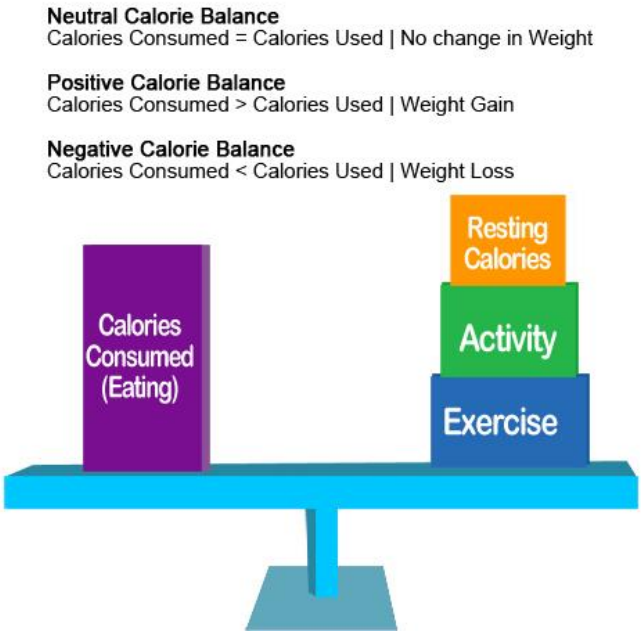
ENERGY BALANCE

Energy balance refers to the relationship between "**energy intake"** (food consumption) and "**energy output"** (basal metabolism and physical activity).

1. ENERGY OUTPUT

In the body human, we found two sources of energy consumption:

- Basal metabolism
- Energy demand about daily activities



To maintain a steady body weight, the energy spent should approximately equal the energy consumed. Daily variations occur, but over time calories out and calories in should be approximately equal.

1.1 Basal Metabolism

Metabolism refers to the processes that the body needs to function.

Basal Metabolic Rate (BMR) is the amount of energy expressed in calories that a person needs to keep the body functioning at rest.

Some of those processes are breathing, blood circulation, controlling body temperature, cell growth, brain and nerve function, and contraction of muscles. BMR affects the rate that a person burns calories and ultimately whether **you maintain, gain, or lose weight**. Your basal metabolic rate accounts for about 60 to 75% of the calories you burn every day. It is influenced by several factors.

There are **several variables that can affect an individual's BMR**. For instance, individuals that live in colder climates are often reported as having higher BMRs on average. The reason for their higher BMR level is the fact that their physical body is required to expend more energy in order to maintain a constant body temperature. Some of this **variables affect an individual's BMR** are as follows:

Body Composition: The more muscle you have, the higher your metabolic rate tends to be even at rest. Muscle burns 3-5 times more calories than fat does.

Exercise: Physical exercise is not only responsible for burning calories, but also for increasing an individual's BMR due to the additional **lean muscle mass** that is created as a result of exercise. Lean **muscle tissue is much more metabolically demanding than fat tissue**, so an individual will burn more calories even while sleeping.

Age: The metabolic rate is highest during the periods of rapid growth. As you get older, the amount of muscle decreases and metabolism naturally slows about 2-5% per decade after age 40 due to decrease in lean mass and a greater percentage of body fatness.

Weight: The heavier you are, the more calories you need. That is one reason it is easier to lose weight at the start of a diet, and harder later. The less you weigh the fewer calories you need.

Gender: Women in general, have a metabolic rate about 5-10% lower than men even when of the same weight and height. Men generally burn more calories at rest than women because they body composition includes more muscle tissue.

Body Surface Area: The greater your body's surface area or skin area, the higher your BMR. Tall, thin people have higher BMRs.

Endocrine Glands: The thyroid hormones are the principal regulators of the metabolic rate. When the supply of thyroxin is inadequate, the BMR may fall 30 to 50%. If the thyroid is hyperactive, the BMR may increase to twice the normal amount. The BMR in women fluctuates with the menstrual cycle. There is an average of 359 calories per day difference between its high point and low point. Pregnancy also increases metabolic rate.

Thermic effect of food (abbreviated as **TEF**), also known as **specific dynamic action** (**SDA**) is the amount of energy expenditure above the resting metabolic rate due to the cost of **processing food for use and storage**.

Secondary factors can also affect metabolic rate. If the body perceives

starvation either by real starvation or by extreme dieting, a person's metabolic rate can go as much as 50% below normal. Diets below 1,000 calories a day can decrease metabolic rate. **The body is programmed for survival** and interprets the reduction in calories as starvation, and all systems slow down to conserve energy.

During sleep, the rate falls about 10% below that of waking levels. **Fever** increases the metabolic rate about 7% for each degree rise in body temperature. How much a person's muscles as relaxed affects the amount of energy used. The less relaxed the muscles are, the greater the metabolic rate. Emotional strain can cause increased tension and thus increase metabolic rate. That being said, do relax and get adequate sleep. People with sleep deprivation tend to have slower metabolisms and higher levels of cortisol, the hormone that can cause fat storage.

1.2 **Which is my basal metabolism?**

To calculate our BMR (basal metabolic rate) we can use two ways:

Direct measurement: Method: direct or indirect **calorimetry**.
BMR: Conditions: measured under very restrictive circumstances and strict adherence to protocols. This method is generally impractical in most cases.
RMR (resting metabolic rate): less restrictive conditions and more easily obtained. The resting metabolic rate is only **marginally** different from the BMR.

Predictive equations:
An alternative method is to use **predictive equations** that can provide a rough *estimate* of the basal or resting metabolic rate. The basal or the resting metabolism is **the largest component of the total energy expenditure** (TEE), usually 60 - 75%. The RMR or BMR is usually at the higher end of this range for sedentary individuals (70-75%) and at lower the end for athletes. We are going to use the Harris Benedict equation to calculate our BRM or RMR (although it is not equal, we are going to use both to refer the same) :

BMR calculation for men (metric)
BMR = 66.47 + (13.75 x weight in kg) + (5.003 x height in cm) - (6.755 x age in years)

BMR calculation for women (metric)
BMR = 655.1 + (9.563 x weight in kg) + (1.850 x height in cm) - (4.676 x age in years)

Result will be expressed in Kcal/day.

FAO (Food and Agriculture Organization), doe to the age factor and puberty, to young people between 10 and 18 years old, applies this equation:

- **Girls**: 7,4 x weight (kg) + 428 x height (m) + 572 kcal/day
- **Boys**: 16,6 x weight (kg) + 77 x height (m) + 572 kcal/day

Now is your moment. Calculate your RMR/BMR using the appropriate equation:

What is your basal metabolism in kilocalories by day? May you calculate it?

And what is your basal metabolism in kilocalories by hour? May you calculate it?

1.3 **Total Energy Expenditure (TEE)**

The total energy expenditure (amount of calories needed per day) is composed of three primary factors: (1) Resting or basal metabolic rate (2) Thermic effect of food (3) Activities of daily living (ADL) - physical activity. This accounts for about 30% of caloric needs. An inactive personal usually requires 30% more calories above basal, whereas a lightly active person might need 50% above basal, a moderately active person 75%, and a very active person 100%.

We are going to calculate our energy consumption with BMR and ADL.

The following activity/stress factors when used along with an estimation of the resting or basal metabolic rate can be used to estimate an individual's total energy expenditure (TEE) in kcal/day

Activity	**BMR variation coefficient (VC)**	**Kcal./hour (BMR X VC)**	**Total hours/day**	**Physical Activities Examples**
Rest	BMR x 1			Sleeping, (comfortable temperature)
Very soft	BMR x 1,5			To paint, to play table games, to play an instrument, surfing web, to study, to read, to watch TV…
Soft	BMR x 2,5			To walk around 4-5 km/h, to work in a workshop or like a waitress….
Moderate	BMR x 5			To walk quickly around 6 km/h, gardening, to ride a bike around 18 km/h, to play tennis or to dance...
Heavy	TMB x 7			To run around 12 km/h, play collective sports, to climb…
Very Heavy	TMB x 15			To practice high intensive sports…. (Usually this activities only can practice for a few minutes)
Total hours in a day			**24 .**	

2. ENERGY INTAKE

Calories (Energy) IN = Calories (Energy) OUT

For a person to maintain their body weight, energy consumed must equal energy expended, thus an imbalance between energy expenditure and consumption will result in weight change.

Calories (Energy) IN > Calories (Energy) OUT = Weight GAIN

Calories (Energy) OUT > Calories (Energy) IN = Weight LOSS

To maintain a correct weight, we need to eat the same amount of energy that we use during a day.

In the first part of this issue, we have learnt how we can calculate our energy out. Now we are going to learn the way to calculate the calories that we eat throughout feeding. To do this we are going to base on the

day which we have calculated our energy output.

1st STEP: We need to write down the food and the weight of nutriments that we will eat in this day.

2nd STEP: We need to organize each eat in a list to calculate the energy that have provided to us.

BREACKFAST: milk + cola cao + 10 cookies + banana			
Food	Energy by 100 (gr)	Weight (gr)	Total energy (cal)
Milk	63	250	258
Cola Cao	378	15	56,7
10 cookies	482	60	282,92
Banana	95,03	160	152,05
TOTAL BREAKFAST ENERGY			749,67

3rd STEP: Repeat this procedure with all your meals.

You can use the nutrients table of nature science or look in website (for instance http://www2.uned.es/pea-nutricion-y-dietetica-I/guia/guia_nutricion/recom_composic.htm)

4th STEP: When you calculate the total energy that you have spent and the amount that you have taken in, How much is the difference between both?

What will be happen if you maintain this? Will you gain or lose weight?

Think about it and write your point of view about this and about the relationship between diet, physical activity and health.

This may be an exam question…