty; most tastes are bitter / sour
- ↓ visual acuity
- ↓ sensitivity to sound
- ↓ response to pain
- ↓ thirst sensation
- ↓ motor skills
- Changes in dentition

CENTRAL NERVOUS SYSTEM

- ↓ neuronal density
- ↓ reflexes
- ↓ sympathetic response
- ↓ proprioception
- ↓ baroreceptor response (postural hypotension)

GASTROINTESTINAL

- ↓ gastrointestinal absorption
- ↓ gastric emptying
- ↓ hepatic blood flow / drug clearance
- ↓ drug absorption
- ↓ motility
- ↓ transit time

Sources: Graf, C. (2006). Functional decline in hospitalized older adults. *ANJ*, 106(1), 58-67; Mick, DJ, Ackerman, MH. (2004). Critical care nursing for older adults: pathophysiological and functional considerations. *Nurs Clin N Am*, 39, 473-493; Watters, JM. (2002). Surgery in the elderly. *Journal canadien de chirurgie*, 45(2), 104-108.

CARDIOVASCULAR

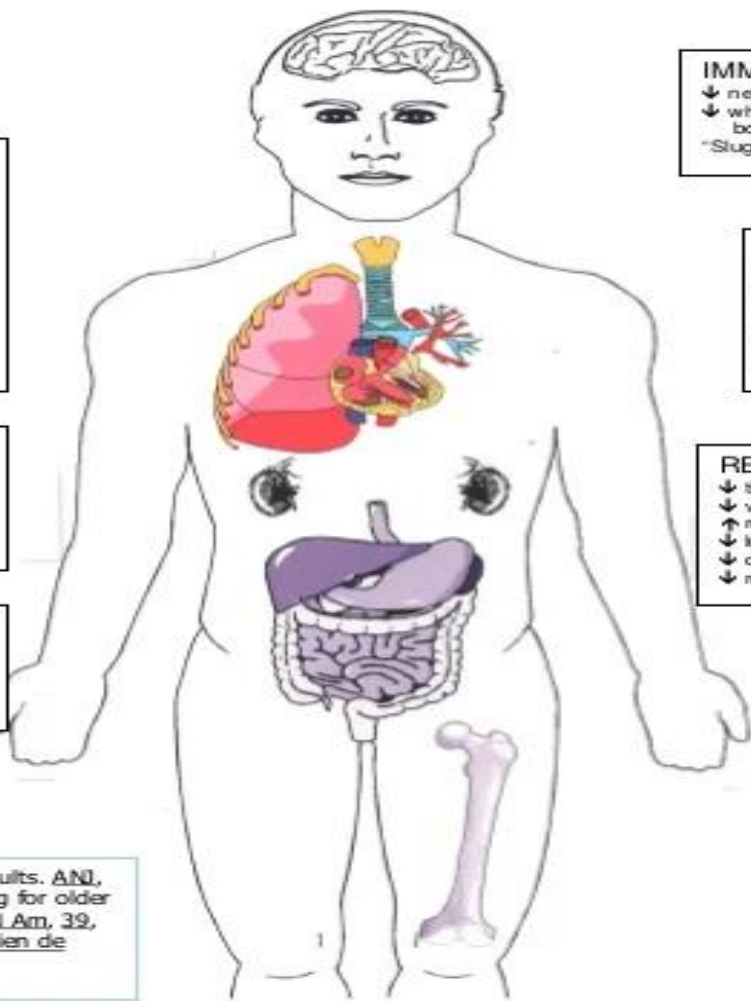
- ↑ myocardial irritability
- ↑ dysrhythmias, e.g.
 - ↑ PVC's/PAC's
 - ↑ A/V blocks
 - ↓ maximal heart rate
 - ↓ sinus rate
- ↓ arterial compliance
- ↑ systolic blood pressure
- ↓ cardiac output
- ↑ circulation time
- ↓ cutaneous/tissue perfusion

RENAL

- ↓ bladder capacity
- ↓ renal blood flow
- ↓ glomerular filtration
- ↓ renal clearance of drugs & metabolites

METABOLIC

- ↓ basal metabolic rate
- ↑ risk for hypothermia
- ↓ temperature regulation response



IMMUNE

- ↓ neurohumoral response
- ↓ white blood cell reserve (secondary to bone marrow/splenic sclerosis)
- "Sluggish" T cell response

BODY COMPOSITION

- ↓ lean muscle mass
- ↓ subcutaneous fat
- ↑ overall body fat
- ↓ sweat glands
- ↓ skin pigmentation
- ↓ serum protein binding

RESPIRATORY

- ↓ tidal volume
- ↓ vital capacity
- ↑ residual volume
- ↓ lung capacity
- ↓ compliance
- ↓ response to hypoxemia/hypercapnia

ENDOCRINE

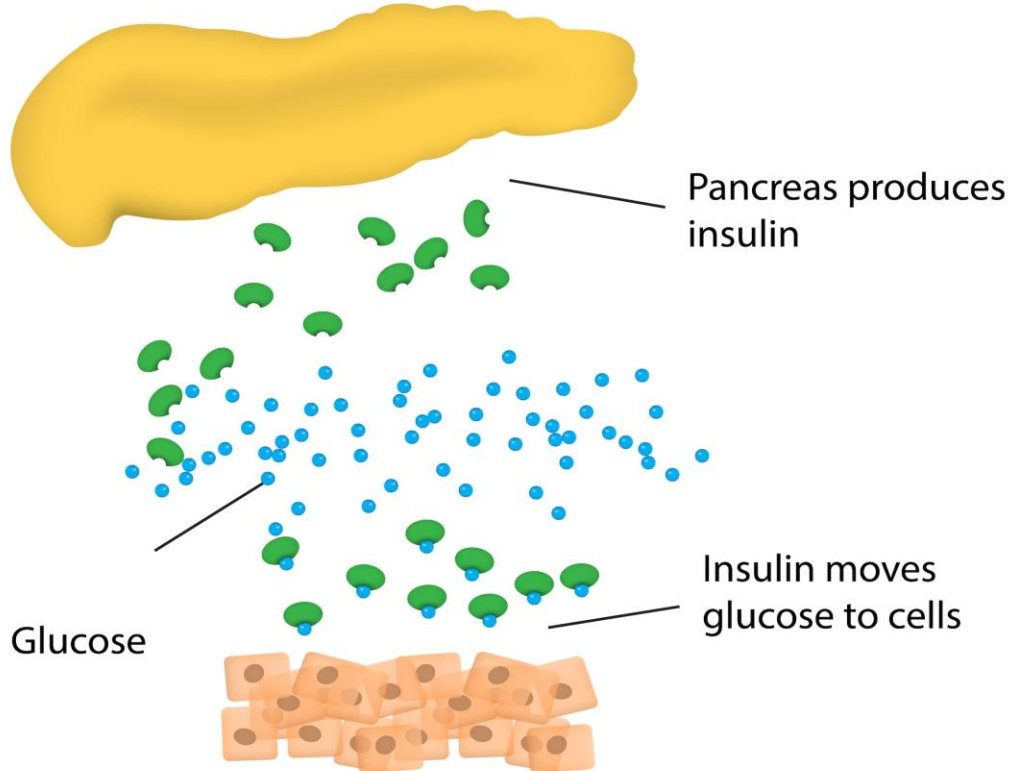
- ↑ or ↓ thyroid function
- Hypo/hyperthyroidism
- ↓ insulin sensitivity

ORTHOPEDIC

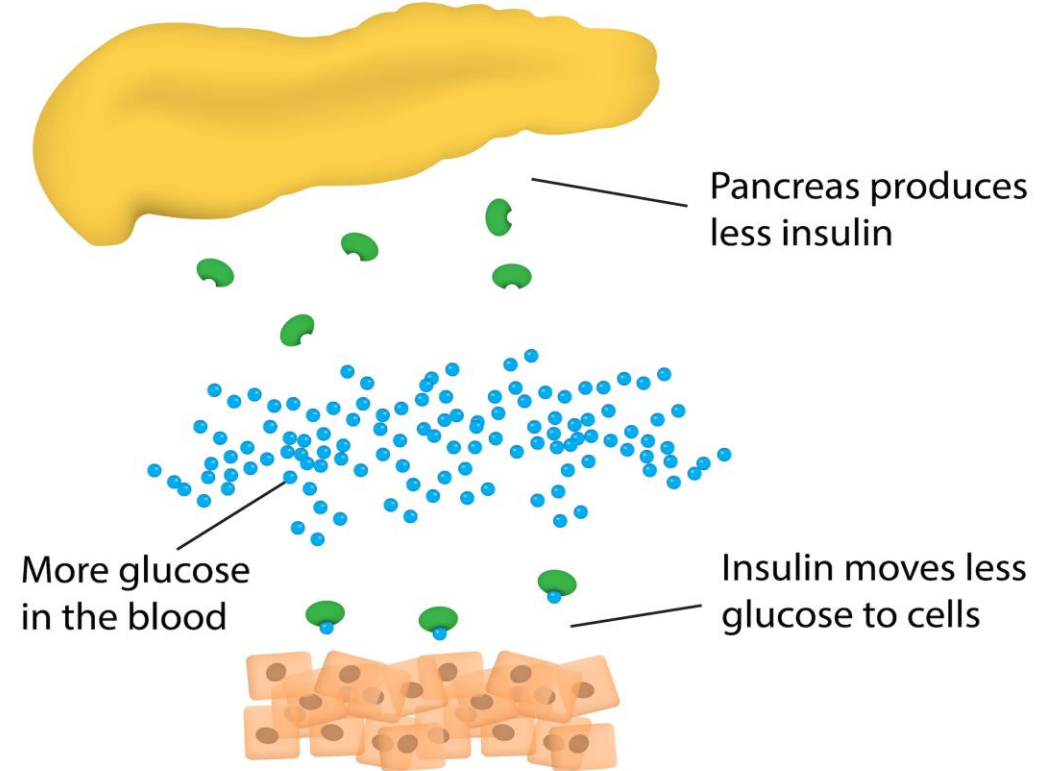
- Osteopenia
- ↑ risk of fractures
- ↓ range of motion
- ↑ ligamentous stiffness

Type 2 Diabetes

Normal



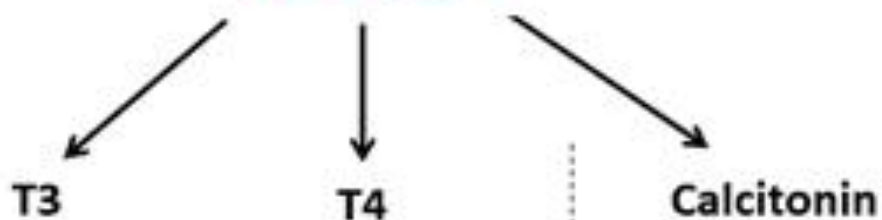
Diabetic



DM 2 and metabolism

- **Diabetes and Metabolism**: Metabolism is affected by diabetes. The metabolism of people with diabetes differs to the metabolism of people without it. In type 2 diabetes, the effectiveness of insulin is reduced and in type 1 diabetes, insulin levels in the body are very low.
- **Insulin allows glucose to move into the cells where it can be used as fuel.** Insulin also allows glucose to be stored by muscles and the liver as [glycogen](#)
- If needed, the **stored glycogen can later be returned to the blood as glucose**
- If needed, the stored glycogen can later be returned to the blood as glucose
- **If there is glucose remaining in the blood, insulin turns this glucose into saturated body fat..**

Thyroid Gland



Heart
function



Digestion



Brain development
and nervous system



Bone
health



Muscle
contractions



Parathyroid
hormone
production



Bone health



Kidney clearance rate

Hypothyroidism and metabolism

- The thyroid hormone helps control the speed of your metabolism. The faster your metabolism, the more calories your body burns at rest. People with hypothyroidism make less thyroid hormone. This means they have a **slower metabolism** and burn fewer calories at rest. Having a slow metabolism comes with several health risks.
- The risks include weight gain, and diet and exercise do not reverse the weight gains. Metabolism slows down and fatigue causes inactivity due to hypothyroidism. The low metabolism causes the body to store the calories as fat vs. burning them.

Hypothyroidism

Symptoms:

Extreme Tiredness/Lethargy/
Lack of Stamina/Motivation
Memory Loss/'Brain Fog'
Depression/
Mood Swings
Hearing Loss

Weight
Gain

3pm
crash

Broken
Sleep

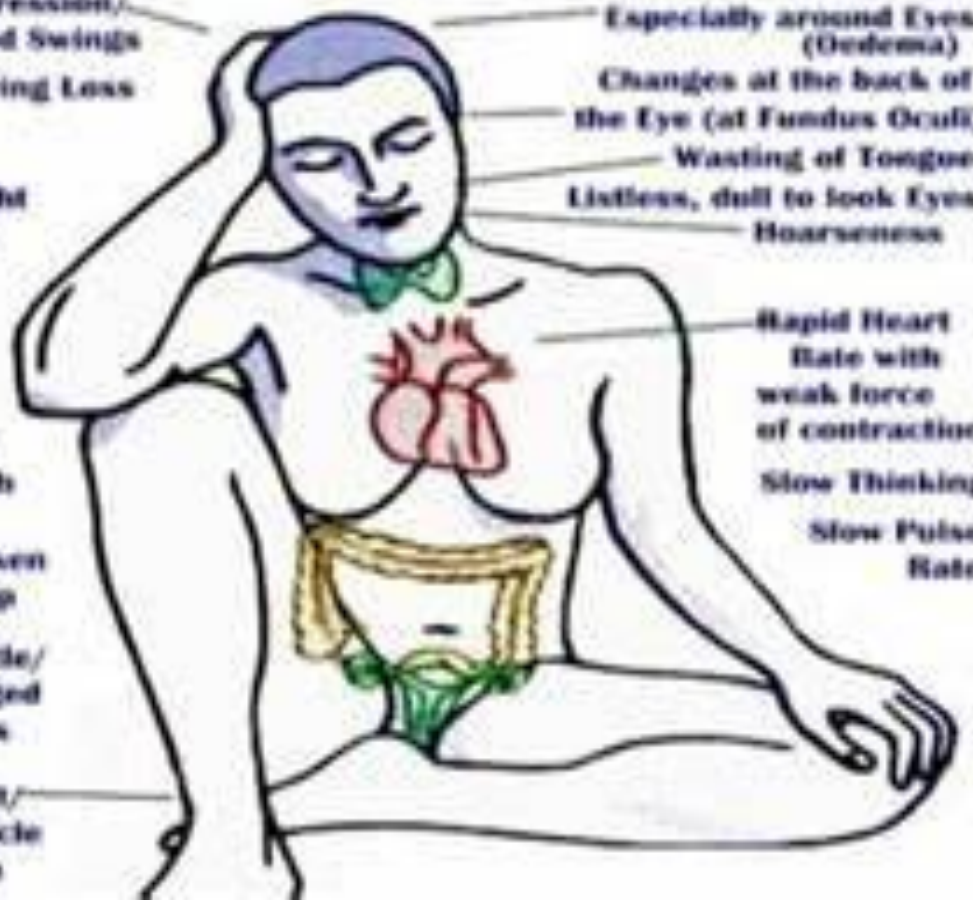
Brittle/
Ridged
Nails

Joint/
Muscle
Pain

Signs:

Sparse Eyebrows
Especially outer ends
Swelling of the Face
Especially around Eyes
(Dedema)
Changes at the back of
the Eye (at Fundus Oculi)
Wasting of Tongue
Listless, dull to look Eyes
Hoarseness

Rapid Heart
Rate with
weak force
of contraction
Slow Thinking
Slow Pulse
Rate



Hyperthyroidism

Symptoms:

Protusion of one or both
eyeballs (exophthalmos)
Breathlessness
Nervousness
Difficulty
Sleeping/
Insomnia

Fatigue

Itching
-overall

Heartbeat
Sensations
Palpitations

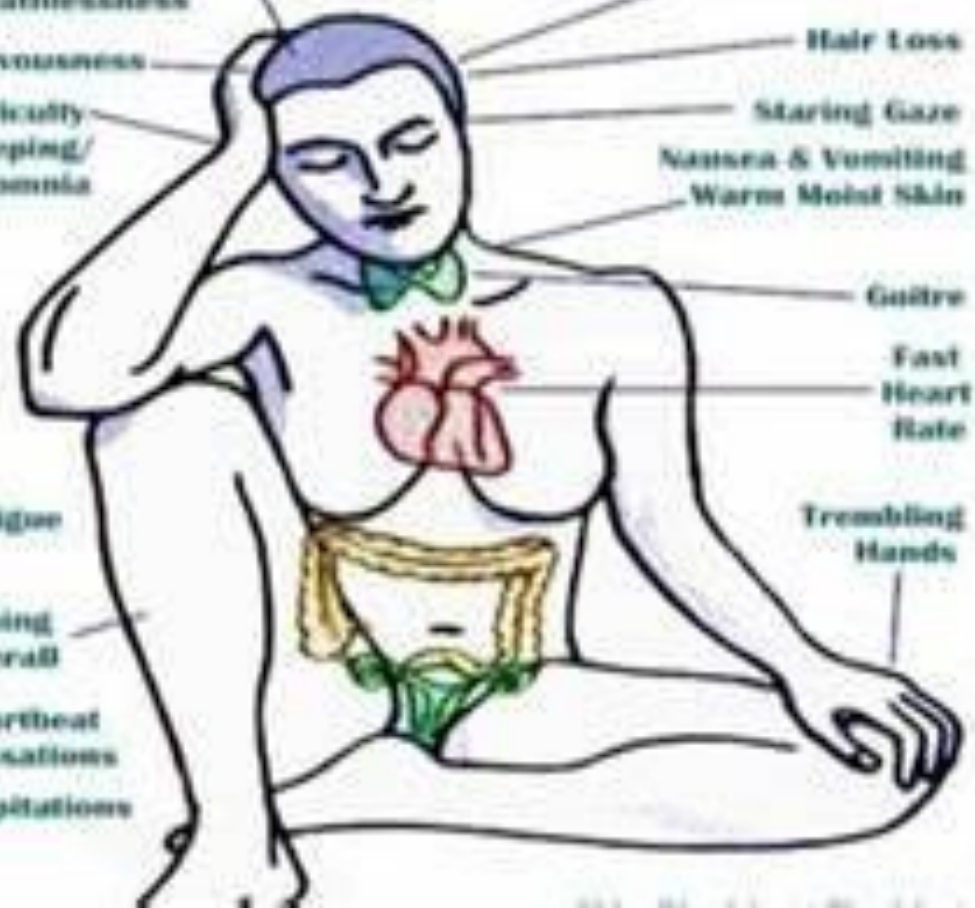
Signs:

Protruding Eyes
(exophthalmos)
Hair Loss
Staring Gaze
Nausea & Vomiting
Warm Moist Skin

Goitre

Fast
Heart
Rate

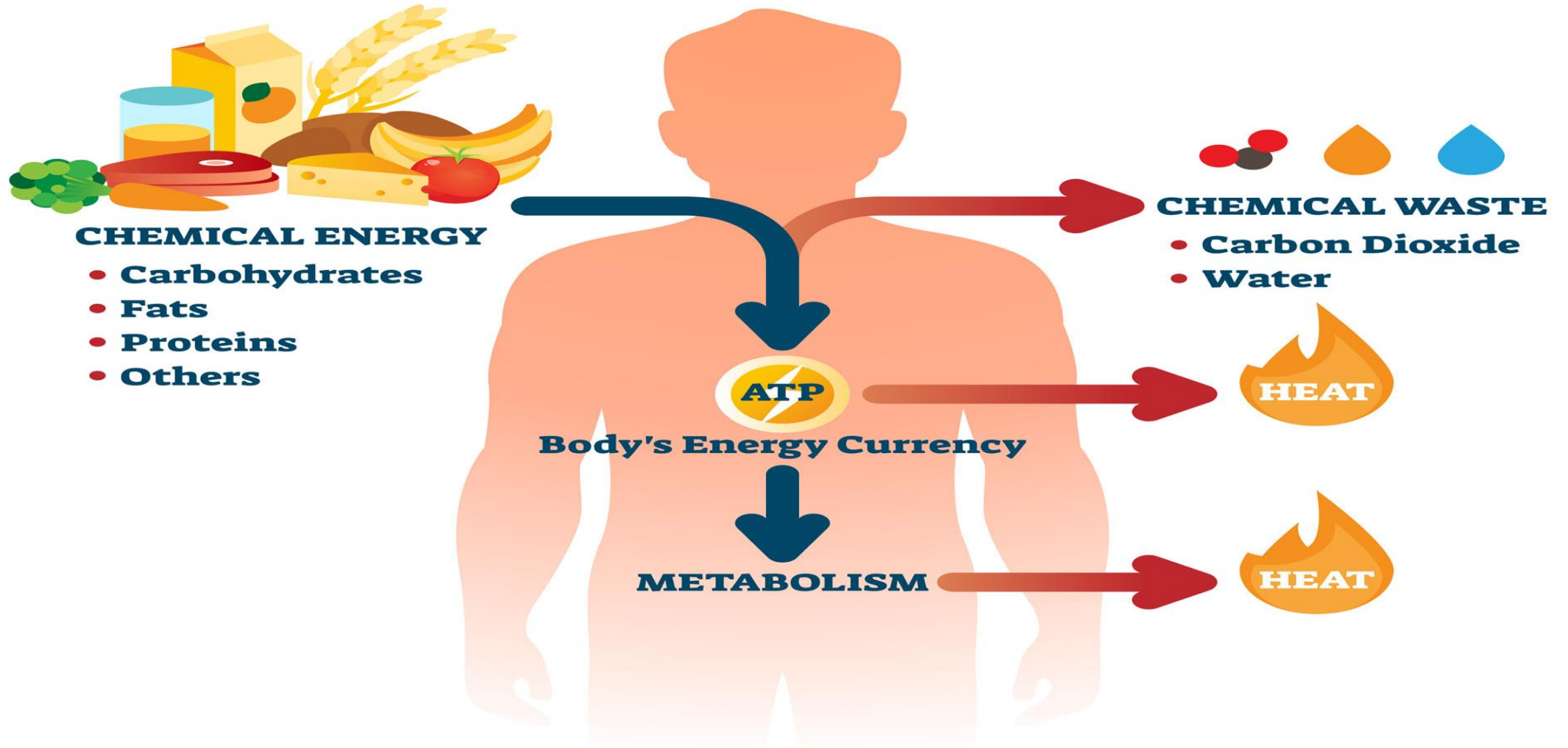
Trembling
Hands



Activity and metabolism

- Activity burns calories.
- Activity, especially exercise builds muscle and strength
- Muscle utilizes energy more efficiently than deposited fat.
- It takes more calories to use your muscles and to maintain them.
- In a way, lean muscle mass is an index of metabolism.
- The down side is this: Older individuals tend to be less active than they used to be.
- Research shows that over a quarter of Americans aged 50–65 don't exercise outside of work. For people over 75, this increases to over a third.

METABOLISM



So what can activity do for us as we age?

- Staying active with exercise and with non-exercise activities can help slow the natural process of the effects of aging, but it cannot stop it.
- The changes with aging are inevitable.
- People tend to lose muscle mass after the age of 30 by an average of 3 to 8% per decade. By the time one reaches 80 the percentage could be as much as 30% loss.
- This loss of muscle is known as sarcopenia. This condition has all kinds of consequences if not slowed down in time. Sarcopenia tends to slow down metabolism, but having more muscle mass tends to increase your RMR.

Losing muscle with Age

- Because muscle mass is affected by your activity level, being less active is one reason why you lose more muscle with age
- It is a use or lose proposition.
- Other reasons include consuming fewer calories and protein, as well as a decrease in the production of hormones, such as estrogen, testosterone and growth hormone.
- [metabolic syndrome](#) and type 2 diabetes, impairs the body's ability to metabolize glucose. Consequently blood sugars become elevated, weight gain is more likely and the resistance to insulin becomes greater. This impairs energy production.

METABOLIC SYNDROME

by the Numbers



Affects **40%** of people over 60 years old

Combines at least 3 of the following issues: abdominal obesity, high blood sugar, high triglyceride levels, high blood pressure or low HDL ("good") cholesterol



A loss of just **3%-5%** of your current body weight can lower your risk for metabolic syndrome



About **85%** of people who have type 2 diabetes also have metabolic syndrome

HDL cholesterol level of less than **50 mg/dL for women** and less than **40 mg/dL for men** is a risk factor for metabolic syndrome



40 mg/dL

50 mg/dL



Fasting blood sugar level of **100mg/dL** or higher is a metabolic risk factor



Large waist circumference that's at least **40 inches for men** and **35 inches for women** is visible sign of metabolic syndrome



Blood pressure of **130/85 mmHg** or higher is a metabolic risk factor



Triglyceride level of **150 mg/dL** or higher is a metabolic risk factor

Metabolic processes slow down with age

- How many calories you burn at rest (RMR) is determined by chemical reactions inside your body.
- Two cellular components that drive these reactions are your sodium-potassium pumps and mitochondria
- The sodium-potassium pumps help generate nerve impulses and muscle and heart contractions, while the mitochondria create energy for your cells. Both engines slow down with age.
- Research shows that both components lose efficiency with age and thus slow down your metabolism.

How much does metabolism slow down?

- The speed of your metabolism is affected by your activity levels, muscle mass and several other factors. As a result, metabolic speed varies from person to person. Therefore, everyone is slightly different in how that process happens.
- For instance, one study compared the RMR of three groups of people: those aged 20–34, 60–74 and over 90. Compared to the youngest group, people aged 60–74 burned roughly 122 fewer calories, while people over 90 burned around 422 fewer calories.
- This shows that maintaining muscle mass is incredibly important

How can we slow down the process of metabolic changes with age?

- **Try resistance training.** Resistance training, or weight lifting, is great for preventing a slowing metabolism.
- It offers the benefits of exercise while preserving muscle mass — two factors that affect the speed of your metabolism.
- One study with 13 healthy men aged 50–65 found that 16 weeks of resistance training three times weekly increased their RMR by 7.7%
- Another study with 15 people aged 61–77 found that half a year of resistance training three times weekly increased RMR by 6.8%

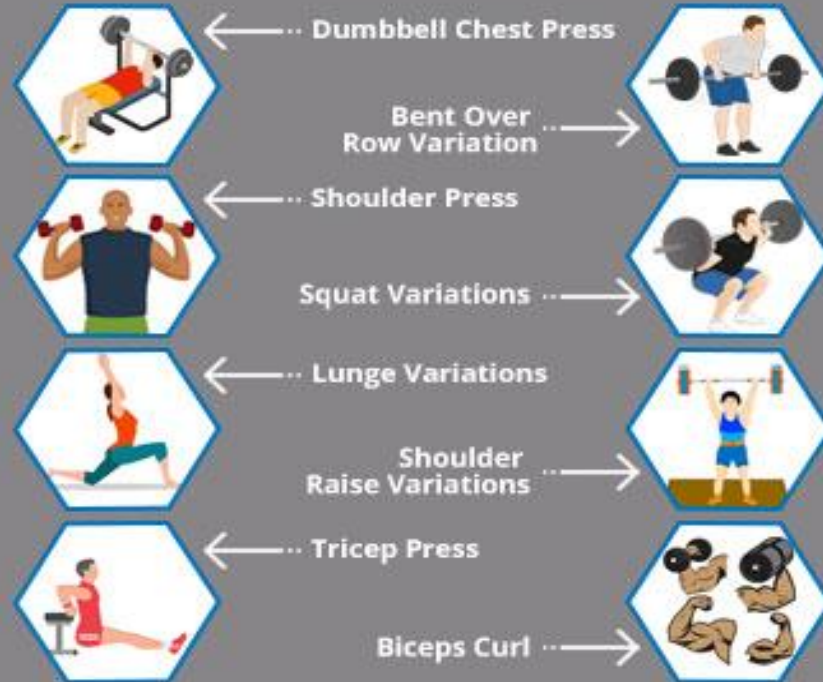
Slowing down the metabolic changes with aging

- **Another approach is engaging in high intensity interval training.** (HIIT) can help prevent a slowing metabolism. It is a training technique that alternates between intense anaerobic exercise with short periods of rest.
- HIIT also continues to burn calories long after you finish exercising. This is called the "afterburn effect." It occurs because your muscles need to use more energy to recover after exercise
- HIIT has been shown to build and preserve muscle mass with aging.

Exercises to maximize your metabolism



Best Exercises For Men after 40: Improve Metabolism & Testosterone Level



More exercises to increase your metabolism

The Metabolism-Boosting Workout



1

Suitcase Deadlift +
Single-Arm Row



2

Walking
Lunges



3

Dumbbell
Bench Press



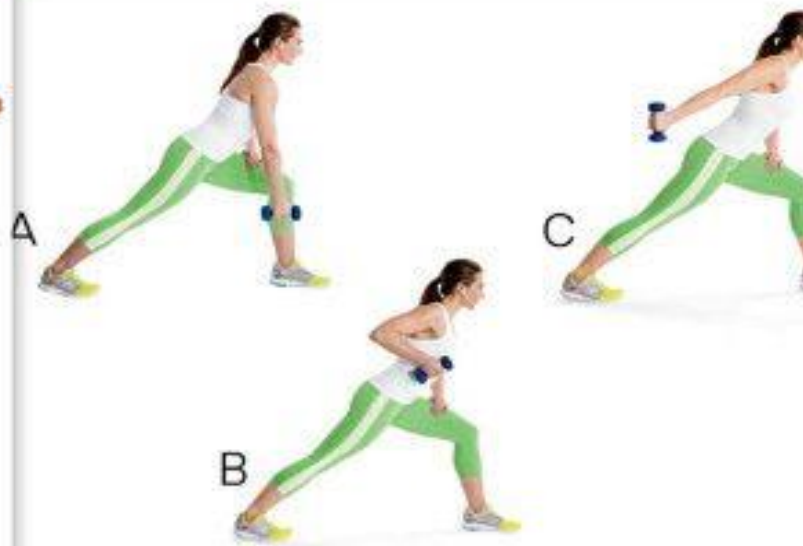
4

Eccentric
Goblet Squat



5

Low-to-High
Woodchop



How does sleep affect metabolism?

- Research shows a lack of sleep can slow down your metabolism. Fortunately, a good night's rest can reverse this effect.
- One study found that 4 hours of sleep reduced metabolism by 2.6% compared to 10 hours of sleep. Fortunately, a night of long sleep (12 hours) helped restore metabolism.
- It also seems that poor sleep may increase muscle loss. Since muscle influences your RMR, losing muscle can slow down your metabolism.

Protein rich food and metabolism

- Eating more protein rich foods can help fight a slowing metabolism. That's because your body burns more calories while consuming, digesting and absorbing protein-rich foods. This is known as the thermic effect of food (TEF). Protein-rich foods have a higher TEF than carb- and fat-rich foods
- In fact, studies have shown that consuming 25–30% of your calories from protein can boost your metabolism by up to 80–100 calories per day, compared to lower protein diets.
- Protein is also essential to fight sarcopenia. Thus, a protein-rich diet can fight an aging metabolism by preserving muscle.

What is the bottom line?

- Research shows that metabolism slows down with age.
- Being less active, losing muscle mass and the aging of your internal components, all contribute to a sluggish metabolism.
- There are several ways to fight aging from slowing down your metabolism:
- Weight lifting, interval training, higher percentage protein intake with meals, and getting adequate sleep. **Green tea** has been shown to benefit metabolism by the caffeine make up and other plant compounds within the tea.

Bottom line continued.....

- **Two other biggies:** Manage your Diabetes and correct your thyroid problems. If these two disorders aren't managed they will have a deleterious affect on your metabolism. Metabolic syndrome becomes a greater risk for you if you don't manage your chronic conditions. This syndrome affects several organ systems of the body and greatly increases your risk of heart disease, DM, and stroke.
- In the end you can't change the fact that you are male or female, or how tall you are, or even how old you are. But you can change your habits of exercise and diet in order to maximize you're your energy and continue to add muscle and energy as you age.