



INE | INSTITUTE OF
NUTRITIONAL
ENDOCRINOLOGY

Micronutrients: Sodium

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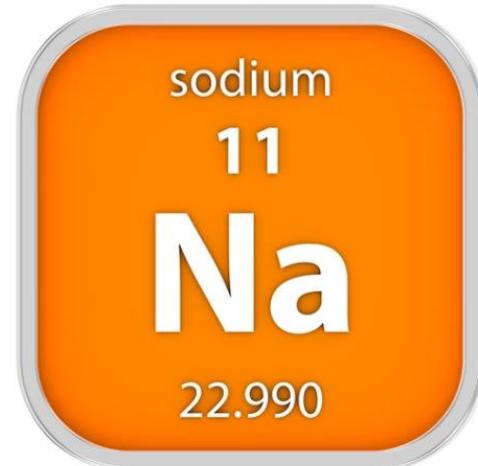


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Sodium General Info

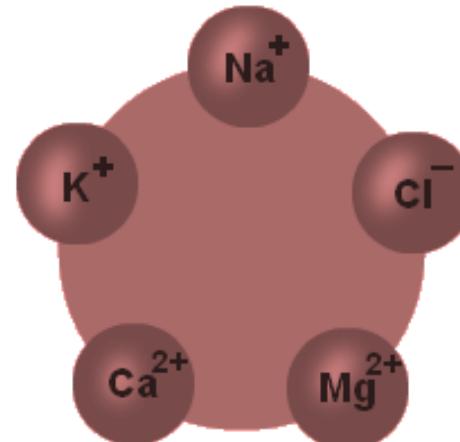
- ✓ Essential macro mineral
- ✓ An electrolyte
- ✓ Contributes to maintenance of concentration and charge differences across cell membranes
- ✓ Most abundant cation in body (93%)
- ✓ It has a single charge as opposed to the two electrical charges on most of the other minerals
- ✓ As a result, it is less tenacious in its hold on other structures and tends to move readily through solutions, especially water



Sodium as an Electrolyte

- ✓ Sodium is a cation
- ✓ An electrolyte is a salt or ion that is electrically-charged and moves to either a **negative (cathode)** or **positive (anode)** electrode:
- ✓ Ions that move to the cathode (**cations**) are positively charged
- ✓ Ions that move to the anode (**anions**) are negatively charged

The main electrolytes in Body Fluid

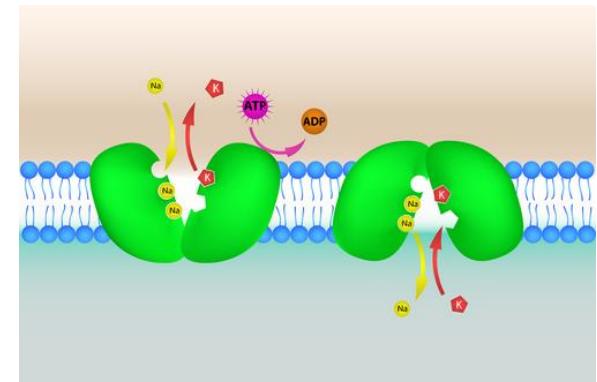


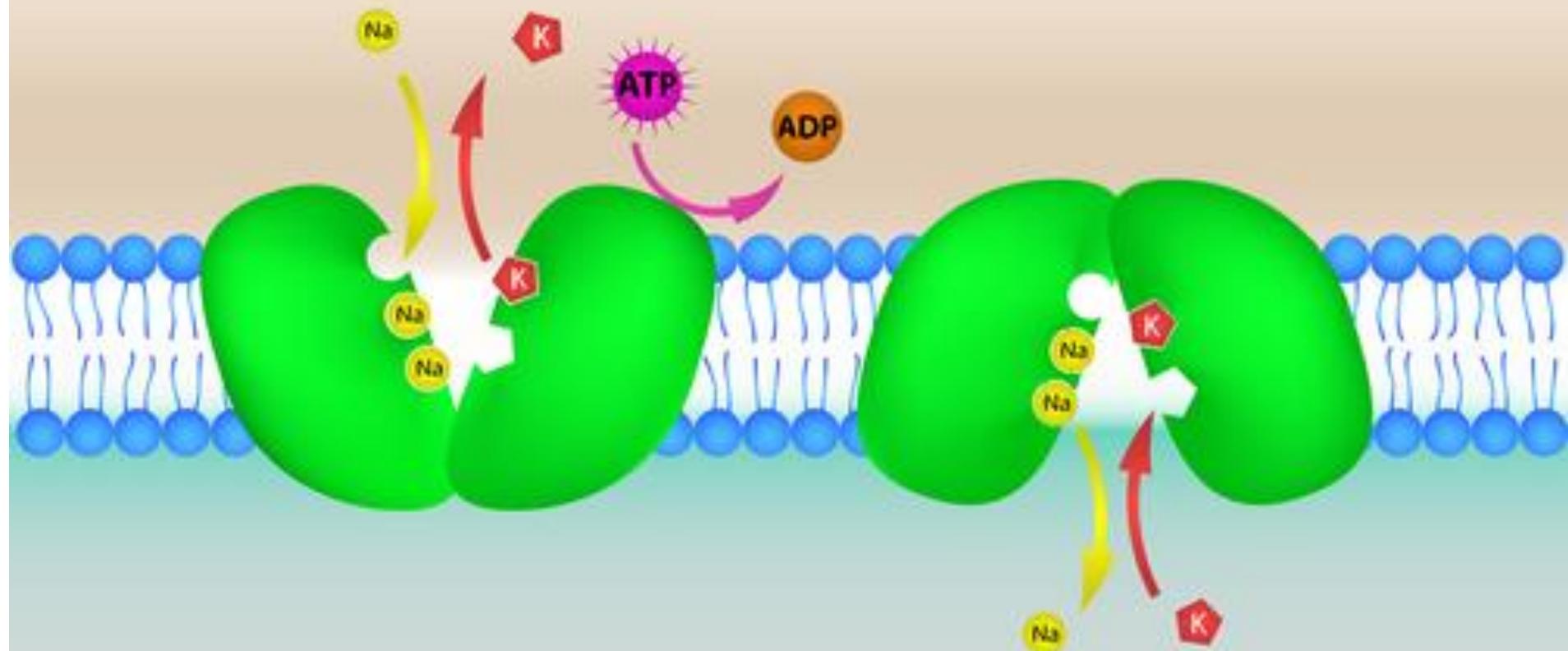
Na^+	Sodium ion
Cl^-	Chloride ion
Mg^{2+}	Magnesium ion
Ca^{2+}	Calcium ion
K^+	Potassium ion

Each ion has its own rules, and body movement is a result of the function of these ions.

Sodium and Cell Membrane Potential

- ✓ Maintains cell's membrane potential via the sodium, potassium-ATPase pumps
 - Pump sodium out of the cell
 - Pump potassium in
- ✓ Activity accounts for 20% - 40% of the resting energy expenditure in a typical adult
- ✓ Tight control of cell membrane potential is critical for
 - Nerve impulse transmission
 - Muscle contraction
 - Cardiac function
 - Stomach function
 - Nerve function





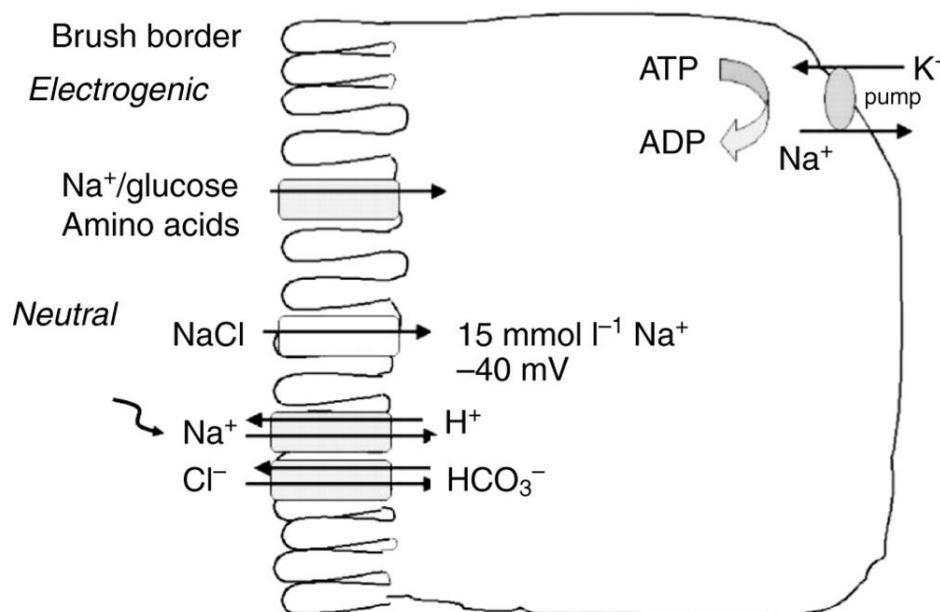
Sodium Functions

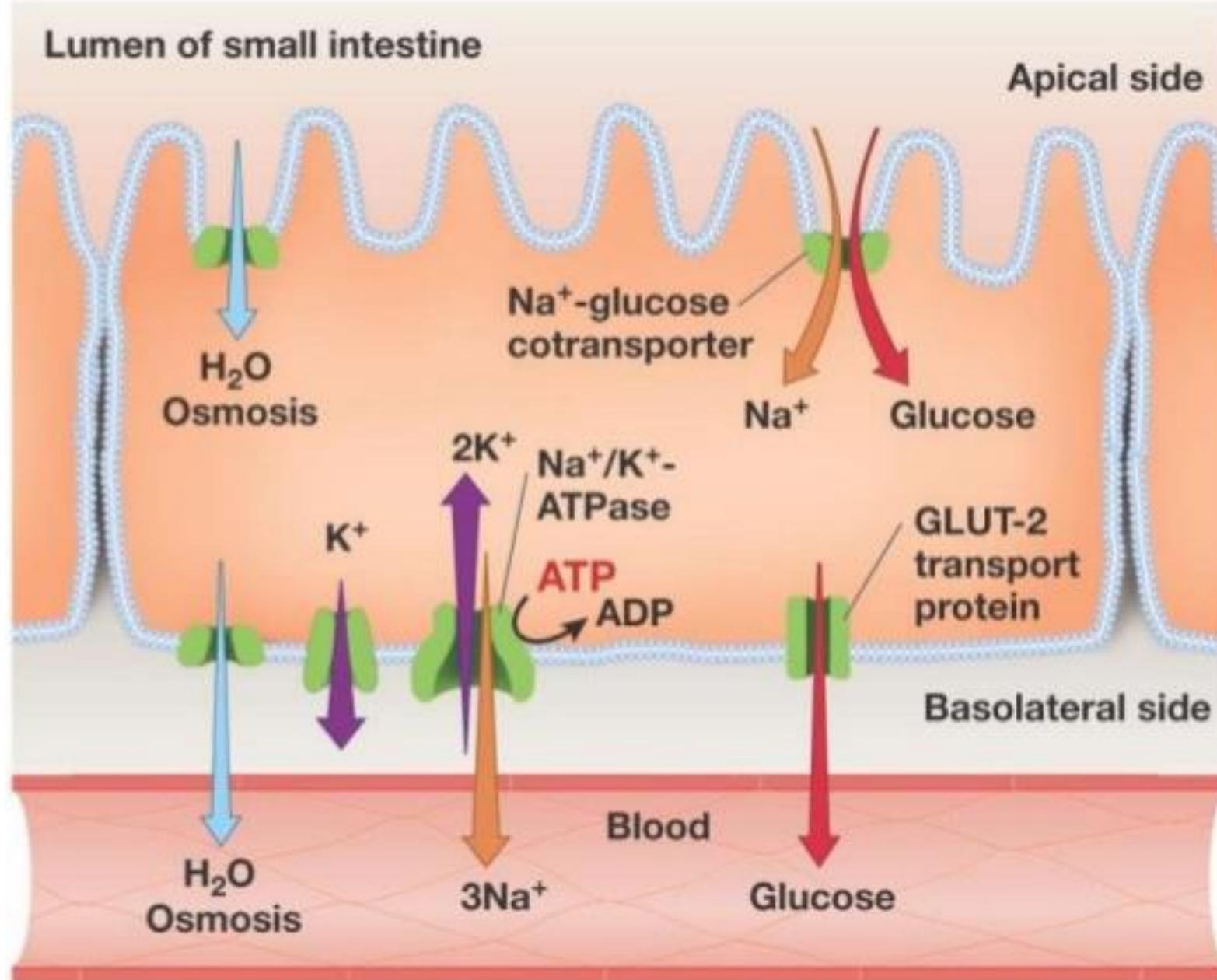
- ✓ Maintains proper water balance
- ✓ Maintains blood pH
- ✓ Involved in acid-base balance
- ✓ Main cation of extracellular fluid
- ✓ Needed by organs (including liver, spleen, and brain)
- ✓ Needed by synovial membranes of joints, cartilage, and ligaments
- ✓ Useful in neutralizing acidic byproducts (lactic, butyric, acetic, and fatty acids) when saturated fats or meats are metabolized



Sodium Absorption

- ✓ 95% to 100% absorbed, remainder excreted in feces
- ✓ 3 major absorption pathways in intestine
 - **Na⁺ – Glucose cotransport system:** Throughout small intestine
 - involves a carrier in brush border
 - **Electroneutral Na⁺ and Cl⁻ cotransport system:** Small intestine and proximal large intestine
 - **Electrogenic sodium transport system:** Mainly large intestine



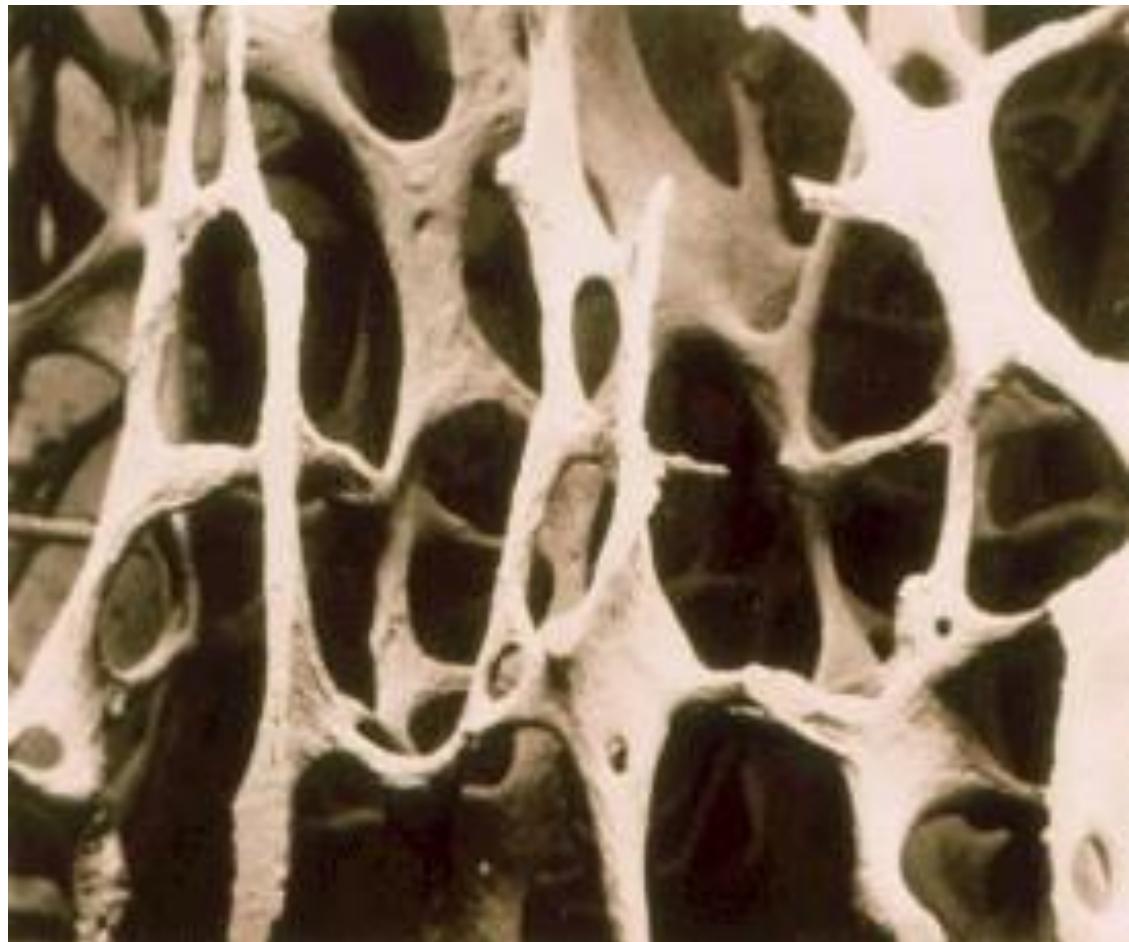


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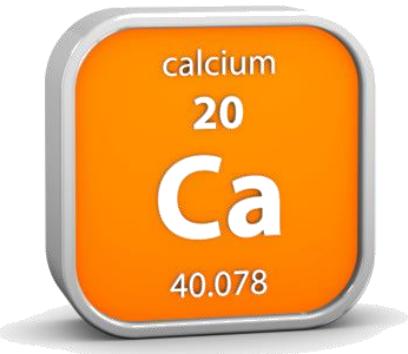
Sodium Storage

- ✓ About 30% stored on surface of bone crystals
- ✓ Remainder is in extracellular fluid, nerve, and muscle tissue

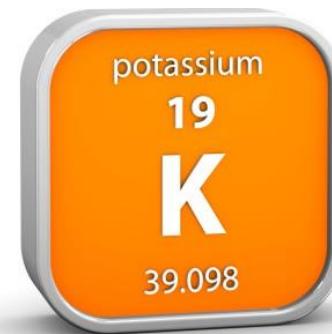


Sodium Interactions

✓ **Calcium:** Excess sodium can deplete calcium; increases urinary loss

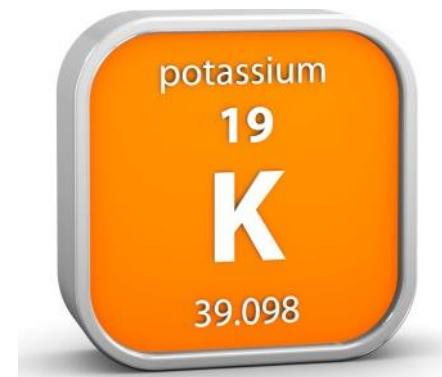
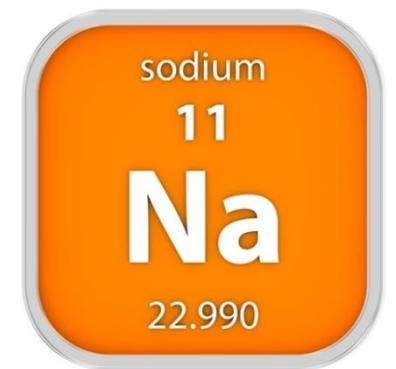


✓ **Potassium:** Excess sodium increases potassium excretion; excess potassium increases sodium excretion



The Sodium-Potassium Balance

- ✓ Potassium concentration higher on the inside of the cell; sodium higher on the outside
- ✓ Delicate sodium-potassium balance is vital for good cellular health
- ✓ Integrity of cell's internal charges must remain in equilibrium with its external charges
- ✓ Balance can not be maintained if excessive sodium is ingested without simultaneously increasing potassium levels



Causes of Sodium Deficiency

- ✓ Extensive sweating
- ✓ Prolonged endurance exercises
- ✓ Vomiting
- ✓ Diuretics
- ✓ Excess ADH
(Anti-diuretic hormone)



Impact of Sodium Deficiency

- ✓ Abdominal cramps
- ✓ Anorexia
- ✓ Confusion
- ✓ Dehydration
- ✓ Depression
- ✓ Dizziness
- ✓ Low blood pressure
- ✓ Memory impairment
- ✓ Muscular weakness
- ✓ Flatulence
- ✓ Hallucinations
- ✓ Heart palpitations
- ✓ Impaired sense of taste
- ✓ Nausea and vomiting
- ✓ Poor coordination
- ✓ Recurrent infections
- ✓ Headache
- ✓ Fatigue
- ✓ Lethargy
- ✓ Seizures
- ✓ Weight loss



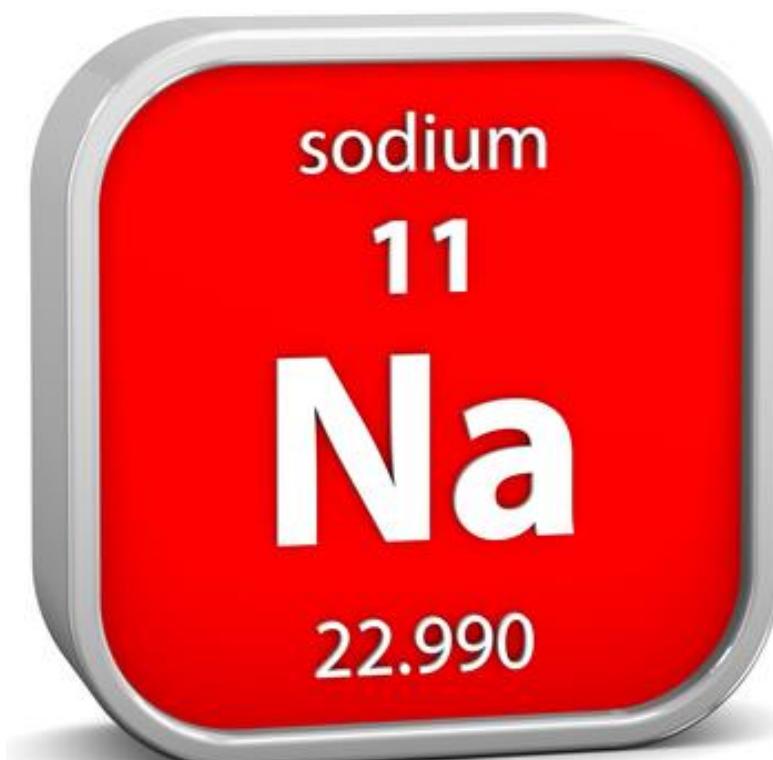
Adequate Intake of Sodium

Life Stage	Age	Males and Females Sodium (g/day)	Salt (g/day)
Infants	0-6 months	0.12	0.30
Infants	7-12 months	0.37	0.93
Children	1-3 years	1.0	2.5
Children	4-8 years	1.2	3.0
Children	9-13 years	1.5	3.8
Adolescents	14-18 years	1.5	3.8
Adults	19-50 years	1.5	3.8
Adults	51-70 years	1.3	3.3
Adults	71 years and older	1.2	3.0
Pregnancy	14-50 years	1.5	3.8
Breast-feeding	14-50 years	1.5	3.8



Sodium Maximum Recommendations

- ✓ No more than 2.3 g or 2,300 mg daily for healthy adults (1 tsp)
- ✓ According to the Institute of Medicine, the maximum daily intake for sodium are the following:
 - Ages 1 to 3: 1,500 mg
 - Ages 4 to 8: 1,900 mg
 - Ages 9 to 13: 2,200 mg
 - Ages 14 to adult: 2,300 mg
 - Sodium sensitive: 1,500 mg
- ✓ Sensitive populations include
 - Adults over 50
 - Blacks
 - Those diagnosed with hypertension
 - Those with diabetes
 - Those with chronic kidney disease



Symptoms of Excessive Sodium

- ✓ Edema
- ✓ High blood pressure
- ✓ Potassium deficiency
- ✓ Liver disease
- ✓ Kidney disease
- ✓ Bone weakness and osteoporosis
- ✓ Stupor
- ✓ Coma



Food Sources of Sodium

- ✓ Kelp
- ✓ Stinging nettle
- ✓ Olives
- ✓ Dulse
- ✓ Sauerkraut
- ✓ Irish moss
- ✓ Chinese cabbage
- ✓ Chinese mustard
- ✓ Lettuce
- ✓ Turnip
- ✓ Spinach
- ✓ Carrots
- ✓ Watercress
- ✓ Dandelion greens
- ✓ Tomatos
- ✓ Radish root
- ✓ Celery
- ✓ Scallop
- ✓ Lobster
- ✓ Beet greens
- ✓ Beets





1 apple
= **1** mg



16 oz soda
= **19** mg



1 chocolate
chip cookie
= **31** mg



1 cup salad = **44** mg
Add 2 Tbsp Salad
Dressing = **438** mg



8 oz milk
= **100** mg



1 cup
Potato Chips
= **256** mg



1 large order
french fries
= **350** mg



1 PB & J sandwich
= **492** mg
1 meat mg&
cheese = **990**



1 slice
pepperoni pizza
= **590** mg



1 cup soup
= **930** mg



Quarter Pounder
with Cheese
= **1190** mg



Condiment Sources of Sodium

- ✓ Kelp
- ✓ Dulse
- ✓ Celery seed
- ✓ Sesame seed
- ✓ Turmeric
- ✓ Dill
- ✓ Cumin
- ✓ Nettle



Classes of Medications that Deplete Sodium

- ✓ Diuretics
- ✓ Non-steroidal anti-inflammatory drugs (NSAIDs)
- ✓ Opiate derivatives
- ✓ Selective serotonin re-uptake inhibitors (SSRIs)
- ✓ Phenothiazines
- ✓ Tricyclic antidepressants



Medications that Deplete Sodium

- ✓ Chlorpropamide (Diabinese)
- ✓ Cyclophosphamide (Cytoxan)
- ✓ Desmopressin (DDAVP; nasal or oral)
- ✓ Clofibrate (Atromid-S)
- ✓ Oxytocin (Pitocin)
- ✓ Vincristine (Oncovin)

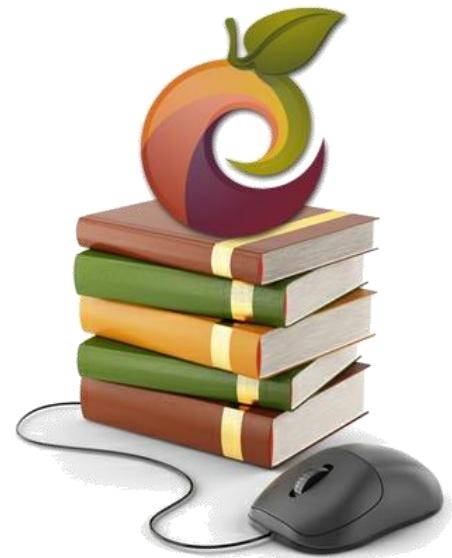


Assessing Status of Sodium

- ✓ Serum level (135-140)
- ✓ Ratio to serum level of potassium and chloride
- ✓ Diet journal
- ✓ Questionnaires and good history taking for signs and symptoms



Resources



- ✓ *Advanced Nutrition and Human Metabolism – Gropper, Smith and Groff*
- ✓ Linus Pauling Institute:
<http://www.drritamarie.com/go/LPISodium>
- ✓ <http://www.drritamarie.com/go/AbsorptionOfNaAndCl>
- ✓ <http://www.drritamarie.com/go/SodiumLauritzenAndSaunders>

