TOPIC 3

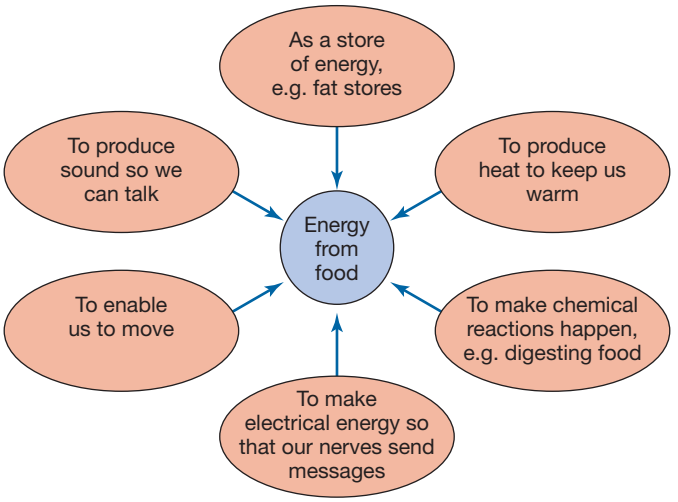
ENERGY AND FOOD

WHAT IS ENERGY?

Energy gives us the ability to do work, move around, keep warm and be active. We need a certain amount of energy just to stay alive and keep everything in the body working – the heart beating, the digestive system working and the brain sending out messages to the body. This amount is called the **basal metabolic rate (BMR).**

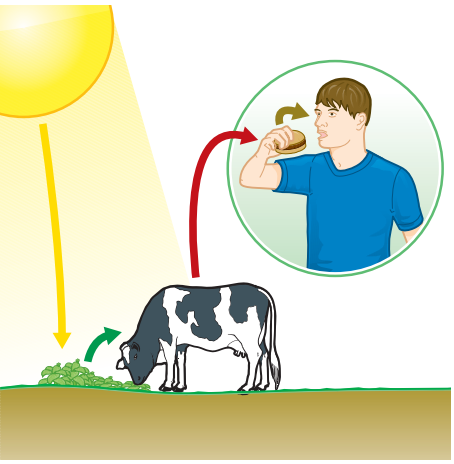
How is energy used in the body?

Energy is used all the time for various jobs in the body.



The amount of energy that different people require varies from day to day. The factors that influence how much energy you need are:

- **Your age:** Babies and children need a lot of energy because they are usually very active and are continually growing. Teenagers need more energy than adults because they are still growing and are often (but not always!) very active. As people get older, their energy requirements gradually get smaller as the body starts to slow down.
- **Your activity levels:** The more physically active you are, the more energy you will use. Some activities – athletics, playing rugby or football, manual building work, working in a job where you are continually lifting heavy objects, climbing mountains and cycling long distances – use up large amounts of energy and people have to make sure that they eat enough energy-dense food at regular intervals throughout the day to sustain them.
- **Your state of health:** Sometimes an illness may increase your energy use as your body tries to fight an infection. The illness may stop you being physically active and it may reduce your appetite, so your body will have to rely on getting energy from its fat stores. This is why people often find they lose weight when they have been ill. When a woman is pregnant or lactating (breastfeeding her baby), her energy needs will increase to cope with the demands of the growing baby on her body.



Where energy comes from

- **Your gender:** On average, males need more energy each day than females because they are generally bigger and have more muscles (muscles use a lot of energy). Everyone has individual needs for energy, so a tall, physically active female will use more energy than a short, non-active male!

Where does energy come from?

All energy originally comes from the sun. Plants trap the sun's energy and store it as carbohydrate (sugars and starch) or fat. Animals eat the plants and use some of the energy from them to be active and store some of it as fat. People eat animals and plants and use the energy that is found in the macronutrients they contain (carbohydrates, fats and proteins).

HOW IS ENERGY MEASURED?

Energy is measured in two ways:

- We use a metric unit called the **joule (J).** One joule is a very small measurement, so for measuring energy in food we use the **kilojoule (kJ).**
- We also use another measurement called the **calorie (cal).** One calorie is a very small measurement, so for measuring energy in food we use the **kilocalorie (kcal).**

1 kJ = 1,000J
1 kcal = 1,000cal
1 kcal = 4.2kJ

SOURCES OF ENERGY

Our bodies prefer to use carbohydrate as the main source of energy. During digestion, the carbohydrate is broken down into individual **glucose** molecules. Glucose travels round the bloodstream to all the body cells to provide them with energy. Some of the glucose is stored as **glycogen** in the **liver** and muscles to provide the body with an easily available supply of energy, e.g. for running.

Fat is also used as a source of energy, but it has to be changed into glucose in the body first. Our bodies store fat under the skin in **adipose tissue** so we can use it if we do not have enough to eat.

The body prefers to use protein for body growth and repair, but it will use it for energy if there is not enough carbohydrate or fat. To do this, it has to change the protein to glucose.

Different foods have different **energy values.** It is possible to measure this in a laboratory using special equipment. Lists of the energy values of lots of different foods are available in books, on special computer programs and on the internet.

The energy values for the three main sources of energy in the diet are shown below.

ACTIVITY

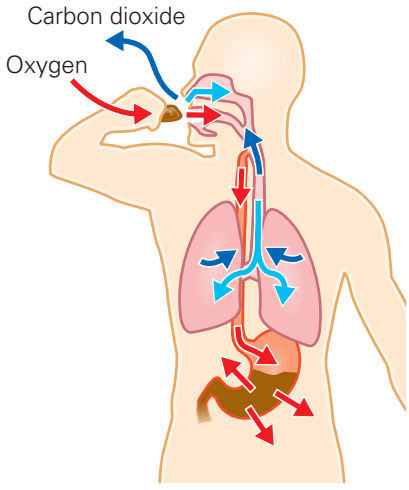
1 How is energy measured?
2 Name two nutrients that are good sources of energy.

Source of energy	Energy value	
	kJ	kcal
1g of pure **carbohydrate**	15.7	3.75
1g of pure **fat**	37.8	9.0
1g of pure **protein**	16.8	4.0

Alcohol also provides the body with energy. 1g of pure alcohol has an energy value of 29.4 kJ/7 kcal.

Energy-dense foods

Low-energy foods



Some foods are energy dense. This means that they will provide a lot more energy than the same weight of another food, which is a low energy food. Here are some examples of energy dense and low energy foods.

Name of food	Weight	kJ	kcal
Milk chocolate bar	100g	2177	520
Potato crisps	100g	2215	530
Pork pie	100g	1514	363
Cornish pasty	100g	1117	267
Cheesecake	100g	1769	426
Green salad	100g	51	12
Salad with nuts and mayonnaise	100g	1056	278
Honeydew melon	100g	119	28
Orange	100g	158	37
Grilled cod fish	100g	402	95

ACTIVITY

1 Which three foods in the chart above are the most energy dense? Explain why.
2 Which three foods in the chart above are the least energy dense? Explain why.

WHAT INFLUENCES AN INDIVIDUAL'S ENERGY REQUIREMENTS?

To understand what influences individual energy requirements we need to look at how energy is released from food into the body.

In every living cell in the body, energy is gradually released in a series of small steps. This is called **respiration**. This happens all the time so that we have a constant supply of energy.

We use **oxygen** to release the energy from food in our bodies. We get the oxygen from breathing it in through our lungs. When energy has been released, water is produced, some of which is used by the body. We also breathe out **carbon dioxide gas** and water (you can see this as you breathe on to a cold window or mirror).

ACTIVITY

1 Identify (list) three uses of energy in the body.
2 Suggest three factors that can influence an individual's energy requirements.
3 Why do babies and children need a lot of energy?
4 Why do teenagers need more energy than adults?
5 Name two activities that use up a lot of energy.
6 Give one reason why a builder might need more energy than an office worker.

Energy intake and expenditure

Most of the energy we need every day comes from the food we eat. We can store energy in the body:

- as glycogen in the liver and muscles (for a quick burst of energy – when you suddenly run)
- as fat in special tissue under the skin called adipose tissue (to supply the body with energy if not enough comes from food).

As noted at the beginning of this topic, we need a certain amount of energy just to stay alive and keep everything in the body working – the heart beating, the digestive system working and the brain sending out messages to the body. This amount is called the basal metabolic rate (BMR).

We also need more energy for any physical activity that we do – walking, standing, nodding our head, talking and picking up a bag.

Energy balance

Over a period of time, if we take in the same amount of energy each day that we use for all body activities, our weight will stay constant (the same). If we take in less energy each day than we use for all body activities, we will use energy from our fat stores and we will lose weight. And if we take in more energy each day than we use for all body activities, we will store the extra as fat and we will gain weight.

When we are young, our energy requirements are high as the body is growing and we tend to be very active. Active children usually have a healthy body weight. However, there is concern that a lot of children and teenagers do not have enough physical activity because they spend a lot of time watching television, using computers and being driven around in cars. These children are likely to become overweight if their energy intake is more than their physical activity.

As we get older, our energy requirements gradually decrease as the body slows down.

ACTIVITY

1. How is energy stored in the body?
2. What happens over a period of time if we take in more energy than we use for all our body activities?
3. A friend of yours has taken up running and swimming. She does these every day for at least an hour. She has cut down on what she eats, especially sugary and high fat foods. What is likely to happen to her weight?
4. Why will this happen?

Physical activity

Some physical activities use a lot of energy, such as running, climbing stairs, swimming, digging, lifting heavy weights and cycling. Some physical activities use very little energy, such as sitting in a chair, watching television, driving a car and using a computer.

People who are very physically active need to make sure they eat enough food to give them the energy they need so that they maintain their weight. For example, an athlete who weighs 50kg and trains for four hours a day will need approximately 13,692 kJ/3,260 kcals each day to maintain their body weight.

Physically inactive (sedentary) people need to make sure that they do not have more energy from their food each day than they use, to avoid gaining weight. For example, a sedentary person in their mid-20s weighing 50kg will need approximately 7,266 kJ/1,730 kcal each day to maintain their body weight.

People who have gained too much weight and want to lose some of it need to make sure that they take in less energy than they use and increase their physical activity, so that their body uses up its fat stores.

This process will not happen quickly and will require determination and perseverance! It takes time to become overweight so it will take time to lose the weight. For example, an overweight person in their mid-20s who weighs 100kg and wants to lose weight will need to increase their daily physical activity levels and take in approximately 6,384 kJ/1,520 kcal per day in order to lose about 0.5 to 1kg per week (which is what is advised as a sensible rate of weight loss).

ACTIVITY

Match each word with its correct definition by drawing arrows between each of the charts.

Energy dense	The amount of energy that a food can supply to the body
Physical activity	The process by which energy is released from food in small steps using oxygen
Energy	The amount of energy needed by the body just to stay alive
Energy balance	Making the body work so that it uses more energy than just the amount needed to stay alive
Basal metabolic rate	Foods that supply a lot of energy compared to the same weight of a low energy food
Respiration	Taking in the right amount of energy from food to match the body's energy requirements
Energy value	The ability of the body to do work, move, keep warm and be active

ASSESSMENT FOR LEARNING

Read the case study below and answer the questions at the end.

Maggie and Leon are in their early 20s and both work in sedentary office jobs. They have decided that they want to improve their long-term health by increasing their physical activity levels and reducing their daily energy intake. This has increased over the last few months due to both of them eating a lot of takeaway and ready meals, energy dense snack foods and alcoholic and sweetened drinks.

Here is a typical day's food intake for each of them.

Maggie	Leon
Breakfast: One fried bacon sandwich	**Breakfast:** Two fried bacon sandwiches
Cup of coffee with cream and sugar	Cup of tea with sugar
Mid morning snack: Three chocolate digestive biscuits	**Mid morning snack:** Large piece of fruit cake
Cup of coffee with cream and sugar	Cup of coffee with cream and sugar
Lunch: Hot meat pasty and a cream doughnut	**Lunch:** Large burger with fries and a vanilla thick shake
Can of cola drink	**After work:** Large bag of potato crisps
After work: Chocolate bar	**Evening meal:** Three glasses of wine
Evening meal: Two glasses of wine	Fried fish and chips with peas
Fried fish and chips with peas	Bowl of ice cream and chocolate sauce
Bowl of ice cream	

1. Using the daily food intake examples above, explain how Maggie and Leon could make their daily food intake less energy dense.
2. Plan three lunch and evening meals for the couple to help them with their change in lifestyle and eating habits. Explain how the menu will help them to balance their energy intake.
3. What might be the consequences for the couple's long-term health if they do not alter their eating habits and current levels of physical activity?