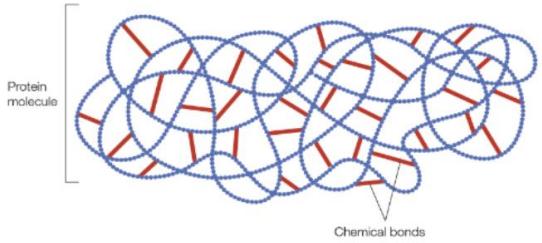
The Working Characteristics, Functional and Chemical Properties of Protein

THE STRUCTURE OF PROTEIN

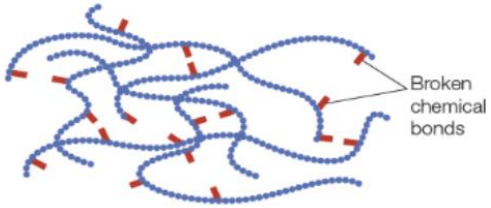
A PROTEIN MOLECULE is made up of a compact bundle. The bundle is made up of strings of amino acids, held together tightly by chemical bonds. This helps the protein bundle to take up less space.



DENATURATION

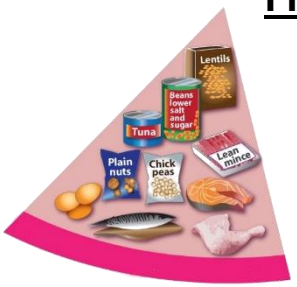
Protein molecules can be denatured.

This means that the chemical bonds break to unravel the tight bundle of amino acids. This causes the protein molecule to unfold and change shape. This takes up more space.



WHAT CASUES DENATURATION?

- Heat (e.g. frying or boiling and egg)
- Acids
  - e.g. when adding lemon juice to cream
  - Marinating meat in an acid such as citrus juice or yoghurt
- Mechanical agitation e.g. when whisking egg whites for meringues



TENDERISATION

THE STRUCTURE OF MEAT

What determines how tender or tough meat is when you eat it?

- The way it's prepared
- Part of the animal where the muscles are well used
- The animal's age

This is all due to the muscle fibres:

Thin, short fibres will give us meat that is mostly tender to eat.

• Thick, long fibres will give us meat that is mostly tough to eat.

• The meat fibres are arranged in bundles, held together with connective tissue.

The muscle fibres in the meat are formed into bundles, and these bundles are surrounded by connective tissue

In older animals, and muscles that work more (like the neck) the muscle fibres are thick and long and therefore tough.
In younger animals, and muscles that are used less, the muscles fibres will be thin and short; and therefore tender.

TENDERISATION BEFORE COOKING (Through Denaturation)

- **Mincing** (making the muscles fibres shorter

- **Mechanical force** (e.g. using a meat mallet)

- **Marinades**

A flavoursome mixture including an ac added spices

THE COOKING OF MEAT

Meat will begin to denature from 50°C and this continues to approximately 70°C.
When meat begins to denature, the two proteins in the meat muscle (myosin and actin) will become firmer. When meat is cooked, the muscle fibres coagulate and water is lost – this can cause the meat to shrink. Depending on the cut of meat and the cooking methods used, the meat can either become more tender or tough. To ensure you achieve the best eating quality, it is important to know and understand the cut of meat you are using and the most appropriate cooking method to use for it.

Dry cooking methods such as grilling and roasting can cause the meat to shrink very quickly and the meat becomes tough to eat. This is because the meat juices are squeezed out as the collagen contracts at around 60°C. These meat juices contain the extractives (flavour compounds) plus vitamins, minerals and soluble proteins. This loss of juice causes the meat to shrink and lose weight, as well as tasting dry and even chewy. This is why only tender cuts of meat should be cooked using dry cooking methods.

Moist cooking methods such as stewing meat in the oven, for example in a casserole, can cause the meat to shrink more slowly. The long slow cooking process also enables the collagen to change to gelatine, resulting in the quality of the meat being more tender. This is why only tough cuts of meat are used for long and moist cooking methods.

Tender cuts of meat – sirloin, rump, rib eye (beef), chops, loin, rib (pork), chops, cutlets, loin (lamb)

Cook these with FAST methods of cooking such as grilling and pan frying.

Tough cuts of meat – Shin, neck, brisket, flank (beef), knuckle, belly, blade (pork), scrag end, breast (lamb)

Cook these using long, moist methods such as simmering on the hob or stewing in the oven (casseroling), slow roasting.

A Note On Fat

Fat found within the meat also affects the flavour and aroma of cooked meat. When meat is cooked using a dry method, such as grilling, the extractives and fat will collect on the surface of the meat. In moist cooking methods such as braising, the extractives and fat will pass into the cooking liquid.

The Working Characteristics, Functional and Chemical Properties of Protein

COAGULATION

- When a protein molecule has denatured, it starts to take up more space.

This makes them bump into other denatured protein molecule and they start to join together in large groups.

This is called **COAGULATION**.

- When protein food coagulate, the protein molecules trap and hold water from the food in pockets.
- This caused the appearance and texture of the protein food to change. In eggs and foods containing egg, the egg will start to

The egg whites and the yolk set at different temperatures, which is why you can have a 'dippy' yolk within a set egg white.

- Due to their ability to coagulate, the proteins in eggs are used to hold other ingredients together. E.g.
  - Vegetables in a quiche flan
  - A breadcrumb or batter coating on the outside of fish/fishcakes
  - Combining the ingredients of a beef burger
- If a food containing protein is overcooked, the coagulated protein molecules tighten up and squeeze out the water they are holding. This is why overcooked meat or fish is chewy and why overcooked scrambled egg becomes rubbery and watery.

GLUTEN FORMATION

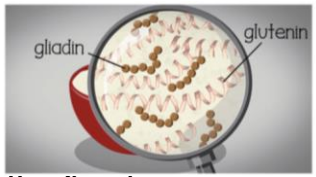
- Gluten is a really important part of getting the correct texture in some baked products.

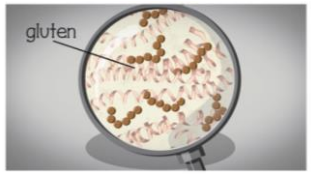
In some baked products, such as bread and cakes, we want them to have a light an open texture.
The raising agent will help with this, by making the raw dough or batter rise in the oven, but the batter needs to have a structure that will this shape in place. It needs to be able to stretch for the mixture to rise. They can stretch because of GLUTEN.

- Strong plain flour contains lots of gluten, with is made of two proteins called gliadin and glutenin.

Therefor, strong plain flour is used when breadmaking as it needs to stretch a lot for how high it rises and hold the shape for a long time.

- Some baked products such as those made with shortcrust pastry, require less gluten, as it doesn't need to rise and would in fact make the pastry more chewy. So regular pain flour is used in these.



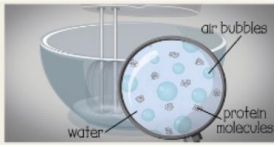


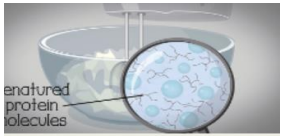
How it works

Liquid is added to the flour, this combines the proteins(gliadin and glutenin) to form a gluten network. This usually just called gluten. * The dough is kneaded to make it smooth and stretchy. Gluten enables the dough to be shaped and stretched. This is known as plasticity The dough is stretchy because gluten molecules are spirals/coiled and will are abled stretch in oud out of shape. * This means when bread is made the dough is able to stretch when the raising agent (e.g. yeast) produces Co2 gas. * The gluten network traps the air bubbles and sets when balked,

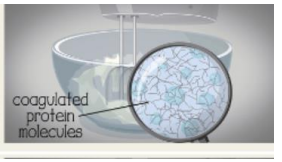
FOAM FORMATION

- Egg white is a liquid made of a mixture of proteins and water.
- It can up to 7 times its own volume in because of the egg white's ability to stretch. When egg whites are whisked (for example to make meringue,) the action of the whisk rotating very quickly traps lots of air bubbles to make a gas-in-liquid foam

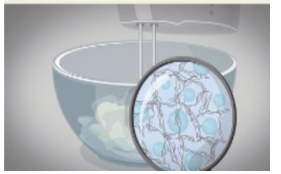




- The action of the whisk also makes some of the protein molecules denature by breaking the bonds that hold the amino acids strings together This caused them
- protein bundle to unfold and join up with other protein molecules, This is called coagulation..



- These denatured proteins then surround the air bubbles and make a 'wall' around them, which holds the air bubbles and water in place so that the foam s stabilised,.



- The foam will not form properly if there is any egg yolk or traces of at in the bowl.
- If you over-whisk egg whites, the foam will start to collapse and become watery and loose.
- This is because if you over-whisk protein the mixture, is make to he coagulated protein molecules bind together too tightly and squeeze out all the water they are holding.

Fruit and vegetable KO

IODINE

It produces the hormone thyroxin in the thyroid gland to control the metabolic rate of the body. It is found in seafood, milk and dairy foods. A deficiency causes the neck to swell up and this is called goitre.

The 5 a day campaign is based on advice from the World Health Organization which recommends eating a minimum of 400g of fruit and vegetables a day to lower the risk of serious health problems such as heart problems such as heart disease , stroke and some kind of cancers.

The government has launched the **five-a-day campaign** to persuade people to eat at least **five** portions of fruit and vegetables every **day**. Fruit and vegetables are packed with vitamins, minerals and fibre, as well as being low in calories, so are vital to a healthy diet.

The fruit can be eaten as fresh, canned, dried, juiced and smoothies.

WATER

Functions

It forms all cells and body tissues as well as all body fluids. It is part of many chemical reactions in the body. It controls body temperature. It is used in digestion and nutrient absorption. It removes waste products from the body. It keeps the digestive system and lungs healthy. It keeps the skin moist and healthy. It controls the concentration of substances in the blood

Sources and amount needed

Drinking tap water or getting water from foods like fruit and vegetables. Each day 1-2 litres of water should be consumed by everyone, increasing if the weather is hot.

Effect of deficiency or excess

Too little water causes dehydration and cause kidney problems. Too much water can over dilute the liquid in the organs.

ENZYMIC BROWNING

What is it—the discoloration of fruit and vegetables due to the reaction of enzymes with plant cell substances and oxygen from the air, e.g. bananas, apples, potatoes, avocados, mushrooms

How it happens –the enzymes in the cytoplasm and the oxygen form the air mix with the substance in the vacuole causing oxidation which changes the colour of the fruit or vegetable.

How to prevent it: add an acid, cooking and blanching (all denature the enzyme protein), putting in cold water to prevent oxygen mixing with the enzymes

Antioxidants

Every day our bodies are exposed to different chemicals from the air, water and food. Some of these pick up oxygen in the body and become reactive 'free radicals". Theses can cause damage to the sells in our bodies which could lead to inflammation, heart disease or cancer. Antioxidants help prevent these chemicals from picking up the oxygen so that they cannot damage the body's cells. Vitamin A, c and E are all antioxidants.. Fruit and vegetables contain good amounts of these antioxidant vitamins.

Effect of food preparation and cooking on vitamins

Effect

The water soluble vitamins B and c plus antioxidants are especially vulnerable to damage and loss during preparation and cooking

Prevention

Storing

- Choose fruit and vegetables that are as fresh and undamaged as possible. This prevents release of enzymes which destroy vitamin C and antioxidants

Preparation

- Cut and tear fruit just before cooking or serving to reduce enzyme release which destroys vitamin c and antioxidant loss.

Cooking

- Prepare fruit and vegetables just before cooking and serving as exposure to light and oxygen in the air destroys nutrients such as B1, C and antioxidants
- Cook in minimum water for the shortest time and use the liquid for gravy or soups. The loner cooking takes the greater the damage. Vitamin B and C are soluble in water so lost in the cooking water

SEASONAL FRUIT AND VEGETABLES

To eat seasonally means eating plant foods that are at the stage of the life cycle when they are ready to be harvested and at there most plentiful. They tend to have better flavour and be fresher. They are also cheaper and more nutritious.

The reasons why it is important are is lowers the carbon footprint of the food and reduces the environmental impact by buying local produce. It supports the local economy and businesses.

Examples of seasonal fruit and vegetables

SPRING	SUMMER	AUTUMN	WINTER
New potatoes	Asparagus Blackberries Carrots New potatoes Strawberries tomatoes	Apples Leeks Sweetcorn tomatoes	Apples Leeks swede

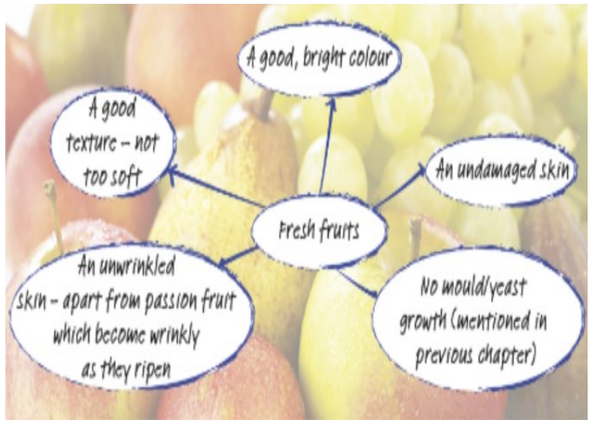
WATER SOLUBLE VITAMINS

Chemical name	Food sources	Function	Defiency
Thiamin B1	Meat,milk, cheese, eggs, vegetables, fresh and dried fruit, wholemeal bread, fortified breakfast cereal	Enables energy to be released from carbohydrates during respiration	Beri-beri causes problems with memory, concentration and heart rate
Riboflavin B2	Milk and milk products, eggs, rice, mushrooms, fortified breakfast cereal	Enables energy to be released from carbohydrates during respiration	Rare
Niacin B3	Beef, pork, flour, eggs, milk, can be made by amino acid tryptophan in the body	Enables energy to be released from carbohydrates during respiration	Pellagra—3 symptoms include diarrhea, dermititus, dementia
Folate B9	Green leafy vegetables, peas, marmite, chick peas, wholegrain rice, fruit, added to bread and cereals, folic acid tablets	Works with B12 to make healthy red blood cells. Reduces risk of developing central nerve defects in unborn babies	Megablastic (large cell) anaemia
Cobalamin B12	Liver, meat, fish, cheese, fortified breakfast cereal	Works with folate	Pernicious anaemia
Ascorbic Acid C	Citrus fruit, blackcurrants, kiwi, guavas, Brussel sprouts, cabbage, broccoli, new potatoes	Helps the absorption of iron, maintains connective tissue and an antioxidant	Iron deficiency anaemia, bleeding unde the skin and wounds taking longer to heal. Scurvy

COOKING METHODS FOR FRUIT AND VEGETABLES AND THEIR IMPACT

Method	What happens	Effect on appearance	Effect on palatability	Effect on nutrients	Heat transfer
BOILING	Cooking food in water at 100'c	Pasta swells, meat shrinks, eggs go opaque,	Vegetables and pasta soften, meat becomes tender	B1,B2 and C are destroyed. Starch is softened	Conduction to convection
BRAISING	Sealing meat in hot fat then cooking slowly in a covered dish with liquid	Vegetables soften, meat denatures, starch gelatinizes	Meat is tenderized	B group vitamins and C are leached into the cooking liquid	Conduction to convection
SIMMERING	Cooking food in liquid just below boiling point	Colours of vegetables intensify	Meat and vegetables are tenderized	B group vitamins and C are leached into the cooking liquid	Conduction to convection
STEAMING	Cooking food in steam rising from the pan below	Vegetables soften, meat denatures, starch gelatinizes	Fish shrinks slightly and becomes flaky.	Less loss of the water soluble vitamins B group and C	Conduction to convection
ROASTING	Cooking food in the oven with oil	Meat turns brown, onions go caramel, eggs become opaque	Softened vegetables and food becomes crispy	Become more energy dense and addition of fat soluble vitamins	Convection to conduction
STIR FRY	Frying food for a short time in oil and a wok	Vegetables soften and meat denatures	Foods become crispier	B1, B2 and C are lost. Foods become energy dense	Conduction
SHALLOW FRY	Frying food in a shallow pan with little oil	Vegetables soften and meat denatures	Foods become crispier	B1, B2 and C are lost. Foods become energy dense	Conduction
SAUTERING	Frying food in a little oil to soften	Intrinsic sugars caramelize	Flavour intensify and vegetables become sweeter	Addition of fat soluble vitamins in cooking fat	Conduction

<u>What to look for when buying fruit and vegetables</u>



Dietary Reference values for vitamins

Age/gender		Vitamin									
		A	D	E	K	B1	B2	B3	B9	B12	C
Children	1–3 years	400mcg	#	–	–	0.7mg	0.6mg	–	70mcg	0.5mcg	30mg
	4–6 years	500mcg	#	–	–	0.9mg	0.8mg	–	100mcg	0.8mcg	30mg
	7–10 years	500mcg	#	–	–	1.0mg	1.0mg	–	150mcg	1.0mcg	30mg
Teenagers (male)	11–14 years	600mcg	#	–	–	1.2mg	1.2mg	–	200mcg	1.2mcg	35mg
Teenagers (female)	11–14 years	600mcg	#	–	–	1.0mg	1.1mg	–	200mcg	1.2mcg	35mg
Teenagers (male)	15–18 years	700mcg	#	–	–	1.5mg	1.3mg	–	200mcg	1.5mcg	40mg
Teenagers (female)	15–18 years	600mcg	#	–	–	1.2mg	1.1mg	–	200mcg	1.5mcg	40mg
Adults (male)	19–50 years	700mcg	#	4mg	0.001mg for each kg body weight (all adults)	1.4mg	1.3mg	17mg	200mcg	1.5mcg	40mg
(female)	19–50 years	600mcg	#	3mg		1.2mg	1.1mg	13mg	200mcg	1.5mcg	40mg
(male)	50+ years	700mcg	^	4mg		0.9mg	1.3mg	17mg	200mcg	1.5mcg	40mg
(female)	50+ years	600mcg	^	3mg		0.8mg	1.1mg	13mg	200mcg	1.5mcg	40mg
Pregnant women		700mcg	*	–		0.9mg	1.4mg	13mg	300mcg	1.5mcg	50mg
Women lactating (breastfeeding) for up to 4 months		950mcg	*	–		1.0mg	1.4mg	13mg	260mcg	1.5mcg	70mg
Women lactating (breastfeeding) for over 4 months		950mcg	*	–		1.0mg	1.4mg	13mg	260mcg	1.5mcg	70mg

The Nutrition and Health of Fats and Oils

Fats – an introduction

Fats and oils are called triglycerides. All fats/oils provide us with energy. 1g of fat = 9 kcals of energy.
Fat intake should not be more than 35% of total energy intake. Only 11 % of our energy intake should come from saturated fat.

Functions of Fats

* Provide energy * Keep the body warm as adipose tissue under the skin *Protect organs (e.g. kidneys) *Provide fat-soluble vitamins A,D, E & K *Provide essential fatty acids *Make you feel fuller for longer because fats slow down the rate at which the stomach empties.

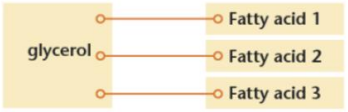
Sources of Fat

Animal Sources	Vegetable Sources
Butter, ghee	Vegetable and plant oils
Lard, goose fat, suet, dripping	Avocados
Meat and meat products	Olives
Oily fish (e.g. mackerel)	Nuts
Full fat Greek yoghurt	Seeds
Hard cheese	Vegetable fat spreads
Cream	Coconut cream
Egg yolk	Salad dressings
Chocolate, pastries, biscuits, cakes (these contain fat like butter)	Sesame, corn, rapeseed oil
Fried chicken/ fried fish	hummus

Chemical structure of fat/oils

Fats are composed of chemical elements: carbon, hydrogen and oxygen

Fat molecules are made of one unit of glycerol and three fatty acids as shown in the diagram.



The fatty acid can be

- **Saturated** (full up with hydrogen atoms)
- **Unsaturated** (not full up) with hydrogen atoms

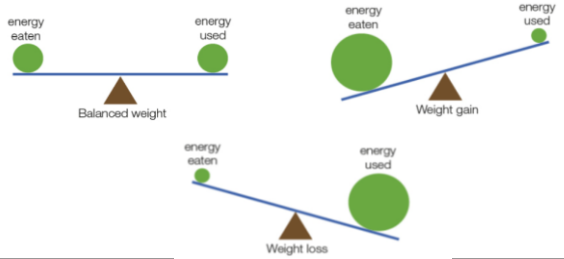
Types of Fats and Oils

Saturated fats – saturated fats are mainly a**nimal foods** (e.g. red meat, butter, cream, hard cheese, eggs). *Too much saturated fats have been linked to high blood cholesterol which causes an increase risk of heart disease, type 2 diabetes and obesity.

Unsaturated fats- are found in animal and plant foods e.g. oily fish, nuts and seeds. * Unsaturated fats are healthier than unsaturated fats. They may lower blood cholesterol levels and reduce the risk of heart disease.
Monounsaturated fatty acids have **one double bond** e.g. avocados, cashews and peanuts
Polyunsaturated fatty acids have **two or more double bonds** e.g. sunflower oil

Energy Balance

As fats are high in calories (Kcals) we need to make sure we are eating the right amounts of them, and /or doing the right amount of exercise to burn excess fat off. Fat can be stored on the body if too much is consumed.



Essential Fatty Acids

Omega 3 and omega 6 are **essential fatty acids** and must be eaten in the diet as the body cannot make them. They are vital for the proper functioning of the brain and nervous system.
Omega 3 is found in oily fish, seeds and green leafy veg. **Omega 6** is found in veg, grains, seeds and chicken

Cholesterol

Cholesterol is a fatty substance that is needed by the body to make cell membranes and help with the digestion of fats.
Eating foods that are high in saturated fat will raise the cholesterol levels in the blood.
Cholesterol is carried around by **lipoproteins.**
There are 2 types of lipoprotein

- Low-density lipoprotein (LDL) called 'bad' cholesterol and
- High density lipoprotein called 'good' cholesterol'

Too much bad cholesterol and unsaturated fat in the body can build up in arteries and cause heart disease.
Good cholesterol may actually help to protect against heart disease.

Dietary Related Diseases (DRDs) related to too much fat in the diet

BMI (Body Mass Index)

The body mass index (BMI) is a measure that uses your height and weight to work out if your weight is healthy.

$$\text{Body Mass Index} = \frac{\text{Weight (in kg)}}{\text{Height}^2 \text{ (in m)}}$$

Obesity

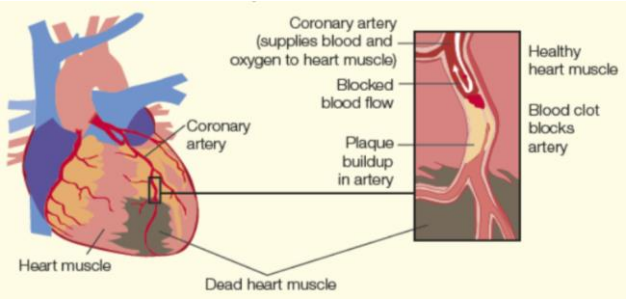
- Obesity is a condition in which excessive fat accumulation in adipose tissue impairs health.
- Being overweight and obesity are usually measured using **body mass index**, although waist circumference is also a useful guide.
- Special growth charts and associated weight recommendations exist for children.
- In the UK and most other countries, the prevalence of obesity in adults and children has been increasing over recent decades.
- Overweight and obesity are associated with an increased risk of developing some cancers, cardiovascular disease and type 2 diabetes.
- A combination of more physical activity and a suitable nutrient rich but energy controlled diet is recommended for overweight/obese adults who wish to lose weight.

Factors that affect obesity

- Physical Activity Level (PAL) – Lack of exercise (energy out)/sedentary lifestyle
- Environmental Influences – unhealthy foods easily available/sleep patterns effect appetite
- Psychological influences – easting a coping mechanism for emotional problems
- Genetics – genetic reasons/medical conditions
- Socio-economic issues – Low-income backgrounds/lack of time/resources, reliance on fast food, parents workings hours

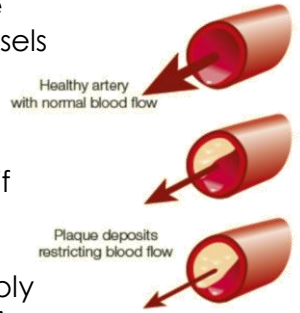
Cardiovascular Disease (CDV)

- Cardiovascular disease covers a group of diseases including coronary heart disease and stroke.
- If blood flow is reduced or stopped by a blood clot or narrowing of vessels, damage may be caused to the body.
- If this happens in the heart; it can cause heart attack.
- If this happens in the brain; the person will have a stroke.



Coronary Heart Disease

- Coronary heart disease occurs when blood vessels to the heart become blocked with fatty deposits.
- This can cause angina if the blood flow is restricted, or a heart attack if the blood supply is cut off completely. It is the main cause of death in the UK.



How to stay healthy

- Reduce energy intake (calories)/increasing Physical Activity Level (PAL).
- Prevent obesity in the first place rather than 'dieting'.
- Children who are overweight or obese should seek medical advise.
- Unnecessary slimming is not advised and could lead to someone being underweight, inadequate intake of nutrients and in severe cases, easting disorders.
- Keep active, this helps improve fitness, prevent cardiovascular disease, some cancers and type2 diabetes.
- Exercise is important – children should exercise for at least an hour a day, adults about 4 hours per week.
- Improving fitness can help mental health too.

8 TIPS FOR EATING WELL

1. Base your meals on starchy foods. (these fill you up for longer)
2. Eat lots of fruit and vegetables. Try to have 5 portions a day.
3. Eat more fish (including a portion of oily fish a week)
4. Cut down on saturated fat and sugar (try having unsaturated fats to reduce cholesterol)(sugary foods can cause tooth decay and are high in calories)
5. Try to eat less salt- no more than 6g a day (too much salt can raise blood-pressure and lead to strokes).
6. Get active and try to be a healthy weight.
7. Drink plenty of water.
8. Do not skip breakfast (you're less likely to snack un unhealthy foods and gives you the energy you need to start the day)

The Working Characteristics, Functional and Chemical Properties of Fats and Oils

Plasticity

The ability of a fat to soften over a range of temperatures and be shaped and spread with light pressure.

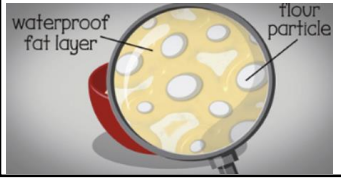
Plasticity can affect spreading, creaming and shortening.
Fats selected for shortening will have good plasticity to coat the flour.

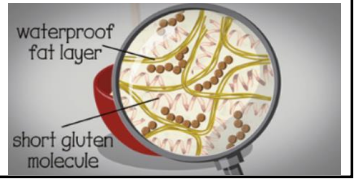
Shortening

The ability of fats to shorten the length of gluten molecules in pastry

Fats and oils give biscuits, shortbreads and pastries crumbly textures.
The best fats for shortening are butter and lard. Butter gives a good flavour and lard gives a good crisp texture whilst remaining flavourless.

By coating flour particles in fat (via the rubbing-in method) it coats the flour particles in a waterproof coating. This prevents the flour from absorbing water and reduces the development of gluten.





Chemical structure of fat/oils

Fats are composed of chemical elements: carbon, hydrogen and oxygen

Fat molecules are made of one unit of glycerol and three fatty acids as shown in the diagram.

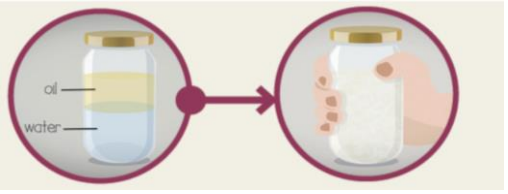
Aeration

The ability of some fats to trap lots of air bubbles when beaten together with sugar

Air is needed in baked products to give them a springy texture. To make a light and fluffy cake, fat and sugar are creamed together using a whisk or wooden spoon.
This traps lots of little air bubbles into the mixture to create a stable foam.

Emulsification

Either keeping drops of oil or fat suspended in a liquid preventing them from separating out; or keeping drops of water suspended in oil or fat and preventing them from separating out

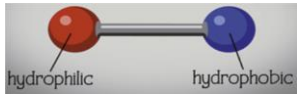


Fats and oils do not mix with water. If you try to and shake them, they will temporarily mix before splitting back out, as shown in the diagram above.

Immiscible means they cannot be mixed.

An **emulsion** is forcing two immiscible liquids to mix together, and this is by using an **emulsifier**.
Lecithin, found in egg yolks, is an example of an emulsifier.

An **emulsifier** has two parts, one end attracts the oil, one end attracts the water. This combination holds the oil and water together to create a **stable emulsion.**



Examples of emulsions are hollandaise sauce, mayonnaise, milk, butter and salad dressings.