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Nutrition for Adolescents and the Elderly– 2<sup>nd</sup> Grade



## Energy and Nutrient Needs in Adolescents





## Contents:

Introduction and Review

DRI

EER



## Learning Outcomes:

- 1 Explain calorie and nutrient needs in adolescents.
- 2 Calculate daily calorie requirements and plan balanced diets.
- 3 Evaluate dietary intake and identify deficiencies.



A **nutrient** is basically any substance that body needs to live, grow, repair itself, and function properly. Think of it as the **fuel and building blocks** of body. Without nutrients, cells can't do their jobs and can't survive for long.



**Macronutrients** – needed in large amounts:

**Carbohydrates** → main energy source. Example: rice, bread, pasta.

**Proteins** → build and repair tissues. Example: meat, beans, eggs.

**Fats** → concentrated energy, essential for hormones and cell membranes. Example: olive oil, nuts, butter.

**Water** → not energy, but crucial for hydration, transport, and reactions.



**Micronutrients** – needed in small amounts, but essential:

**Vitamins** → regulate metabolism, immunity, growth. Example: Vitamin A, B-complex, C, D, E, K.

**Minerals** → structural and functional roles. Example: calcium (bones), iron (blood), magnesium (enzymes).

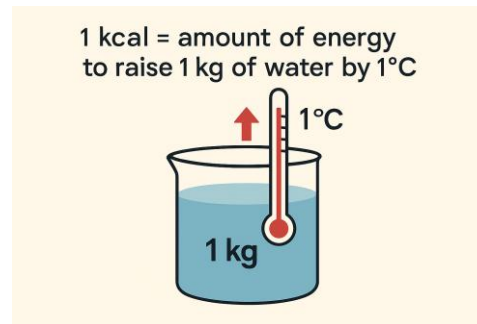
# Energy

## Energy (Calories)

- The fuel the body uses to perform all functions — from breathing to running. “Energy is what keeps you alive *and* growing.”
- Energy is measured in **kilocalories (kcal)** or **kilojoules (kJ)**. For most nutrition purposes, we use **kcal**.
- 1 kcal = amount of energy to raise 1 kg of water by 1°C.

## Where energy comes from in food:

- Carbohydrates** → 4 kcal per gram
- Proteins** → 4 kcal per gram
- Fats** → 9 kcal per gram
- Alcohol** → 7 kcal per gram (technically not a nutrient, but it gives energy)



Fuel	Energy conversion	Waste products
<p>Gasoline</p> <p>+</p> <p>Oxygen</p>	<p>Heat energy</p> <p>Combustion</p> <p>Kinetic energy of movement</p> <p>Energy conversion in a car</p>	<p>Carbon dioxide</p> <p>+</p> <p>Water</p>
<p>Glucose</p> <p>+</p> <p>Oxygen</p>	<p>Heat energy</p> <p>Cellular respiration</p> <p>ATP</p> <p>ATP</p> <p>Energy for cellular work</p> <p>Energy conversion in a cell</p>	<p>Carbon dioxide</p> <p>+</p> <p>Water</p>



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## **Adolescence**

Period between 10–19 years with rapid physical, psychological, and hormonal changes.

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## **Growth Spurt**

A rapid increase in height and weight during puberty.

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## **Peak Height Velocity (PHV)**

The **fastest rate of growth in height** during adolescence.

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## **Puberty**

Biological process where the body becomes sexually mature (driven by hormones).

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## **Body Composition**

Proportion of fat mass vs lean mass (muscle, bone, water).

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# DRI (Dietary Reference Intakes)

- DRI are a set of **nutrient reference values** used to plan and assess diets for **healthy people**. Its like a **roadmap** telling how much of each nutrient is **needed for health, growth, and prevention of deficiencies**. In another term, chronic disease prevention, functional outcomes, and population diversity. **DRIs are not a single number**—**DRI consist of several core values, each serving a different purpose.**

EAR → the starting point for nutrient requirements; it's the median need.

RDA → built from EAR to cover almost everyone safely.

AI → used when data is insufficient for RDA.

UL → the maximum safe intake to prevent toxicity.

EER → separate from nutrients; tells how many calories you need for energy balance.

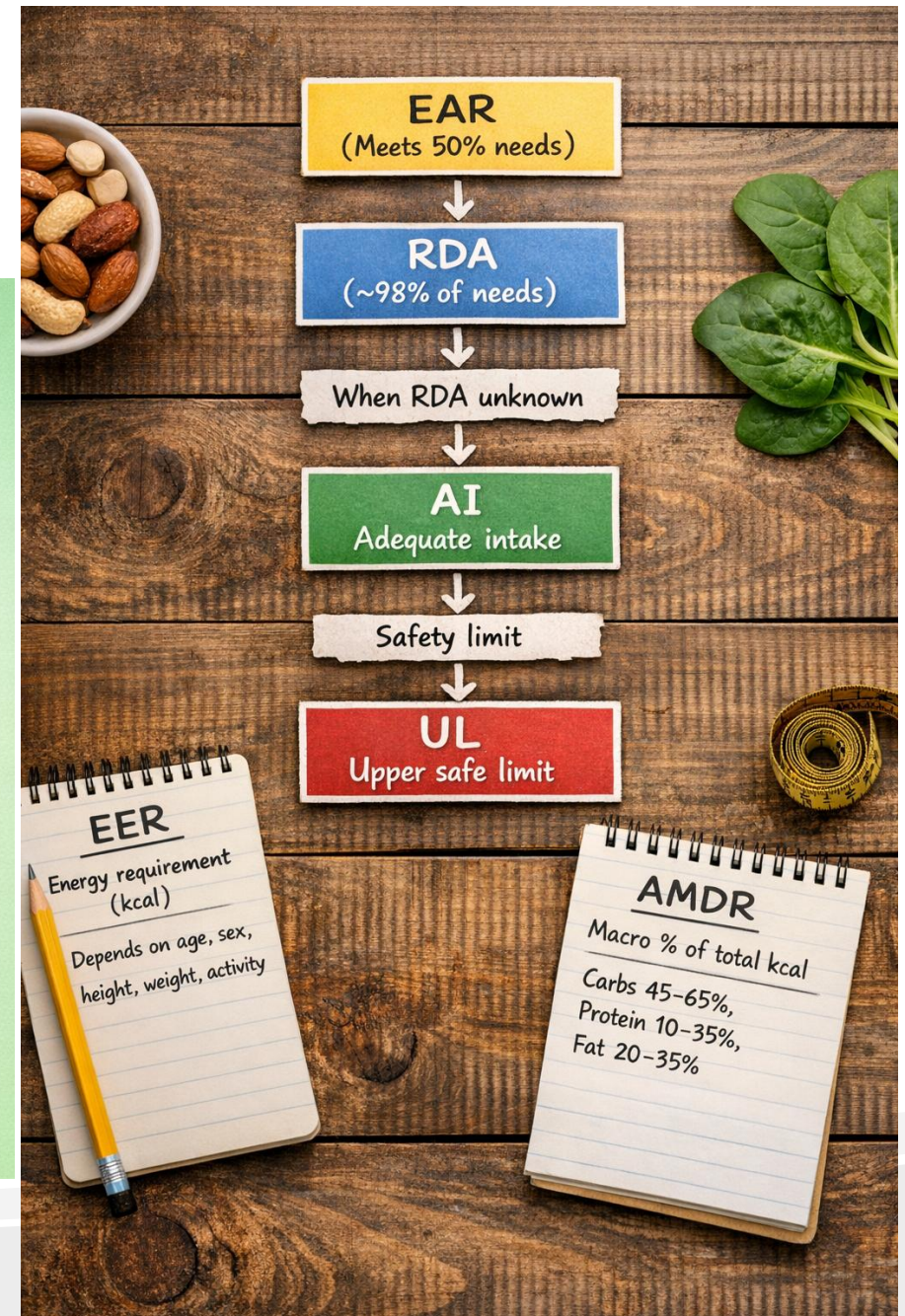
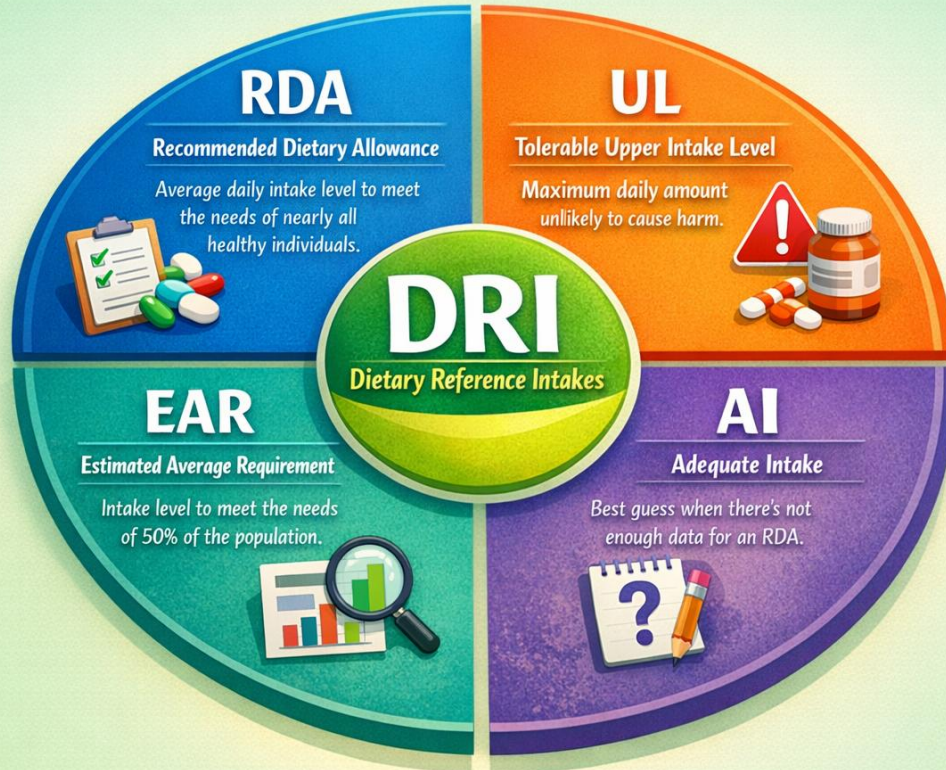
AMDR → ensures macronutrients are consumed in healthy proportions.

# A Summary with Formulas and with an Example

DRI Component	Definition	Formula / Calculation	Adult Male Example	Adult Female Example
<b>EAR</b>	Intake to meet <b>50%</b> of population	From research: EAR = average requirement	Calcium EAR = 800 mg/day	Calcium EAR = 800 mg/day
<b>RDA</b>	Intake to meet <b>~98%</b> of population	$RDA = EAR + 2 \times SD$ of requirement	Calcium RDA = 1,000 mg/day	Calcium RDA = 1,000 mg/day
<b>AI</b>	Used when RDA can't be determined	Observed intake of healthy group	Vitamin K AI = 120 µg/day	Vitamin K AI = 90 µg/day
<b>UL</b>	Maximum safe intake	Highest intake not causing adverse effects	Vitamin D UL = 4,000 IU/day	Vitamin D UL = 4,000 IU/day
<b>EER</b>	Energy intake to maintain balance	<b>Adults:</b> $EER = 662 - (9.53 \times \text{age}) + PA \times [(15.91 \times \text{weight}) + (539.6 \times \text{height})]$ weight in kg, height in m, PA = physical activity factor	30 y, 70 kg, 1.75 m, moderate PA → 2,700 kcal/day	30 y, 60 kg, 1.65 m, moderate PA → 2,200 kcal/day



## — Cores of DRI (Dietary Reference Intakes) —



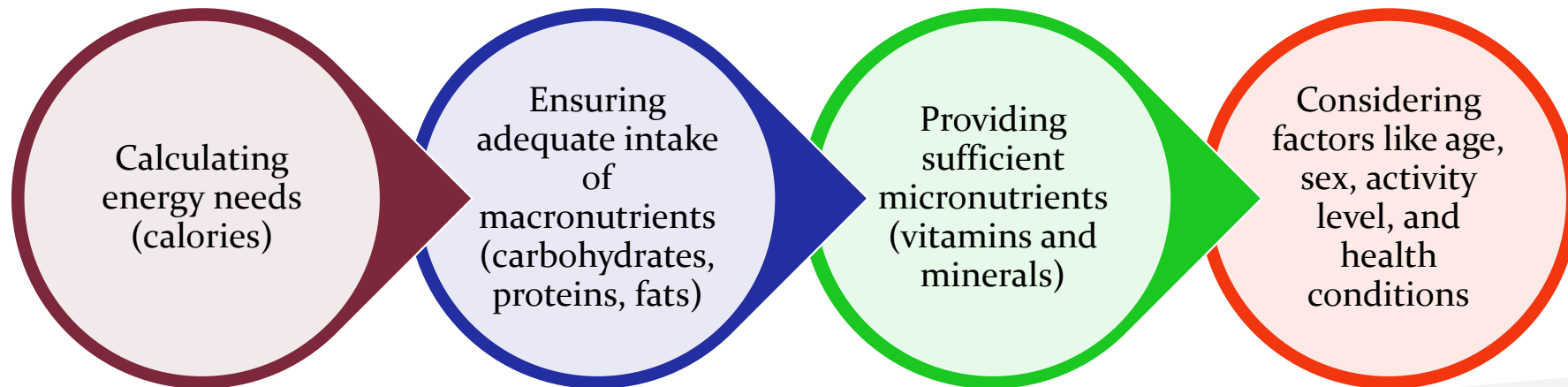


## Difference between DRIs:

DRI Component	Purpose	Target Population	Unit
EAR	Meets 50% of needs	Group assessment	mg/day, g/day
RDA	Meets ~98% of needs	Individual goal	mg/day, g/day
AI	Adequacy when RDA unknown	Individual/group	mg/day, $\mu$ g/day
UL	Avoid toxicity	Individual	mg/day, $\mu$ g/day
<b>EER</b>	Energy balance	Individual	kcal/day
AMDR	Healthy macronutrient %	Individual/group	% of total kcal

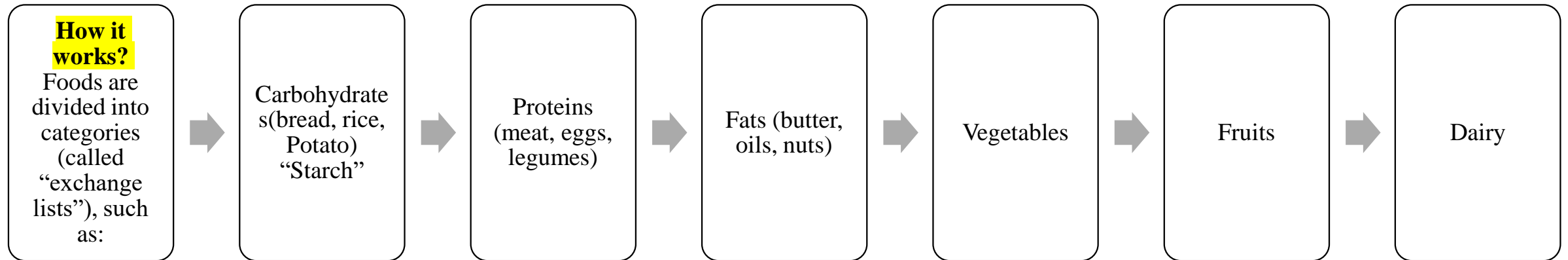
## Meal Planning:

- Meal planning is the systematic process of **selecting, organizing, and scheduling food intake** to meet an individual's physiological and nutritional requirements, based on principles of Nutrition Science and energy balance.



# A food exchange system

- is a method used to plan meals by grouping foods with similar nutritional content so they can be “**exchanged**” or **substituted** for one another. It’s most commonly used in nutrition planning and managing conditions like Diabetes.



Each portion within a group has roughly the **same amount of calories, carbs, protein, and fat**. So you can swap foods within the same group without significantly changing your overall nutrition.

## Example:

- 1 slice of bread  $\approx$   $\frac{1}{2}$  cup rice  $\approx$  1 small potato
- All are considered one **carbohydrate exchange**



## Why it's useful?

- Helps control **calorie intake**
  - Keeps **blood sugar stable** (important for diabetes)
  - Makes meal planning more flexible
  - Encourages balanced nutrition
- The system is often used in clinical nutrition programs developed by organizations like the American Diabetes Association.

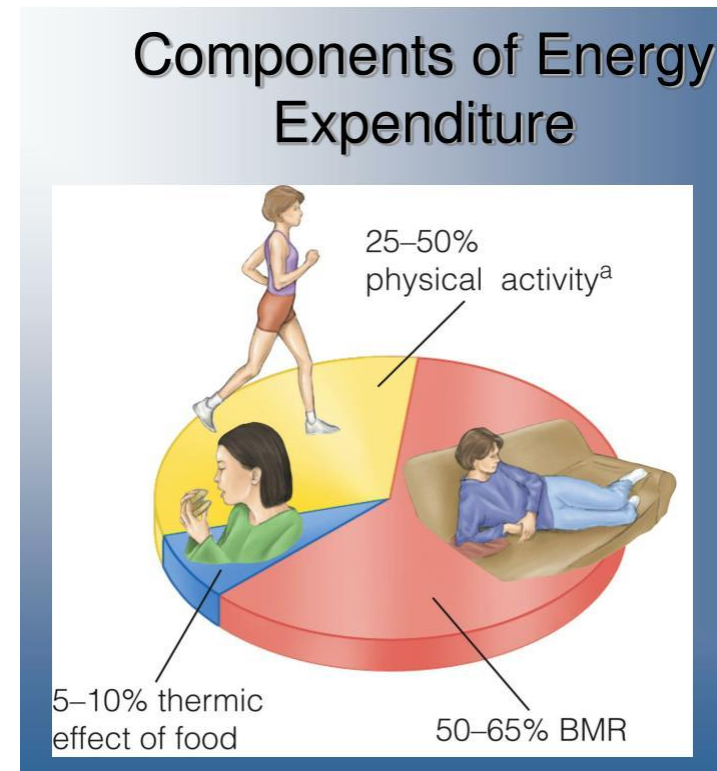


# Energy Calculation:

- An important goal in human nutrition is to ensure that the energy ingested in food is adequate to meet energy demands.
- The (FAO/WHO/UNU, 2004) report defined Energy Requirement as the amount of food energy needed to balance energy expenditure to maintain body size, body composition and a level of necessary and desirable physical activity, consistent with long-term good health.
- The first important principle is that energy requirement must be estimated on **the basis of energy expenditure** and not of energy intake.
- It is based on the recognition that it is energy expenditure that drives energy needs rather than intake, which does not necessarily reflect energy needs and may vary independently.

## Determine the Components of Energy Expenditure

- The amount of energy spent in a day differs for *each individual*, but in general, basal metabolism is the largest component of energy expenditure and the thermic effect of food is the smallest.
- The amount spent in voluntary physical activities has the greatest variability, depending on a person's activity patterns.






# Energy Requirement

- Total calories needed to maintain growth, metabolism, and activity.
- **Estimated Energy Requirement (EER)**  
Formula-based estimate of daily calorie needs based on:
  - Age
  - Sex
  - Weight
  - Height
  - Physical activity


# Energy Requirements: Stages of Life

**Adolescents =  
construction  
mode** 

Need extra calories, protein, calcium, iron, vitamins for growth.

**Adults =  
maintenance  
mode** 

Energy mainly supports activity and body function.

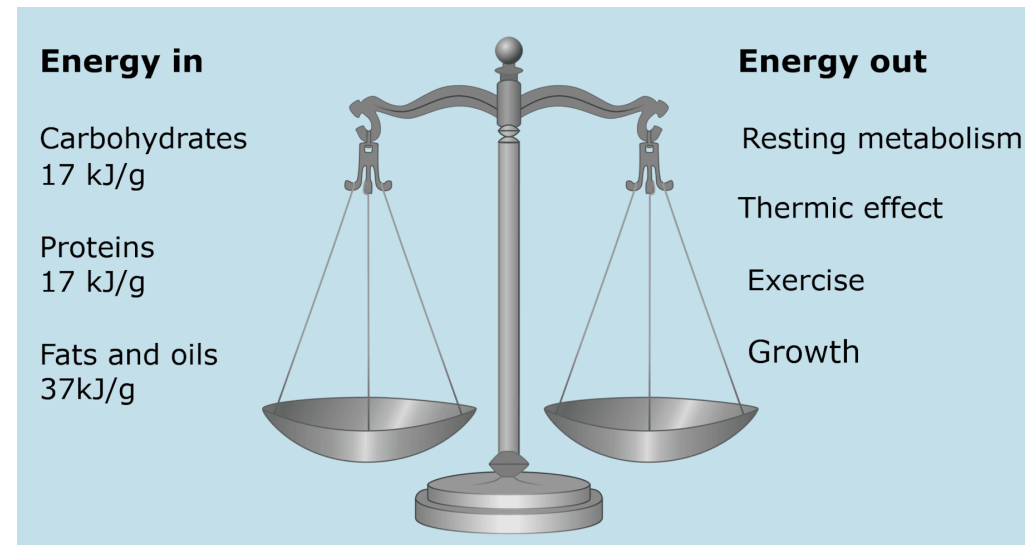
**Elderly =  
preservation  
mode** 

Lower energy needs due to slower metabolism

Protein, calcium, vitamin D become more important to prevent muscle loss, bone loss, and frailty

# Estimated Energy Requirement (EER)

- EER is the average dietary energy intake (calories) predicted to maintain energy balance in a healthy person.
- “Energy balance” = calories in = calories out, so weight stays stable.
- It’s different from RDA—this is about energy, not nutrients.





<b>Feature</b>	<b>RDA</b>	<b>EER</b>
<b>What it measures</b>	Nutrients (vitamins, minerals, protein)	Energy (calories)
<b>Unit</b>	mg, µg, g	kcal/day
<b>Purpose</b>	Prevent deficiency, support health	Maintain body weight / energy balance
<b>Based on</b>	Average requirement + variation	Age, sex, weight, height, activity level
<b>Covers</b>	~98% of population	Individual or population average
<b>Example</b>	Calcium RDA = 1,000 mg/day	EER = 2,950 kcal/day (male, 30 y, moderate activity)



## Why EER is Important?

- **Helps dietitians plan meal plans** for health, sport, or clinical purposes.
- **Maintaining Energy Balance:** It helps individuals maintain their current body weight by matching energy "in" (food) with energy "out" (metabolism and activity).
- **Growth and Development:** For children and pregnant/lactating women, the EER includes the additional energy needs for the deposition of tissues or milk production.
- **Preventing Chronic Disease:** Overestimating EER can lead to obesity, while underestimating it can lead to malnutrition or impaired physiological function.



# Estimated Energy Requirement (EER)

## **BMR / REE (Basal/Resting Metabolic Rate):**

- Energy your body burns at complete rest just to keep organs alive.

## **Physical Activity (PA):**

- Extra energy burned through movement, exercise, and daily tasks.

## **Thermic Effect of Food (TEF):**

- Energy used to digest, absorb, and metabolize the food you eat.

## **Age factor:**

- Adjusts EER because metabolism naturally slows with age.

## **Sex factor:**

- Accounts for differences in body composition between males and females.

## **Weight & Height factor:**

- Larger bodies burn more calories even at rest, so EER scales with size.



## General Formula of EER:

$EER = BMR + \text{Physical Activity Energy} + \text{Thermic Effect of Food} + \text{Energy Deposition}$

EER is based on:

- **Basal Metabolic Rate (BMR)**
  - **Physical Activity Level (PAL)**
  - **Thermic Effect of Food (TEF)**
  - **+ Energy deposition (only for growth stages like adolescence)**
- ✓ Calculating the **Estimated Energy Requirement (EER)** for adolescents is more complex than for adults because it must account for **Growth (Energy Deposition)** and the specific metabolic demands of puberty.

# Adolescents (Boys 9–18 y)

- $$EER = 88.5 - (61.9 \times \text{age}) + PA \times (26.7 \times \text{weight} + 903 \times \text{height}) + 25$$

**age:** years

**weight:** kg

**height:** meters

**PA:** Physical Activity coefficient  
(varies by activity level)

**+25:** extra adjustment for  
growth

Activity Level	Description	PA Value
Sedentary	Only usual daily living, very little extra activity	1.0
Low Active	Some light physical activity beyond daily living	1.13
Active	Moderate activity most days	1.26
Very Active	Hard activity or sports most days	1.42

## EER Formula for Girls (9–18 y)

- $$\text{EER} = 135.3 - (30.8 \times \text{age}) + \text{PA} \times [(10.0 \times \text{weight}) + (934 \times \text{height})] + 25$$

**Age** = years

**Weight** = kg

**Height** = meters

**PA** = Physical Activity  
coefficient

Activity Level	Description	PA Value
Sedentary	Only usual daily living	1.0
Low Active	Some light activity beyond daily living	1.16
Active	Moderate activity most days	1.31
Very Active	Hard activity or sports most days	1.56



## The "Base" Numbers (Constants)

- **Intercepts (88.5 and 135.3):** These represent the starting mathematical constant derived from clinical studies (doubly labeled water) to align the equation with metabolic data.
- **Age Multipliers (61.9 and 30.8):** These numbers account for the gradual decline in Basal Metabolic Rate (BMR) per unit of body mass as a person ages.
- **The "+ 25" (Energy Deposition):** This is a crucial "step" for adolescents. Unlike adults, teenagers need an additional **25 kcal/day** specifically to support the synthesis of new body tissues (growth).
- 26.7 represents the calorie contribution of body weight (per kg) to energy needs for adolescents.
- **26.7, 903, 934 are empirical constants**, not random—they translate **body size into energy needs** in kcal/day.

Component	Male Adolescents (10–18 yrs)	Female Adolescents (10–18 yrs)	Notes
<b>BMR (Basal Metabolic Rate)</b>	$BMR = 17.5 \times \text{weight(kg)} + 651$	$BMR = 12.2 \times \text{weight(kg)} + 746$	Weight in kg; derived from Schofield equations
<b>PAEE (Physical Activity Energy Expenditure)</b>	$PAEE = BMR \times (PAL - 1)$	$PAEE = BMR \times (PAL - 1)$	PAL = Physical Activity Level (e.g., 1.2 sedentary, 1.55 moderate, 1.9 very active)
<b>TEF (Thermic Effect of Food)</b>	$TEF \approx 10\% \times (BMR + PAEE)$	$TEF \approx 10\% \times (BMR + PAEE)$	Approximation for digestion energy
<b>TEE (Total Energy Expenditure)</b>	$TEE = BMR + PAEE + TEF$	$TEE = BMR + PAEE + TEF$	Sum of all energy burned in a day
<b>Energy deposition (growth)</b>	+25 kcal/day (average)	+25 kcal/day (average)	Only for adolescents; adults = 0
<b>EER (Estimated Energy Requirement)</b>	$EER = TEE + \text{Energy deposition}$	$EER = TEE + \text{Energy deposition}$	Total calories needed per day for balance + growth

## 1. BMR Calculation: BMR for Adolescents (10–18 years)

These are based on the **Schofield equations**, widely used in nutrition science.

<b>Sex</b>	<b>BMR Equation</b>	<b>Units / Notes</b>
<b>Male</b>	$\text{BMR} = 17.5 \times \text{weight}(\text{kg}) + 651$	Weight in kg, BMR in kcal/day
<b>Female</b>	$\text{BMR} = 12.2 \times \text{weight}(\text{kg}) + 746$	Weight in kg, BMR in kcal/day

- BMR represents energy used at rest for basic body functions: heartbeat, breathing, cell maintenance.
- For TEE and EER, this BMR is then adjusted for physical activity, TEF, and energy deposition.



## Example:

### Male adolescent

•Weight = 55 kg

$$BMR = 17.5 \times 55 + 651$$

$$BMR = 962.5 + 651 = 1613.5 \approx 1614 \text{ kcal/day}$$

### Female adolescent

•Weight = 50 kg

$$BMR = 12.2 \times 50 + 746$$

$$BMR = 610 + 746 = 1356 \text{ kcal/day}$$

# Assignment: FIND BMR

Name	Sex	Age (yrs)	Weight (kg)	Height (cm)
Adam	Male	15	55	160
Sara	Female	14	50	155

## 2. Calculate PAEE (Physical Activity Energy Expenditure)

- $PAEE = BMR \times (PAL - 1)$
- Accounts for calories burned during movement and exercise.

- **Example:**



Use the **Schofield equation for males 10–18 yrs:**

$$BMR = 17.5 \times \textit{weight} + 651$$

$$BMR = 17.5 \times 55 + 651 = 962.5 + 651 = 1613.5 \approx \mathbf{1614 \textit{ kcal/day}}$$

**Calculate PAEE**

$$PAEE = BMR \times (PAL - 1)$$

$$PAEE = 1614 \times (1.55 - 1) = 1614 \times 0.55 = 888 \text{ KCAL}$$



### 3. Calculate Thermal Effect of Food

- $TEF \approx 10\% \times (BMR + PAEE)$
- TEF represents the energy the body uses to digest, absorb, and process food.

**First, sum BMR + PAEE:**

$$1614 + 888 = 2502$$

**Take 10%:**

$$TEF = 2502 \times 0.10 = 250.2 \approx \mathbf{250 \text{ kcal/day}}$$



## TEE (Total Energy Expenditure),

- **TEE (Total Energy Expenditure)**, which is:
- $TEE = BMR + PAEE + TEF = 1614 + 888 + 250 = 2752 \text{ kcal/day}$
- **EER** for growth:
- $EER = TEE + 25 \text{ kcal} = 2752 + 25 = 2777 \text{ kcal/day}$



# AMDR

- AMDR stands for **Acceptable Macronutrient Distribution Range**. It's a guideline used in nutrition to indicate the recommended percentage of your daily calories that should come from each macronutrient—carbohydrates, proteins, and fats—for overall health and disease prevention.
- For adolescents, the AMDR (Acceptable Macronutrient Distribution Range) is slightly adjusted to support growth, puberty, and higher energy needs.
- The ranges are generally: Carbohydrates: 45–65% of total daily calories, Protein: 10–30% of total daily calories (slightly higher than adults for growth) , Fat: 25–35% of total daily calories (emphasizing healthy fats)
- **Why it differs from adults:** Adolescents are in a rapid growth phase, so protein needs are relatively higher, and they also need sufficient energy from carbs and fats to support physical activity and brain development.

## Define the AMDR percentages

From dietary guidelines for adolescents:

Carbs:  
45%–65%

Protein:  
10%–30%

Fat:  
25%–35%

**Fat kcal** = Total Calories × AMDR fraction

Lower limit:  $2777 \times 0.25 = 694.25 \approx 694 \text{ kcal}$

Upper limit:  $2777 \times 0.35 = 971.95 \approx 972 \text{ kcal}$

**Protein kcal** = Total Calories × AMDR fraction

Lower limit:  $2777 \times 0.10 = 277.7 \approx 278 \text{ kcal}$

Upper limit:  $2777 \times 0.30 = 833.1 \approx 833 \text{ kcal}$

**Carb kcal** = Total Calories × AMDR fraction

Lower limit:  $2777 \times 0.45 = 1249.65 \approx 1250 \text{ kcal}$

Upper limit:  $2777 \times 0.65 = 1805.05 \approx 1805 \text{ kcal}$

## Convert kcal to grams

- Carbs & Protein: 1 g = 4 kcal
- Fat: 1 g = 9 kcal
- Examples:
- **Carbs**
- $\text{g/day} = \frac{\text{kcal}}{4}$
- Lower:  $1250 \div 4 = 312.5 \approx 313$  g
- Upper:  $1805 \div 4 = 451.25 \approx 451$  g

### Protein

$$\text{g/day} = \frac{\text{kcal}}{4}$$

$$\text{Lower: } 278 \div 4 = 69.5 \approx 70 \text{ g}$$

$$\text{Upper: } 833 \div 4 = 208.25 \approx 208 \text{ g}$$

### Fat

$$\text{g/day} = \frac{\text{kcal}}{9}$$

$$\text{Lower: } 694 \div 9 \approx 77 \text{ g}$$

$$\text{Upper: } 972 \div 9 \approx 108 \text{ g}$$

# Daily water needs for an adolescent

- **Water needed (liters/day)=Body weight (kg)×0.035**
- **Suppose an adolescent weighs 50 kg:**
- $50 \times 0.035 = 1.75 \text{ liters/day}$
- **For moderate activity, you can add ~0.5–1 L:**
- $1.75 + 0.5 \approx 2.25 \text{ liters/day}$

depends on how active the adolescent is:  
Sedentary → +0 L  
Moderate → +0.5 L  
High → +1–1.5 L

The same equation can be used for both male and female adolescents, because it's based primarily on body weight and activity level, not sex.



## **Points to be Discussed: Proposal Assignment**

- Traditional Kurdish Foods and Their Nutritional Value – Explore local dishes, ingredients, and their health benefits.
- Nutrition Needs at Different Life Stages – Infants, children, adolescents, adults, and older adults.
- Local Nutrition Guidelines and Recommendations – How regional guidelines support healthy eating across life stages.
- Impact of Modern Food Trends and Technology – Role of food apps, food trucks, and fast foods on dietary habits.
- Strategies to Promote Healthy Eating Across Life Stages – Education, adaptation of traditional recipes, and community programs.
- Role of Hospitals and Healthcare Facilities – How hospitals support nutrition through patient care, dietary counseling, and public health initiatives.



# Assignment:

## Case 1:

**Teen girl :** 17 years old, 60 kg, 165 cm, very active (training 2 hours/day, 6 days/week)

## Case 2:

**Teen Boy:** 16 years old, 75 kg, 170 cm, moderate activity

- Calculate her daily calorie requirement using a standard adolescent formula.
- Determine AMDR-based grams of carbohydrates, protein, and fat.
- Calculate her daily water requirement based on weight and activity.
- Plan 3 main meals + 2 snacks that meet calorie and macro needs.
- Calculate: hydration schedule across the day.



- **Apps for Meal Planning & Calorie Tracking**

- **Eat This Much – Meal Planner** – Automatically generates daily or weekly meal plans based on your calorie and macro targets, food preferences, and schedule. You tell it what you want to eat and how many calories you want, and it builds the plan.
- **Calz – Calorie Counter AI** – Tracks calories and macros using AI and helps plan your meals while logging what you eat, either by scanning your food or searching from a database.
- **Nutrifio: Calorie Counter & Diet** – Smart food and macro tracker with built-in meal planning features to help meet your calorie goals.
- **CalMeal – ) أعداد السعرات الحرارية (iPhone)** – Tracks calories, macros, and food intake to help you stay within your calorie goals, which you can use to plan meals accordingly.
- **MyPlate Calorie Tracker** – Logs your food and estimates calories and nutrient intake so you can plan meals that match your daily calorie goals.
- **Meal Plan & Tracker: NutriPlan** – AI-assisted meal planning with calorie tracking and daily nutrition recommendations.

- **Professional & Advanced Software**

- **Foodzilla** – A professional meal planning platform used by dietitians and nutritionists to create customized, calorie-based meal plans, including nutrient breakdowns and grocery lists.
- **Nutrition Maker** – A cloud-based tool that calculates calorie needs (using weight, age, activity level, etc.) and builds meal plans automatically — great for coaches or detailed personal planning.

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