Zig Zag Education

Food and Nutrition **GCSE | AQA | 8585**

Course Companion

For AQA GCSE Food Preparation and Nutrition: Food Provenance

zigzageducation.co.uk

POD 7738

Contents

Teacher's Introduction

This resource is designed to meet the Food Provenance (3.6) element of the AQA GCSE Food Preparation and Nutrition qualification.

What it covers

The resource comprises two chapters covering the following:

Chapter 1: Environmental impact and sustainability of food	Chapter 2: Food processing and production
3.6.1.1 Food sources 3.6.1.2 Food and the environment 3.6.1.3 Sustainability of food	3.6.2.1 Food production 3.6.2.2 Technological developments associated with better health and food production

How to use this resource

The resource covers all aspects of Food Provenance and is designed to increase knowledge of the topic and enable learners to test their understanding and skills through a variety of assessment methods.

Learning Outcomes enable the learner to clearly see what they are expected to know at the end of each chapter.

The **Overview** provides a brief summary of what will be covered in the chapter and the **Key Terms** box provides information on key terms within the resource (key terms are emboldened within the chapter text).

Did you know?	These boxes contain handy tips
Things to think about	These boxes provide learners with a chance to develop cognitive skills, do some research (books, Internet, people) and take part in a discussion
Apply	These boxes provide the learner with the opportunity to further their skills, either through cognitive or practical application
Skills	Based on the 'suggested application and food preparation skills' section of the AQA GCSE Food Preparation and Nutrition specifications, these test learners' skills in food safety through practical application
Exam tip	Useful tips to help the learner concentrate on important aspects that may appear in the final assessment
Check your understanding	Six multiple-choice questions and one longer open question, similar to Section A and Section B of the AQA GCSE paper, at the end of each section, to test knowledge and understanding
Quiz-ine	A crossword-style quiz at the end of each chapter to test learners' understanding of key terms used within the resource. When rearranged, the shaded squares spell out a word associated with the chapter text.
Answers	Answers to questions are provided at the end of the resource

For all links go to zzed.uk/**7738**

May 2017

Chapter 1: Environmental im
sustainability of food

Overview

In this chapter you will learn how to distinguish between grown, reared and caught produce. You will also explore environmental issues associated with food. The third part of this chapter is about the impact of food on local and global markets and communities – here you will learn about climate change and global warming and the challenges of providing a sustainable and secure supply of nutritional foods.

Learning outcomes

After studying this chapter, you should be able to do the

- ❑ know and distinguish between grown, reared and
- ❑ identify the main environmental issues associated
- ❑ explain what a carbon footprint is and how to min
- ❑ understand the idea behind organic farming
- ❑ list and explain reasons behind local marketing
- ❑ be aware of climate changes in the world and their
- ❑ explain why fair trade is important for global deve
- ❑ list and explain other challenges to provide manki

Key Terms

Organic	Grown or reared with restricted use of any chemicals, or GM feed and GM organisms, under strict condition
Free-range	Egg production in which hens are let outside of the ba
Genetically modified (GM)	When the DNA of a given organism is manipulated by its features
Seasonal food	Food characteristic for a given season of the year
Food waste	Food that is rotten, spoiled or wasted in another way,
Carbon footprint	How much energy has to be used, and, therefore, how the production, processing and transportation of food
Sustainability	Ability to maintain the natural environment and produ
Fairtrade	Ethical category that enables fair wages and prices for developing countries; designed to prevent human exp
Food poverty	Inability to provide oneself with enough food, both in
Food security	A term created by the United Nations, meaning that, a given place in the world, each person should have acc safe and nutritious food
Livestock	All animals domesticated and reared to provide food,
Local food	Food produced locally, in a given region
Food miles	How far the food has to travel from the producer to th
Orchard	Enclosed area of land used to grow fruit or nut trees
Polytunnel	Tunnel frame covered with polyethylene, used to grow
Intensive farming	Type of agriculture focused on intensifying food produ herbicides, GM crops and other methods
Factory farming	Type of agriculture focused on intensifying food produ of animals in small areas of land, to increase productio minimise potential costs
Fish farms	Tanks or enclosed sea areas in which fish or seafood is

How food is made

For a long time, people were hunter-gatherers, which means that their diet was b
their surroundings. This included wild animal meat, fish, and some fruit and herb
was invented and started to revolutionise humans' diet. Today, most of our food
of modern technologies; only a small amount of the food we eat is still gathered o

Grown foods

Foods may be grown in fields, orchards or polytunnels.

The most traditional way of growing foods includes fields and **orchards**. These are large areas in which roots, bushes and trees are grown to produce vegetables, fruits, nuts and seeds. They are kept under the open sky, which means that they are susceptible to all weather changes, low and high temperatures, droughts and floods, soil overexploitation, pests, rodents, wild animals and birds. Managing a field or an orchard in a certain region also involves deciding what plants are actually capable of living in given conditions. All these factors mean that crops from fields and orchards are very unpredictable and require various treatments to overcome all possible dangers. To increase crops and prevent possible damage, most farmers decide to use pesticides, herbicides and many other chemicals.

The
area
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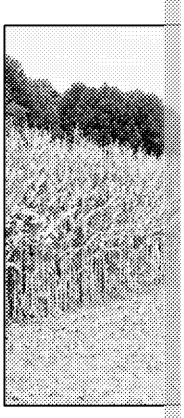
Picking apples in an orchard



Field

Polytunnels were invented in the 1940's to enable the growth of tropical plants. created to ensure the warmth and humidity necessary for proper development o polytunnels, we can enjoy strawberries, cucumbers and lettuce all year long. Po external hazards such as weather changes or insects, and, therefore, it is easier t produced.

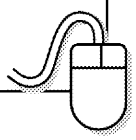
Strawberries in a polytunnel

What food is grown there	Examples
grains	cereals such as wheat, rye, rice, maize, oats
oil plants	flax seed, rapeseed, sunflowers, soy
root vegetables, cruciferous plants and brassicas	potatoes, beetroots, cabbages, carrots
mostly hard fruit and nuts	apples, cherries, pears, plums, avocados, olives, walnuts
mainly soft fruit	strawberries, blueberries, raspberries, tomatoes
vegetables	lettuces, radishes, cucumbers
mushrooms	white mushrooms, Portobello mushrooms

?

ıs lettuce, basil or wasabi may be grown using hydroponics. This means that soil, but their roots are put directly in water.

n be grown hydroponically at
.com/ArticleLibrary/WhatCanYouGrowHydroponically.html



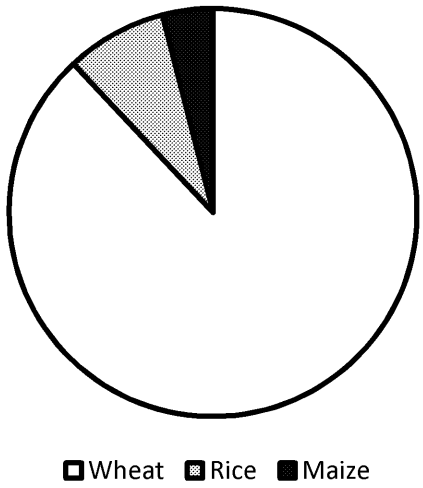
Hydroponic farming

The region in which people live often determines what can be grown and, therefore, decides their diet. This usually is embodied in national dishes; for example, Mexican cuisine uses a lot of sweetcorn because maize grows in Mexico, but traditional British cuisine doesn't have any sweetcorn in it because the grain was introduced to the UK only at the end of the fifteenth century, and for a long time couldn't even be grown here because of the climate.

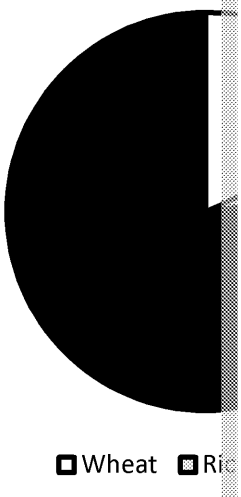
The charts below illustrate the main three grains consumed around the world – w

Notice how consumption patterns change with the region and climate of each co
certain produce. According to *National Geographic*, the most popular grain in th
consumption) and wheat (18% of total consumption). Next, there are vegetable

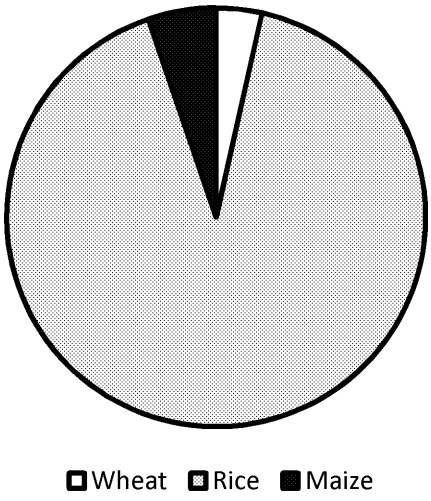
United Kingdom



Mexi



Vietnam



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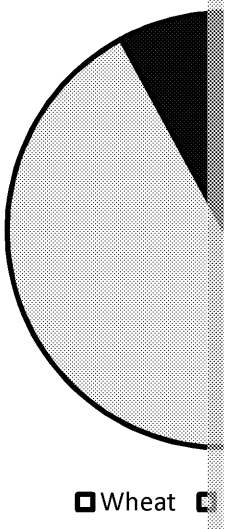

All food ingredients can be grown or reared in various ways. Most commonly us
and **factory farming**, although in the past decade **organic** farming has been gaini

Conventional (or **intensive**) farming is a kind of agriculture in which the main tar
To achieve that, farmers may choose to use:

- pesticides
- herbicides
- GM seeds which are resistant to poor weather conditions
- artificial fertilisers
- *or all of the above*

Conventional farming usually leads to deterioration in soil quality, which means t
cannot be used for growing any more. Conventional farming may also lead to lo
compromised ecosystems, since so many chemicals are introduced.

Factory farming

Factory farming is an agriculture method in which a large amount of **livestock** is kept in small areas. This is to increase production of meat, milk or eggs, and to lower possible costs and investment at the same time. Since profit is the most important consideration, factory farms can choose to rear certain breeds of animals (lowering biodiversity) and use antibiotics to prevent potential diseases. Other practices may be even more drastic and include cutting birds' wings or beaks to prevent them fighting with each other, which is often a concern for animal welfare activists and organisations.

Apply

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Organic farming

As opposed to conventional and factory farming, organic farming is focused on p
soil quality, ecosystems, natural resources and biodiversity. Organic farming is s
it can only use very restricted chemicals – not including artificial fertilisers, pestic
preventive antibiotics, **genetically modified (GM)** crops or animal feed made wit
can sustain their crops by the use of natural methods such as crop rotation and n
support soil health. Antibiotics can only be used in case of disease (to cure it, no

More about organic and conventional farming will be covered later on in this cha

Reared foods

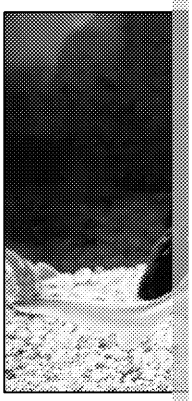
People have learnt to rear a number of species to satisfy the needs of growing po
(among others) cattle, goats, sheep, pigs, rabbits and poultry. Animals are reare
and wool, and for their muscle power (for example, horses are still used as worki
in some countries). Also their excrement is used to produce energy or as a fertili
local habits or requests, people can rear camels, reindeer or even snails.

The need to maintain economic growth and produce more and more food has le
farms. These are usually large enterprises, rearing hundreds or often thousands
especially to cows (milk farms), pigs (reared mainly for pork) and hens (reared fo
often apply the rules of **intensive farming**, to increase production and the profit

The following table provides a summary of what animals people rear and why.

What people rear…	
Cattle	Leather, beef, milk
Poultry	Meat
Horses	Meat, entert
Pigs	Pork, l

Also, some fish are considered reared foods. These include salmon, trout, cod, carp, catfish and some shellfish raised on **fish farms** that were created especially for human needs. In fish farms, fish are kept in large containers (fish tanks), which are sometimes seriously overcrowded.



Sturge

Although this might be ethically dubious, fish farms help to prevent and avoid overfishing of the seas and oceans, and help to preserve naturally occurring species. The fish in fish farms is reared for meat and caviar, and leftovers or non-edible parts are used to produce animal feed.

Research

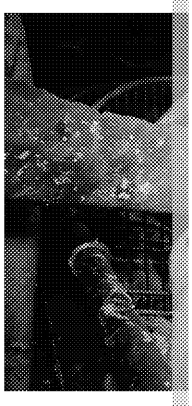
Read more about fish farming in the UK at **https://www.rspca.org.uk/adviceandwelfare/farm/fish/farming** and dra steps in fish production. Do fish farms use organic or conventional farming me

Poultry, such as hens, ducks, geese and turkeys, is also reared around the world f animals are usually kept in henhouses. The birds may be kept in tight cages, or m around the henhouse and even be allowed to go outside. The way is which poul meat and eggs produced. Also, **organic farming** rules may apply here – this is wh feed, are not given antibiotics if not necessary.

Nowadays, it is more and more popular to rear animals which were traditionally h boar.

You may sometimes meet ecologists or animal welfare activists who are protesti of the conditions the animals are kept in or the way they are treated.

An example of this is rearing geese in France using a method in which feed is forced into their stomachs via tubes to increase the growth of liver and fat tissue, for the production of foie gras. This method of rearing has been labelled as cruel and, therefore, banned in the UK, although it is legal to buy foie gras.



Force-feedi fattening

Another example is squeezing many animals in tight boxes placed on top of each other, as is the case in battery farms (cage egg farms). The hens can also have their wings cut to prevent them from moving too much and their beaks trimmed to prevent them from fighting with each other.

Other concerns include:

- keeping animals in closed buildings, without access to natural sunlight
- cramming in animals so they can't turn around or move (e.g. cows in feedlo
- using antibiotics to prevent diseases and speed up the growth of animals, w in microorganisms (which, in the near future, may lead to creation of new, l
- genetically manipulating DNA of animals to produce more muscle tissue, eg animals would
- overexploiting animals, which shortens their life (an intensely reared cow liv to around 20 for one living in the wild)
- transport conditions – when animals are finally transported to slaughterhou trucks and often spend a couple of days without food or water before they
- slaughtering conditions, in which animals' throats are slit open and the anim

Caught foods

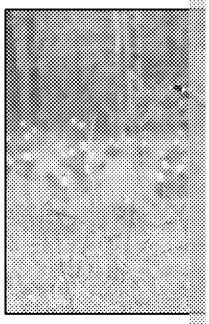
Caught foods include all wild animals that can be hunted and eaten. This includes game and wild fish that live in the seas and oceans (such as tuna, mackerel, herring and shellfish).

In the United Kingdom, game (or quarry) is defined by the Game Act of 1831 and the Deer Act of 1991. The name applies to such animal species as grouse, ducks, geese, pheasants, hares, rabbits and deer. The deer meat can be also called venison.

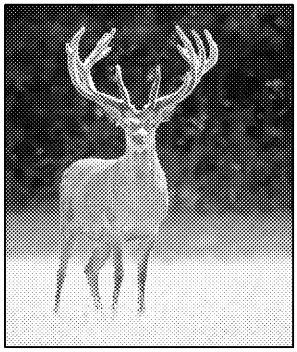
People have been hunting animals for centuries – either for food, horns and antlers, sport or entertainment. Since this has led to the extinction of many species, it is now often either forbidden to hunt certain species or it is allowed in certain seasons only.

Some wild animals – especially those high in numbers and causing damage to crops – can be hunted all year long with a permit. This applies to wild boar, for example.

Pheasant is often hunted for its delicate meat



Certain breeds to



Some species, such as deer, can only be hunted outside the breeding season. This is to protect the species and prevent its extinction.

Gathered foods

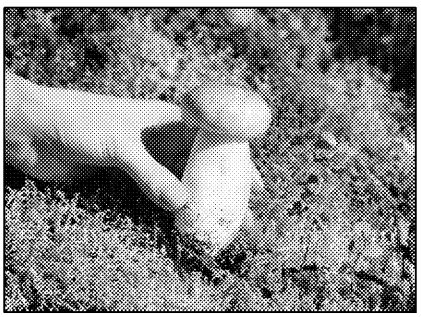
In some countries and communities, gathering foods is still popular. This includes wild berries and roots.

Herbs such as stinging nettles may then be used for production of herbal infusions, medicines and dietary supplements, cosmetics and even as animal feed.

Mushroom picking is popular especially in Eastern European countries, where various kinds of mushroom are picked from early May (e.g. chanterelles) to late October (e.g. boletus). They are usually dried or pickled and eaten during winter. In parts of France and Italy, it is still popular to gather truffles. This usually requires the use of a truffle hog (specially bred kind of pig, nowadays used rather rarely) or specially trained breeds of dogs, since truffles grow underground. For this reason, it is also known as truffle hunting. Truffles are used to prepare many luxurious dishes, such as truffle risotto or ice creams, and to infuse olive oil.

Berries growing in the wild include blackberries, bilberries, elderberries and wild s used to prepare jams, desserts, fruit yogurts and alcoholic beverages. Elderberri production of some medicines.

Gathered roots may include wild horseradish, which is typically more pungent than t parsnips, although the abundance of produce in supermarkets has caused people to



Picking mushrooms and forest fruit is popular in many European countries

Things to think about

Discuss the advantages and disadvantages of growing foods in field

Apply

List five different foods which can be gathered in your area and, for each, list

Organic, conventional and sustainable farming

The way we grow and rear our food is very important due to health and environm

Organic farming means that fewer fertilisers and pesticides are used (under restrictions), and that are naturally based. 'Organic' means:

- fewer pesticides
- no artificial colours or preservatives
- the highest standards of animal welfare
- no routine use of antibiotics
- GM free

It is believed that organic food is healthier for people, but it also requires more r expensive than conventional foods. Organic farmers often apply crop rotation a the soil, and plant certain species of plants to fertilise the crops and fight off ver maintenance of species diversity, as farmers often choose to plant many differen harvesting period. Also, as naturally occurring plants have various requirements warmth, farmers around the world have to use different varieties, as others wou unfriendly conditions.

Research

Find out more about organic food at **http://www.organicukfood.com/**

Organic farming in the United Kingdom is promoted by the Soil Association, whic standards and is a certification body for farmers. Specific and detailed restrictio Union (EU) to ensure standards are met around the continent.

Soil Association organic symbol

EU organic log

Conventional farming (or industrial agriculture) allows the use of fertilisers, pesti organisms to obtain high-yield crops and, therefore, produce a larger amount of people. This method is used more and more often since it increases production a

Studies have shown that various pesticides and chemicals used in conventional farming may be harmful for human health. Also, intensive farming includes the choice of certain breeds to increase crops, which may lead to some species extinction. For example, genetically modified seeds are more resistant to water, so will survive during a flood, while naturally occuring seeds will rot. Also, choosing to rear just one breed of cow because it produces more muscle tissue for meat means that all the other breeds will not be reared any more.

Did

The use of a pigs has led many bacter

This is dange will be no a to help peop

Sustainable farming allows the use of modern technologies but under the conditi
ability to maintain their populations. It is especially important in fishing, since ex
countries and corporations have put many wild fish species at risk of extinction (e
Sustainable farming means that eco-friendly rules are applied in order to maintai
animal welfare and quality of life are maintained, and various resources (such as

It is worth noting that sustainable farming and intensive farming can work togeth
the maintenance of high-yield crops, and keep soil healthy and nutritious for futu

Research

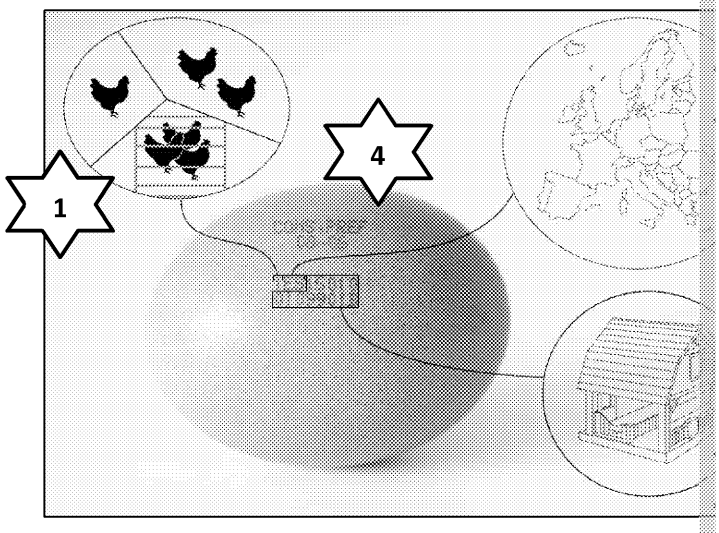
Visit the website **http://www.greenpeace.org.uk/oceans/what-we-are-d
seafood/sustainable-seafood-frequently-asked-questions** and list fish sp
endangered due to overfishing. Then try to research fish species which are sus

Things to think about

Discuss why sustainable fishing is important for all life on Earth.

Egg production – cage, barn, free-range and organi

The way eggs are produced affects their safety and nutritional value. In the Euro
label eggs with a stamp that contains certain information about their origin and



The stamp on the eggs has to contain the following information: 1) method of pr
producer's ID; 4) date marks.

1. The first information in the code is **method of production**. That refers to the way the hens were reared and shows whether they were kept in cages, allowed to move around the barn or allowed outside.

The details of egg production methods are specified in the table below.

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Would y

Method of production	Description
Cage	• Hens are kept in tight cages placed on top of each • Hens cannot move around the barn • Hens often have cut wings to minimise movement • Hens may have trimmed beaks to avoid fights • The most popular method in Great Britain • Very cost-effective
Barn	• Hens can move freely around the barn • Hens can have cut wings to prevent them from fly • Hens may have trimmed beaks to avoid fights • Their activity–sleep time is regulated by artificial li
Free-range	• Hens are let outside for at least part of the day • Space per bird is increased (stocking density is nine metre) • Perching space provided for each hen • Hens have to access natural sunlight for at least pa • Second most popular method in Great Britain
Organic	• Has to respect all criteria for free-range rearing • Birds have to be fed organic feed only

In the United Kingdom, animal welfare can be ensured by following the stan
of the Royal Society for the Prevention of Cruelty to Animals (RSPCA). The l
be found on foods where animals have had a better life.

The code on the label also indicates:

2. The country of origin is indicated by the letters following method of product
and uses commonly recognised country symbols; for example, UK means Un
Kingdom, ES means Spain, DE stands for Germany and NL is the Netherlands

3. The farm ID allows you to trace which farm produced the egg; this is especia
important if food poisoning occurs, because it can help stop further spread o
disease.

4. Best before date.

Some people prefer to buy eggs directly from local farmers. This may affect the s
the eggs because they often do not perform antimicrobial tests (or don't wash th
for example), which puts them at risk of spreading *Salmonella*. Spreading of the b
is prevented in the UK by vaccinating hens, following the rules of the British Lion
scheme.

Did you know?

In 2015, there were 10,020 million eggs produced in the UK. An additional 2.1 b
imported.

Apply

While shopping, check the labels on eggs and make notes about their origin a
Which ones are the most popular?

Research

Visit the website **https://www.egginfo.co.uk** and find out differences in the qua

Genetically modified foods

All food comes from living organisms – plants, fungi or animals – and, therefore, e
unique DNA code. DNA contains genes, which determine all the features of a giv
colour and nutritional value. Modification of DNA – replacing one or more of the
development of various plant and animal species that grow larger, are resistant t
tissue.

Why we use GM

- to increase crops and avoid food shortages
- to improve 'shelf life' in foods and lengthen storage time
- to produce biofuel
- to develop resistance to pests in plants
- to decrease the amount of herbicides and pesticides needed
- to increase the amount of eggs, milk or meat produced
- to increase immunity in animals
- to increase the amount of vitamins and other nutrients in food
- to overcome climate challenges
- to prevent malnutrition and fight off hunger
- to improve flavour, colour, appearance or size of fruit and vegetables

The experiments to design and produce GM foods started in the 1980s and, there
(yet) whether they are safe and healthy to consume, because that requires longi
long time, e.g. 50 years). European Union law allows for GM crops of cotton, ma
sugar beet.

Did you know?

The so-called 'Golden Rice' was developed to prevent widespread vitamin A d
countries. However, it wasn't very successful at the beginning because people
unnatural-looking yellow rice!

Many people oppose GM foods because:

- there is no scientific proof that long-term use of GM food is healthy and safe
- they believe GM food increases the risk of allergies and cancer
- they may contribute to increased body mass and so to the recent growth in o
  around the world
- they may lead to antibiotic resistance
- GM seeds mix with naturally occurring plants and may cause their extinctio
  decreased)
- genetic modifications often require the use of viruses or bacteria, such as *E.* c
  creation and spread of new diseases

On the other hand, genetically modified foods have multiple advantages, and scientists around the world work hard to ensure the newly produced species are not only environmentally friendly, but also safe to consume.

Compared with naturally occurring plants and animals, genetically modified ones
- contain more macronutrients, such as protein, which help to alleviate hunge
- contain more polyunsaturated fatty acids, which may help to lower heart at countries
- contain more micronutrients, necessary to prevent malnutrition
- require fewer resources, such as water, and can be grown almost everywhere in almost all weather conditions
- have a longer shelf life, so help to limit **food waste**
- are resistant to pests, so no chemicals have to be used
- produce more meat, milk or eggs, so fewer animals have to be reared and less land has to be devoted to pastures or animal farms
- are resistant to bacteria, so no antibiotics have to be used

GM advocates also claim that for these reasons GM foods are a way of providing generations.

Research

Read about GM crops and foods at **http://www.genewatch.org/sub-56854**
- whether GM crops or animals are grown/reared in Great Britain
- what different forms of GM crops enter Europe
- whether it's easy to find GM-free products in the shops

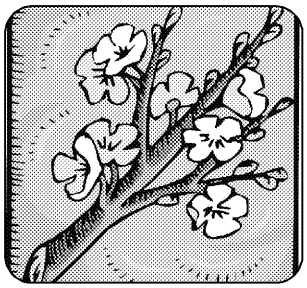
Seasonal and locally produced foods

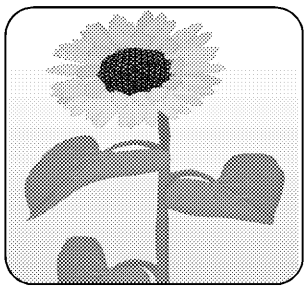
Before the development of modern technologies, people had to eat what was av environment. This forced them to eat only seasonally growing, **local foods** (for e no lemons or oranges). Today, some people are turning back to the idea, claimin

There are four main seasons of the year, and each can be characterised by differ
- In spring, most plants start to bloom and produce their first shoots. As June become available.
- Summer is usually very rich in various fruit and vegetables, because sunlight them with excellent growth conditions.
- In autumn, most root vegetables are harvested. Also, while the crops last, f produced for the winter.
- In winter very few plants produce any food, and, therefore, the diet is base kept during the whole year – thus, Christmas pudding is full of dried fruit!

Did you know?

This is close to the Ch which bases the diet o seasonally available.





Spring	Summer	Autumn
sprouts	peas	aubergines
rhubarb	berries	apples
leeks	courgettes	pears
cauliflowers	cucumbers	plums
lettuces	cherries	pumpkins
kale	peaches	celery
spring onions	apricots	cabbages

Plant foods characteristic of each season

The development of transportation, increasing imports and new technologies have allowed people to bypass these rules. Thanks to these developments, tomatoes, for example, can be produced in polytunnels and oranges can be brought from overseas, and some fruit and vegetables (such as strawberries) are available all year long!

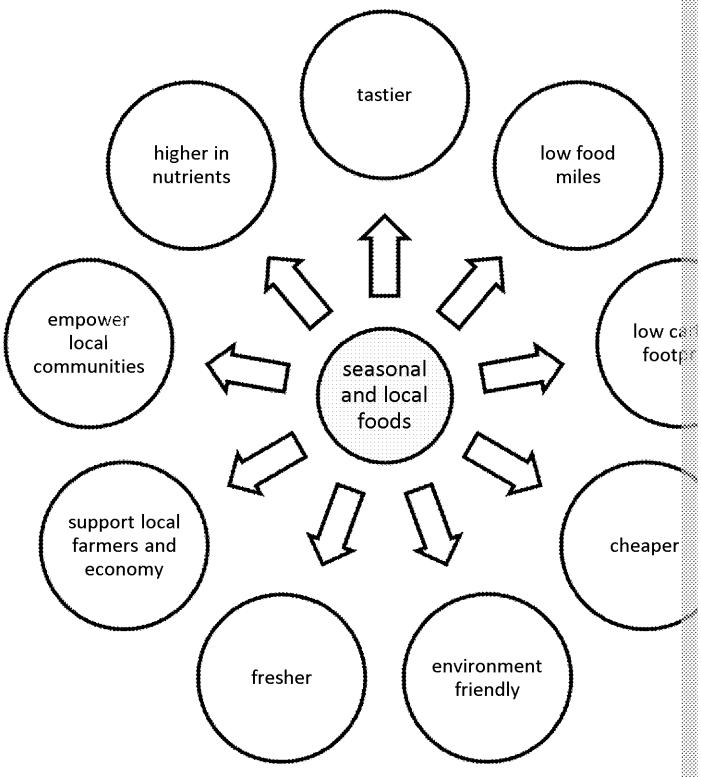
Seasonality applies also to non-plant foods. It may just as well be linked to fish, meat, poultry and eggs. This is based on the natural cycles of animals' lives – from birth, through growth to maturity and breeding.

Also, cheese production has, for hundreds of years, been linked to the lactation p nature, cows and sheep produce milk between March and October only and, the their milk is tastier then. However, intensive farming methods allow production therefore, we can enjoy tasty, fresh cheese whenever we wish.

Examples of seasonal animal-based foods are shown in the table below.

Month	Food available
January	Duck, turkey, haddock, halibut, lobster, oysters
February	Hare, partridge, venison, lemon sole, scallops, turbot
March	Mussels, oysters, salmon, mackerel
April	Lamb, wood pigeon, crab, plaice, sea trout
May	Lamb, prawns, sardines, shrimps
June	Scallops, coley, herring
July	Rabbit, pollock, whitebait
August	Beef, lamb, rabbit, venison, monkfish, pilchard
September	Beef, duck, grouse, guinea fowl, crab
October	Goose, venison, mackerel, oysters
November	Mallard, pheasant, turkey, skate, winkles
December	Goose, rabbit, turkey, venison, cod, Dover sole, queen scall

As with anything, seasonal and local foods have their benefits and downsides.



Advantages of seasonal and local foods

It is believed that **seasonal foods** are higher in nutrients – that's because they were a
natural conditions, with access to water, nutrient-rich soil and natural sunlight. Also
produced locally and, therefore, there is no need to pick them prematurely to transp

For this reason, the foods are fresher, because there is no need to store them fo
because they don't have to travel long distances from producer to customer.

Because the foods are often left to ripen naturally, they are higher in sugars and othe
tastier.

Local production is also environmentally friendly because it reduces the **food mi**
footprint.

Low transport costs is a factor that affects the final price of the food, usually mal

Buying locally also enables economic growth, supports local communities and ensures fair wages and prices for local farmers.

The disadvantages of seasonal and local food include:

- narrow choice – because only certain foods can be produced on an area of given land (that applies especially to plants)
- lack of diversity
- unpredictability – weather changes, floods or droughts and vermin may lead quantities of crops, which may result in food shortage or food waste and the storage)
- loss of convenience – because you can eat or cook only what's just growing have sushi for dinner (unless there are rice crops nearby)
- need for creativity – so that your meals aren't boring (after all, you only have a

Research

Visit the website **http://www.eattheseasons.co.uk** to list the foods which a current season. Are any of them produced in your area?

3.6.1.1 Check your understa

1. Which of the following statements about organic farming is TRUE? *(1*

   a. It allows the use of herbicides. ☐ b. It allows the u
   c. It allows the use of GM feed. ☐ d. None of the a

2. Which of the following is TRUE about free-range hens? *(1 mark)*

   a. They live in cages. ☐ b. They are allow
   c. They live in barns. ☐ d. They only eat

3. Genetically modified foods… *(1 mark)*

   a. can be grown freely ☐ b. need to obtain
   c. need to be labelled ☐ d. Both b and c a

4. Which of the following is UNTRUE? *(1 mark)*

   a. Locally produced foods increase emission of greenhouse gases.
   b. Locally produced foods are always organic.
   c. Seasonal foods are often more nutritious than non-seasonal food
   d. Seasonal foods are usually more expensive than non-seasonal fo

5. Cattle are reared for… *(1 mark)*

   a. meat ☐ b. milk ☐
   c. biofuel ☐ d. all of the above ☐

6. Eggs laid by hens which can move freely around the barn are labelled w

   a. 0 ☐ b. 1 ☐
   c. 2 ☐ d. 3 ☐

7. Give three reasons for and three reasons against GM foods. *(6 marks)*

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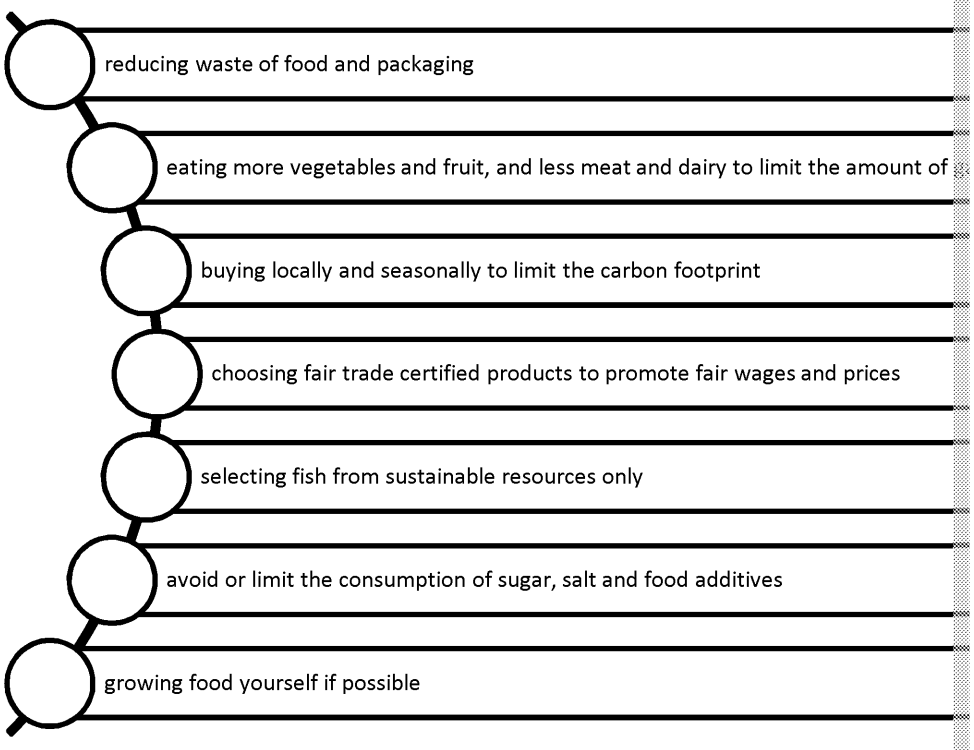
Sustainability of food

As the world population grows, more and more food has to be produced to mee
Currently (March 2017) there are 7.5 billion people living on Earth, and the Unite
will grow to 11 billion by 2100.

The more people there are, the more food is needed – but the area and resource
Food production and transportation require a lot of resources such as water and
generate a lot of waste and pollution. Intensive farming and fishing can lead to e
species and to soil exhaustion. For these reasons, the idea of **sustainable food** is
important. The point of sustainable food is to use the available resources only to
overexploit them and allows them to be replenished.

The main principles of food sustainability are:



The idea of sustainability is supported by the European Union, which created a 'F
Europe'. The aim of the policy is to reduce waste, improve efficiency of resource
consumption in order to protect the environment.

Research

Discover more about sustainability of food at **http://ec.europa.eu/environm**

An example of how the policy is implemented is **fish farms**.

Fish is a source of complete proteins, omega-3 fatty acids and vitamins A and D.
of a healthy diet. Unfortunately, the growing need for them and illegal fishing ha
of natural fisheries are overexploited. This is not only because a large number of
because destructive catching methods were being used. For example, bottom tra
fishing net along the sea floor, which disrupts the ecosystem. Another method is
net is stretched between two boats. This leads to a by-catch, which means catch
other sea creatures. Also, the size of fishing nets plays a role, as using openings

the catching of very small fish, which won't be used for food and also won't be a
population.

For this reason, the Common Fisheries Policy was implemented. It states the wa
(especially in wild fisheries) and at what rate – this is important to avoid extinctio
them to regrow their population.

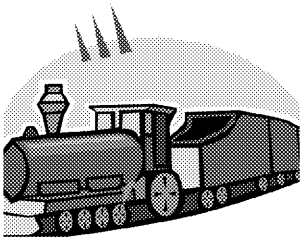
Sustainable fish farms should implement two general rules: ensure the health of
the catching method. Fish farms help to protect wild fish and other species that
producing enough food to feed the growing population.

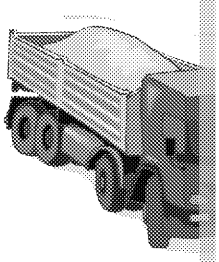
Other forms of sustainable agriculture include the use of such methods as nitrog
amendment or soil steaming. They allow the maintenance of high-yield crops as
necessary for the proper growth of plants.

Transportation and carbon footprint

Food can be transported even from very distant countries by trains, lorries, ships
means of transport need a lot of energy – from either carbon, petrol or wood. C
producing dust, exhaust gases and carbon dioxide. They contribute to general ai
pollution of the air and ground (especially near main roads and motorways).

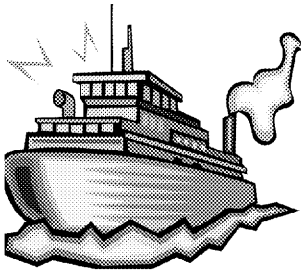
Transport by land





Transport by water

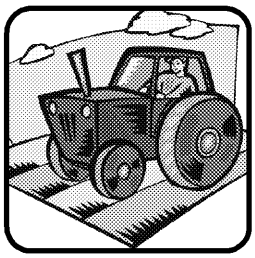
Transport



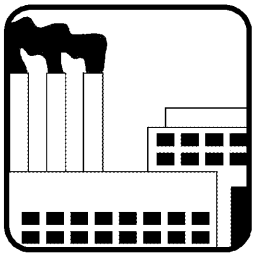
Foods and other goods are transported by different means. Which do you think p

An important effect of rising global transportation (and consumption of fuels) is
change. This is because large amounts of greenhouse gases are produced during
of foods. Greenhouse gases include water vapour, carbon dioxide, methane and
produced in large amounts by households (e.g. when heating the house and usin
people (e.g. buses and cars). All the greenhouse gases produced as a result of so
carbon footprint.

Buying locally reduces the need for transportation of produce, and, therefore, is
carbon footprint. It also reduces **food miles** – the distance which food has to tra



The farmer uses fuel to run his tractor and gather crops, and transport them to the factory.



The factory uses fuel and energy to process the food.

The shop uses fue to transport the food from the factory, and energ to run the shop, cash desks, etc.

Food miles and carbon footprint are built up all the way from the field

Reducing the amount of greenhouse gases produced during production and tran for saving the Earth. It can be achieved by:

- using alternative sources of energy such as wind or solar panels to run facto
- using more effective ways of transportation and improving exhaust filters in
- choosing local foods to reduce the need for transportation at all
- planting more trees and stopping deforestation

Research

Visit the website **http://footprint.wwf.org.uk/tips** and discuss how YOU ca footprint.

Food waste

Food waste is, in general terms, all the food that is rotten, spoiled or wasted, and thrown away. It can be created by food producers, retailers and households. Fo waste is one of the major problems of rich, developed countries. In 2012, in the United Kingdom alone, the amount of food waste produced by households was about seven megatons, and by manufacturers – 3.9 megatons.[1]

Here are five reasons why food waste is wrong:

1. **Wasting food in unethical**. We live in a world of large social inequalities, where over one third of the population is obese, while another billion peopl suffer from famine.[2, 3]
2. **Wasting food is environmentally unfriendly**. Many resources – water, elec produce and transport it. Not only were they used, but, in the meantime, a
3. **Wasting food is uneconomical**. Many people were involved in the process paid for. The Waste and Resources Action Programme estimates that each f simply by avoiding food waste.[4]

[1] *http://www.wrap.org.uk/sites/files/wrap/UK%20Estimates%20October%2015%20%28FINAL%29*
[2] *http://www.who.int/mediacentre/factsheets/fs311/en/*
[3] *https://www.thelifeyoucansave.org/Causes/Hunger-and-Nutrition?gclid=CPPwk4nIvNACFUNmGw*
[4] *https://www.lovefoodhatewaste.com/*

4. **Wasting food requires organisation**. After all, someone has to pick up the rubbish from your home and either recycle it or store at a rubbish dump. That, again, contributes to the carbon footprint and increases the social cost of food waste.
5. **Wasting food creates pollution**. The food had to be produced (carbon dioxide), transported (greenhouse gases), packed (plastic) and cooked (carbon dioxide again). All the by-products of food production and consumption find their way into the environment and contribute to the overall pollution of the planet.

Did you kn

The top five waste
Kingdom are:
- bread
- potatoes
- apples
- meat and fish m
- vegetable meals

A number of policies were designed to help prevent food waste:

- **Recycling** – of both food and food packaging. The leftover food can be used ways, e.g. as animal feed.
- **First in, first out** – rotation of stock helps prevent food waste by controlling before' dates.
- **Storing the food in proper conditions** – helps prevent food spoilage by eithe vermin or environmental factors.
- **Redistribution** – giving away anything that cannot be sold. Some of the larg in charity programmes which help distribute the food to those who are in ne

Food waste in food production

There are several reasons why food may be wasted before it even gets to a shop

- **Crop failure** – poor weather conditions, drought, flood, vermin, pests – all these factors can cause a lot of food to go to waste before it is even harvested.
- **Overproduction** – sometimes good weather conditions support growth of fruit and vegetables so efficiently that too much is produced and, as a result, farmers can't sell the overabundance; in these cases food is often left in the field to rot.
- **Throwing away** – producers may choose to throw away 'ugly', misshapen fruit or vegetables; this is because, in many cases, the produce has to fulfil international standards, as otherwise it can't be sold in shops.
- **Faulty methods** – faulty methods of production, e.g. in factories, may lead to the waste of many foods.

The

Limiting food waste at these stages might not be easy, as it may require legal cha couple of ways which can help to limit the wastage.

- Farmers may choose to use pesticides or herbicides, or to grow foods in polytunnels to prevent crop failure caused by pests, vermin or weather conditions.
- Farmers can choose GM crops which are resistant to weather conditions.
- Farmers can try to sell the food more cheaply for freezing or canning.
- Factories can adjust their processing methods to minimise wastage.
- Factories can sell the food waste to produce natural fertilisers or animal fee
- At all stages of production – when transporting, cleaning, sorting, cooking, p or storing the food – producers can maintain proper conditions to prevent spoilage caused by microorganisms or rodents.

Apply

Think o such as p

- Factories can use packaging to protect food from external factors – modern modified atmosphere packaging or vacuum packaging can help to extend the affecting nutritional value.
- Producers can use preservatives – although this might be socially unaccepta extending the shelf life of food products.

Food waste in retailers

Smaller and larger shops struggle with large amounts of food which are not sold.

- not paying attention to date marks
- not storing the food in the correct conditions
- improper management and over-ordering

Shop managers may need to implement a couple of strategies to reduce food wa such as:

- Daily check of date marks, especially of fresh produce – a food past its date mark cannot be sold.
- If a food is past its 'best before' date, it is usually still edible, so can be donated to food banks or even given for free to the shop workers and customers.
- Control storage conditions, both in the storeroom and in the sales hall – this applies especially to temperature and sunlight, as many foods will be packaged at this stage so will be protected from other external factors.
- Lower the price for foods which are close to their 'use by' date as they won't be safe to eat beyond that date.

What can you do to stop wasting food?

Food waste in homes is usually caused by buying too much, cooking too much, not paying attention to date marks or improper storage conditions. Food may also be wasted due to lack of skills or knowledge, for example, when a person buys a new product and doesn't know what to cook with it or when a person can't cook and burns the meal.

Reducing food waste at home can include:

- Planning your meals and writing a shopping list – buy only the foods you need, in the amount you need. That applies especially to fresh foods, which cannot be stored for a long time.
- Using leftovers – you can use cooked vegetables to prepare a salad (or a cream soup), leftover mashed potato can be used to prepare fish cakes, and stale bread is great for a pudding (or simply for breadcrumbs).
- Freezing foods that you cannot eat right away – that applies especially to meat and fish, and to cooked meals. Vegetables have to be blanched or pre-cooked before freezing.
- Serving only as much as you need. If there is too little, you can always ask for an extra helping.

If your food unfortunately gets spoiled or goes rotten, don't worry – store it in a s compost (or give it to someone who owns a garden).

Research

Visit the website **https://www.lovefoodhatewaste.com** and try to list five w may contribute towards lowering food waste.

Packaging and environment

Packaging as we know it became very popular after World War II – before that p
or paper containers to carry all kinds of food. Plastic bags gained popularity in th
and convenience.

Food can be packed in various types of container: bags, sacks, boxes, bottles… Foo

- paper and/or cardboard
- plastic
- glass
- steel
- aluminium (tins and cans)
- wood (baskets and crates)

The materials can also be combined; for example, to insulate cardboard boxes so

They are specially designed to:

- protect the food from external factors (such as light, oxygen, dirt or microor
- inform the consumer about the product (information)
- attract consumers to the product and tempt them to buy it (marketing)
- increase the shelf life of a given product

Landf

Packaging has a big impact on the environment – from the moment it is produced to the time it is discarded or destroyed. Production of packaging – no matter what material is used – entails the use of water, electricity, detergents, labour and other resources. Then, the packages have to be transported to the factory, where the food is packed – that contributes to the carbon footprint. After the food is eaten, packages are discarded – ideally, into recycling containers.

British people buy 22 million metric tonnes of food every year – and all that food comes in packaging. It is important to dispose of the packaging properly, so it can be recycled or destroyed in a controllable, environmentally friendly way. This is because materials such as glass or plastic will not decompose at all or the process will tak
below). For this reason, the government and many international organisations s
plastic bags used (introducing the 5p payment per bag has already halved the nu

Did you know?

In 2013, British consumers took home 7.4 billion plastic bags from supermark

Source: https://www.gov.uk/government/news/plastic-bag-numbers-rise-for-the-fifth-

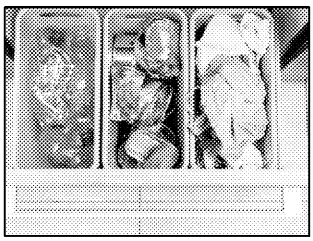
Material	Time tak
Paper	2–6 weeks
Food	1–6 months
Milk cartons	5 years
Cigarette butts	10–12 years
Batteries	100 years
Aluminium cans	80–200 years

[5] *http://www.bbc.co.uk/news/uk-34346309*

Material	Time taken to decompose
	250–500 years
	450 years
	10–10,000 years
	Millions of years
	NEVER[6]

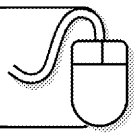
Recycling

Recycling is a w… y way. To facilitate this, colour-coded b… n to help people identify what litter go… d even different city councils) can h… ours, some only sort waste into 'dry' and …



Resear…

Visit the we… eate a poster in which you will indicate where and how you…



Typical colo… the bin	…	What happens to it later
Blue	glass …tic food	The materials are recycled to obtain new packages, recycled toilet rolls, etc.
Brown	…lls, …owers,	This is decomposed and used as fertilisers, for example.
Green or g…	…,	These are not recyclable and, therefore, have to be destroyed in a controlled way (e.g. burnt) or collected in a rubbish dump.[7]

[6] *https://www.th… compose-2878033*
[7] *https://www.th… goes-in-your-bins*

3.6.1.2 Check your understa

1. Which of the following statements about food sustainability is UNTRU

   a. It encourages people to limit food waste ☐ b. It helps use resc
   c. It overexploits natural resources. ☐ d. It limits the carb

2. Which of the following can be used in organic farming under certain co

   a. GM feed ☐ b. fertilisers
   c. herbicides ☐ d. antibiotics

3. Food waste is produced by… *(1 mark)*

   a. households ☐ b. retailers
   c. food producers ☐ d. all of the abov

4. Which of the following is TRUE about packaging? *(1 mark)*
   a. It causes food spoilage.
   b. It contributes to animal extinction.
   c. It is used to pack perishable foods only.
   d. Most of packaging cannot be recycled.

5. Food miles is the distance… *(1 mark)*
   a. from the farm to the factory
   b. from the farm to the shop
   c. from the factory to the shop
   d. from the farm to the consumer's home

6. Which of the following is UNTRUE about greenhouse gases? *(1 mark)*
   a. They are released during food production and transportation.
   b. They are harmless.
   c. They can cause climate changes.
   d. They include carbon dioxide, methane and nitrous oxide.

7. Explain how deforestation and globalisation contribute to the increase

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3.6.1.3 Sustainability of foo

Sustainability of food concerns scientists, governments and ecologists all around t
climate change and growing population, may affect food availability in the future.
technologies can come to the rescue, keeping the most pessimistic visions at bay.

Climate change and global warming

Earth's climate changes in cycles – just like seasons. Temperatures on Earth have
years, causing the ice to form or melt, depending on the stage of a given cycle. B
experienced six glacial periods!

For centuries, climate change was caused by variations in Earth's orbit and in sol
determined the amount of warmth the planet received from the Sun. The Sun's
atmosphere and are then reflected by Earth's surface. In normal conditions, the
without further consequences. Unfortunately, greenhouse gases (such as carbon
Earth's atmosphere which traps the warmth. Therefore, Earth's surface and the a

How do we know that global warming is not just part of Earth's cycle?
Thanks to modern technologies, scientists can measure and compare the amount of carbon dioxide in various ice layers in glaciers, and what they have found is undeniable. They have proved that carbon dioxide levels have varied over time, but they have never been as high as for the last 100 years. This means that the global warming we're experiencing now is not caused by nature alone, but by human actions. The massive production of greenhouse gases came about because of the Industrial Revolution, and although increased automation allowed people to produce many different goods in large amounts and ship them all over the world, the price for all this convenience is increased carbon footprint and global warming.

Di
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Sou
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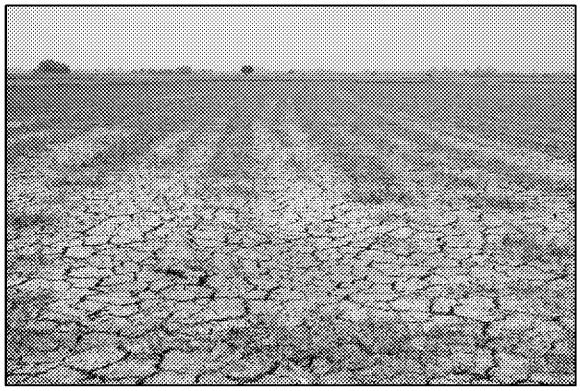
signs

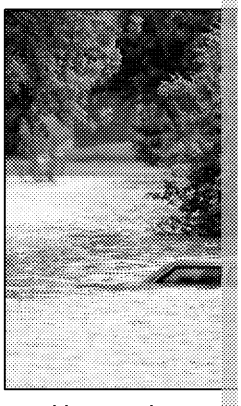
The main reasons for rising carbon dioxide levels are:

- burning coal, oil and wood to obtain energy, and also for food production ar
  countries
- deforestation to obtain fuel and land for agriculture

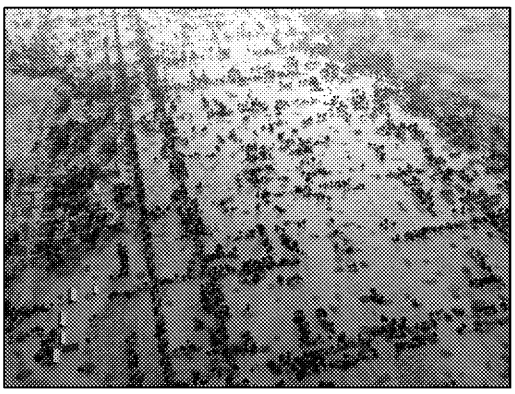
Global warming is dangerous. It can lead to:

- melting of glaciers and a rise in sea levels
- a rise in global temperatures
- warming of the oceans
- extreme events such as hurricanes, intense rainfall, heatwaves, droughts an
- acidification of the oceans

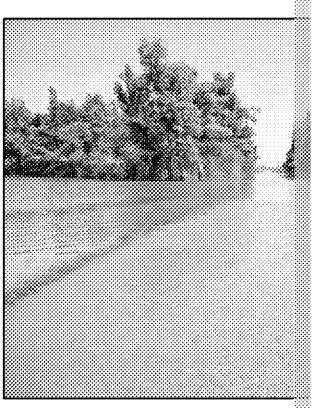




Droughts and floods are both the effect of climate change and have a devasta



A flooded farm



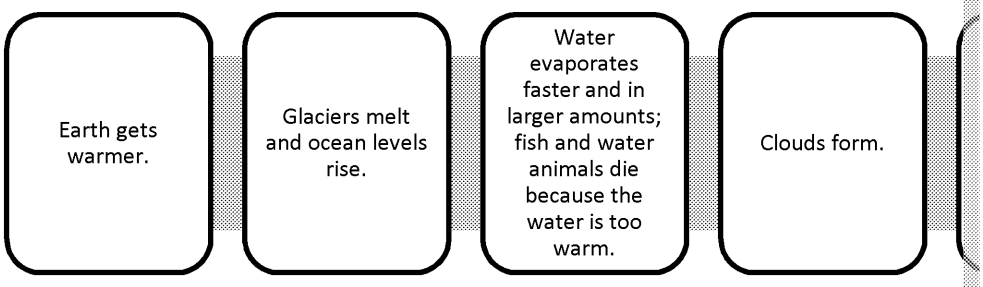
A farm which is so badly
it's a farm a

How does climate change affect food production and availability?

The effects of global warming that have been observed over the past 50 years ar

- They cause the mass extinction of many animal and plant species, as many o
  the new conditions (such as high temperatures or lack of water).
- They lead to the disappearance of land and whole countries under water, si
  land which can be used for planting crops or grazing farm animals.
- They can cause food shortages and famine by causing crop failure (due to bo
- They change the pattern of the seasons, which can affect plants' life cycles a

How does this work?



How can we ensure food availability when facing climate change?

Climate change is a global problem. It affects individuals, communities and whol around the world are involved in the fight against carbon dioxide emissions. An Paris Agreement, which obligates 197 countries to undertake certain actions to h warming. Actions have to be taken to:

- mitigate (stabilise and reduce) levels of CO_2 released into the atmosphere, e from fossil fuels to water or solar power, limiting transportation and using n limiting the use of packaging, lowering food waste, recycling and reusing go
- adapt to the changes that have already happened – this involves making the experience, such as a prolonged summer which allows more crops to grow

Things to think about

Discuss how food waste, transportation and packaging contribute

Research

Visit the website **http://climate.nasa.gov** and list things you and your family c emission of greenhouse gases and lower your contribution towards climate cha

Availability of food

According to the Food and Agriculture Organization of the United Nations (FAO), f
any given time and place, any person should have access to sufficient amounts o
growth of the human population means that more and more food has to be prod

What makes food available?

- Sufficient production – means that enough food is made; intensive farming a
as GM) have made it possible, but unfortunately almost all that food stays i
- Access to retailers – means that shops or farmers are close enough for peop
from them
- Price – means that a person has enough money to buy the food she or he ne

What threatens food availability?

- Climate change and the effects of global warming
- Droughts, which make growing plants impossible
- Floods, which damage the crops
- Pollution caused by production and transportation of goods
- Insufficient land for growing food – there are more and more people to feed
- Lack of resources, such as water or fossil fuels
- Overexploitation of soil, which decreases its usefulness for growing plants
- Poverty and lack of money

What does 'nutritious food' mean?

Food should not only fill you up and stop you feeling hungry – it is also a source of important macro- and microelements, which are crucial for the proper growth, development and functioning of the body. The food should, therefore, be rich in nutrients such as proteins, fats, carbohydrates, vitamins and minerals. The abundance of cheap, low-quality food in developed countries has led to the situation where 1.9 billion people worldwide are overweight or obese,[9] and at the same time 30% of them are undernourished.[10]

Food poverty

Food poverty means that a person or a family doesn't have enough money to bu
(healthy and nutritious) food. In many areas, especially in developing countries, t
diseases and deaths. UNICEF states that half of the deaths among children unde
undernutrition.[11] Food poverty is not restricted to poor countries only. Even rich
the United Kingdom struggle with the problem. According to OXFAM, 2 million B
while another 500,000 rely on food parcels from charities to feed their families.[12]

[8] *http://www.fao.org/fileadmin/user_upload/suistainability/Presentations/Availability.pdf*
[9] *http://hungerreport.org/2016/infographics-2/*
[10] *http://drhyman.com/blog/2012/02/29/how-malnutrition-causes-obesity/*
[11] *http://data.unicef.org/topic/nutrition/malnutrition/*
[12] *http://policy-practice.oxfam.org.uk/our-work/inequality/food-poverty#contentprimary_0_ctl00_*

What can be done to make food available?

- Many international organisations, such as the Red Cross, deliver free food to war zones
- Increase salaries – although this is not easy to do, since it depends on many
- Decrease prices and make food more affordable for people, especially those done by supporting local farmers
- Food vouchers – which are a way of helping people financially without giving money from being misused, because it can be spent on food only, and not o
- Create food banks – places where food can be given for free to those in nee
- Avoid food waste – and give what you don't eat to those who might need it
- Use modern technologies, such as GM crops, to induce more efficient agricu
- Improve storage conditions to enhance the shelf life, e.g. by the use of mod vacuum packaging.

Research

Read the report on **http://www.manchesterfoodpoverty.co.uk/sites/default/files/Facts%20verty%20Report.pdf** and the reasons and outcomes of food poverty in Grea

How much land is needed to make food?

37% of land in the world is used for agriculture. In some countries, fields and orc
country's surface, while in other countries the area dedicated to agriculture is m

Country	% of area
United Kingdom	
Switzerland	
Spain	
Norway	
Libya	
Brazil	
Algeria	

There are various reasons which determine how much land is used to grow food
- Climate – if it's too hot or too cold, the food cannot be grown (compare Liby
the desert, and Norway, which is mostly covered in snow)
- Possibility of droughts and floods – usually, land in high-risk areas is not use
- Landform – e.g. high mountains are usually impossible to use for agriculture
mostly in the Alps), but flat areas of land are good for the purpose (look at S
- Access to water – water is necessary to grow plants and feed animals, so its
Brazil and Libya again)
- Quality of the soil – nutrient-rich soil in Spain or Great Britain allows plant g
Algeria don't.
- Government policy – if a government supports local farming, more land are

Land is used to rear animals and grow plants in order to produce meat, milk, egg
and animal feed.[14] Research shows that the lacto-vegetarian diet is the most eff
fossil energy use. To produce food for a vegetarian, less than 0.4 ha of land is ne
needed to produce meat and products eaten in a conventional diet. The area inc
plants, vegetables and fruit to feed the people and the area used to grow animal

Since the world population in on the rise and the land surface isn't expanding (qu
due to climate change), it is important to use the remaining resources in a clever
Vegetarian Society, a cow needs 7 kg of grain to produce 1 kg of beef, while a pig
1 kg of pork. 70% of all the land used for agriculture is grazing land.[15] A simple c
reducing the amount of meat eaten) can contribute to food sustainability.

[13] *http://data.worldbank.org/indicator/AG.LND.AGRI.ZS*
[14] *http://ajcn.nutrition.org/content/78/3/660S.full*
[15] *http://www.vegsoc.org/document.doc?id=524*

Fairtrade

Although slavery was banned in 1833, modern societies tend to overexploit their resources – including labour – in order to produce more goods and create a bigger profit. In many countries, children are forced to work, and people are not paid fair for their work – which leads to high poverty rates in such countries as China, Indonesia and India.[16]

Fairtrade is, therefore, a way of stopping modern slavery. It has the following benefits:

- fair prices and wages for producers and farmers
- decent working conditions (such as working hours, breaks and tools)
- ends child labour and forced labour
- empowers local farmers, their families and communities – having more money allows them to make choices about their lives and send their children to school
- enables local growth and sustainability

Fairtrade rules are designed to enhance the social, economic and environmental well-being of producers – not large intercontinental corporations.

The most popular Fairtrade products include:[17]

- bananas
- chocolate/cocoa beans
- coffee beans and tea leaves
- cotton
- sugar

Did you know?

The United Kingdom is the largest Fairtrade market in the world!

Apply

While shopping, try to find five products that come from Fairtrade producers.

Research

Research and prepare a presentation on why Fairtrade standards are…

[16] *http://www.worldbank.org/en/topic/poverty/overview*
[17] *http://www.fairtrade.org.uk/en/buying-fairtrade*

3.6.1.3 Check your understa

1. Which of the following statements about climate change is UNTRUE? (

   a. It is caused mainly by eruptions on the Sun. ☐
   b. It leads to global warming. ☐
   c. It causes mass cataclysms. ☐
   d. It is caused by greenhouse gases. ☐

2. Which diet is the most efficient in terms of land sustainability? *(1 mark)*

   a. vegan ☐ b. lacto-vegetari
   c. pescatarian ☐ d. fruitarian

3. Which statement is TRUE about food poverty? *(1 mark)*

   a. It affects only developing countries. ☐ b. It does not ex
   c. It does not exist in developing countries. ☐ d. It affects peop

4. Which of the following does not contribute to an increase in carbon f

   a. using oil as fuel ☐
   b. using carbon as fuel ☐
   c. using wood as fuel ☐
   d. building wind- and solar-driven power plants ☐

5. Which of the following statements is TRUE about Fairtrade? *(1 mark)*

   a. It empowers local farmers. ☐
   b. It allows fair payments for workers. ☐
   c. It helps stop child labour. ☐
   d. All of the above. ☐

6. State two factors which can improve food availability, and two factors

.....

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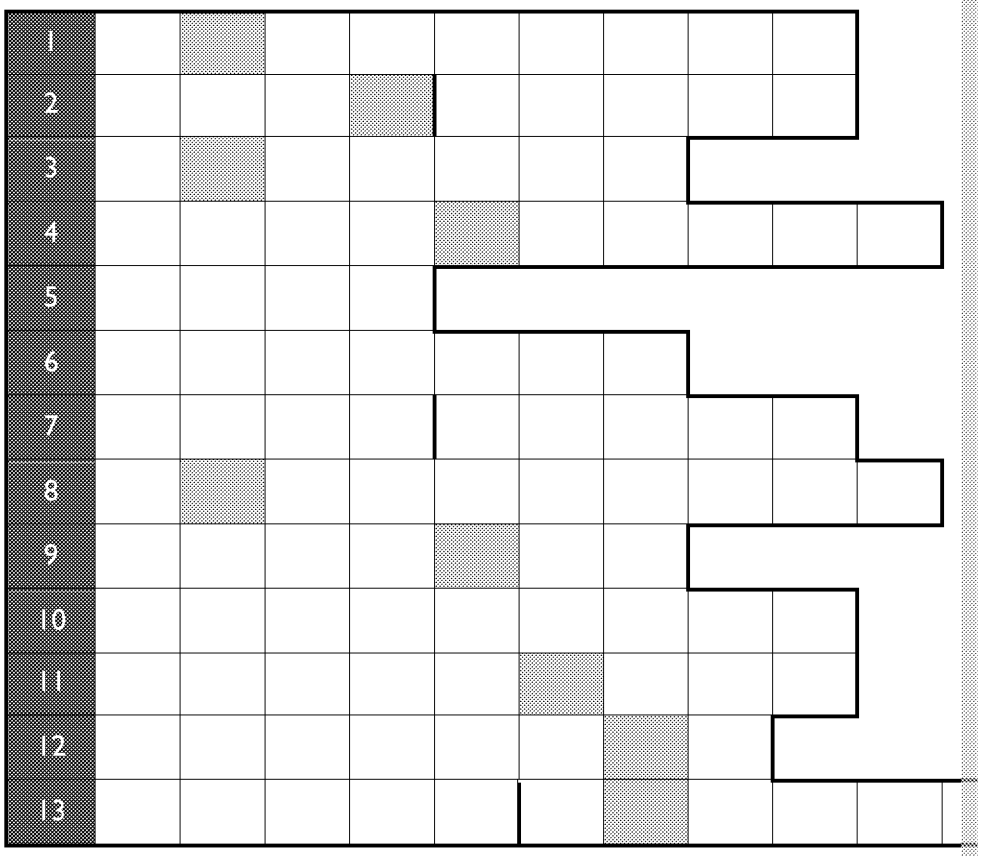
3.6.1 Quiz-ine

Fill in the answers to the questions below and then use the letters from the grey s
to sustainability of food.



1. Animals reared to provide food or other goods **(9)**
2. The distance travelled between a farm and a plate **(4,5)**
3. Grown or reared without the use of chemicals or GM products **(7)**
4. Long plastic construction for growing plants in **(10)**
5. The most popular grain in the world **(4)**
6. The meat of a deer **(7)**
7. Eggs that are labelled with number 1 **(4,5)**
8. Bacteria species found on raw eggs **(10)**
9. The most widespread genetically modified crop **(7)**
10. The practice of reusing items that would otherwise be discarded as waste **(9)**
11. An artificial product that never decomposes **(9)**
12. When they melt, the sea level rises **(8)**
13. Food that provides no nutrients **(5,8)**

The shaded squares reveal this word:

_ _ _ _ _ _ _ _ _

Chapter 2: Food processing and

Overview

In this chapter you will learn what primary and secondary processes the food has to go through before finding its way to your plate. You will also learn how the processing affects nutritional and sensory features of the food. Lastly, you will discover how technology helps obtain food that improves health, and what additives in foods are for.

Learning outcomes

After studying this chapter you should be able t

- ❑ describe the difference between primary a
- ❑ distinguish between processed and unpro
- ❑ explain how processing affects the nutrit of foods
- ❑ list what additives are used in foods and
- ❑ explain how technology can help make fo

Key Terms

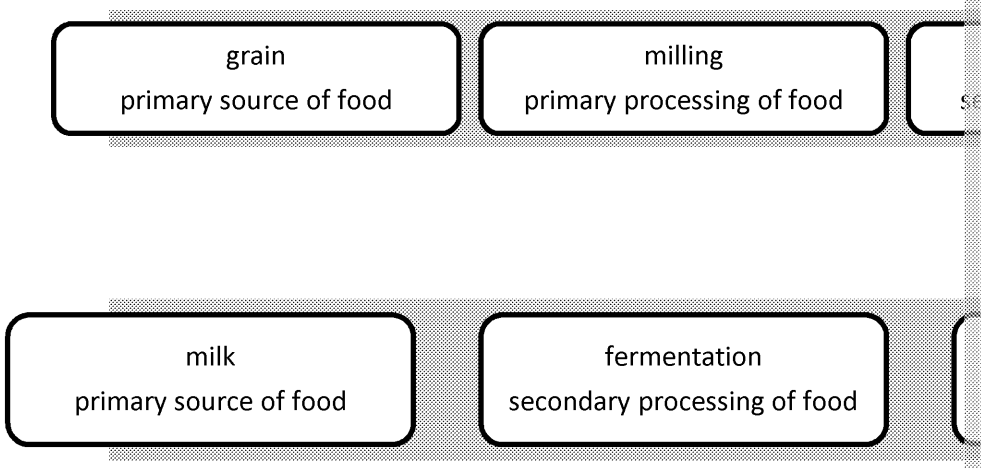
Fortification	A process in which vitamins and minerals are adde to increase their nutritional value
Additives	Artificial or natural substances that do not usually oc them to enhance their features or shelf life
Primary processing	All actions applied to food that do not change its fe significantly
Secondary processing	Actions applied to food which change its features s
Bran	Outer layer of a grain
Pasteurisation	A process in which product is heated to 72 °C to kil shelf life
Sterilisation	A process in which a food is heated to high tempera microorganisms and spores and enhance shelf life
Fermentation	A process in which sugar is turned into lactic acid o conducted by bacteria and yeast
Coagulation	A process by which proteins aggregate together an yogurt and cheese
Probiotic	Bacteria species that are beneficial for health
Rennet	An enzyme found in calves' stomachs, used in chee
Curd	Coagulated milk, a stage in cheese production
Whey	A milky liquid by-product of cheese production
Lactose	Milk sugar
Trans fats	Harmful fats generated as an effect of prolonged h
Homogenisation	The process of breaking down fat molecules to mak them more evenly throughout the mixture
Irradiation	The application of ionizing radiation to food produc life by killing microorganisms and insects.

3.6.2.1 Food production

Food production is the process of growing crops and rearing animals, and then c
appetising meals. Many raw products are edible, but still have to go through so
they can be actually eaten; for example, strawberries have to washed and potat
processed to ensure it's safe to eat, lengthen its shelf life, maintain its nutritiona
use, and assure its variety and affordability. Food processing includes two main

1. **Primary processing**, which makes the food usable
2. **Secondary processing**, to make food more convenient to use and lengthen i

The foods in their natural state are called primary sources of food – they include
eggs in their natural, raw state. If they are processed in any way, they are called
can see examples of primary and secondary sources of food on the diagram belo

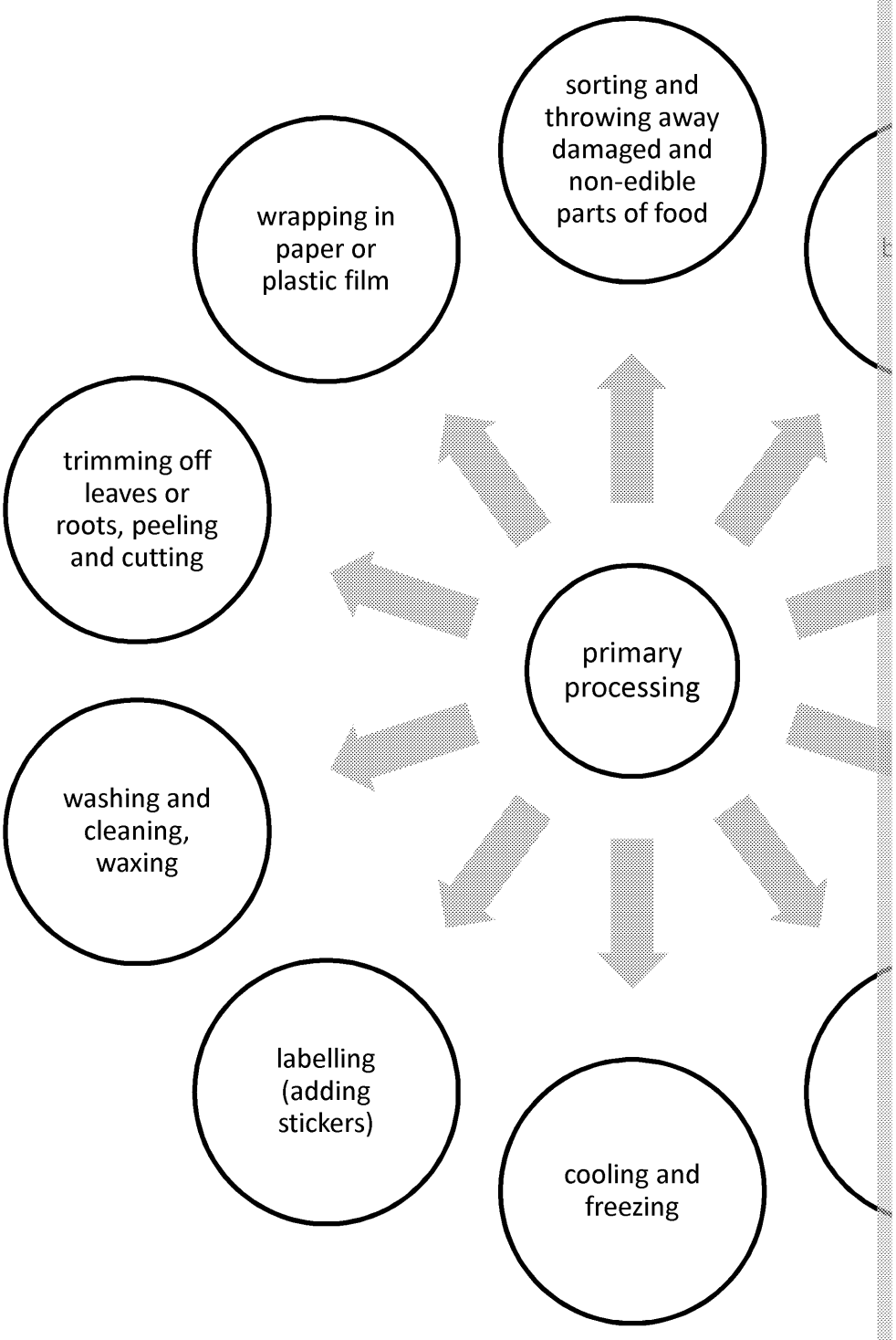


Primary processing of food

Primary processing of food consists of all actions taken to make raw produce rea
does not affect the features of nutritional value of food products in a significant

Primary processing of plant-derived foods
That includes actions taken after the produce has been harvested or picked, such
slicing, bagging, labelling and many other actions taken to make sure the plant-d
eaten or used for further processing.

Primary processed fruit and vegetables are usually sold raw, dried or frozen, eith
primary processes applied to plant-derived foods are shown in the diagram belo



Apples are washed and waxed before being packed and shipped to shops

The first couple of primary processes are pretty straightforward – the food has to
sand, trimmed to remove inedible parts, and sorted to separate it from misshape
either prepared for sale (e.g. by waxing and adding stickers) or processed further
safer to use. These stages could include one or more of the following processes:

Blanching is the process in which fruit or vegetables are immersed into boiling w
around two minutes) and then plunged into ice-cold water. The process is mainly
would otherwise be susceptible to enzymic browning, such as apples or potatoes
some fruit and vegetables before freezing. Blanching prevents the food from be
preserves its nutritional value.

Cooling includes refrigeration and freezing foods – all the way from the factory t
point of this is to slow down the growth of microorganisms which could spoil the
value.

Drying is a process in which most of the water in food is evaporated at high temperature. Lack of water makes food less prone to microorganism growth and, therefore, extends its shelf life. Drying can be applied to foods that are resistant to heat, and helps obtain such products as powdered milk, cereals, potato flakes and powdered soups.

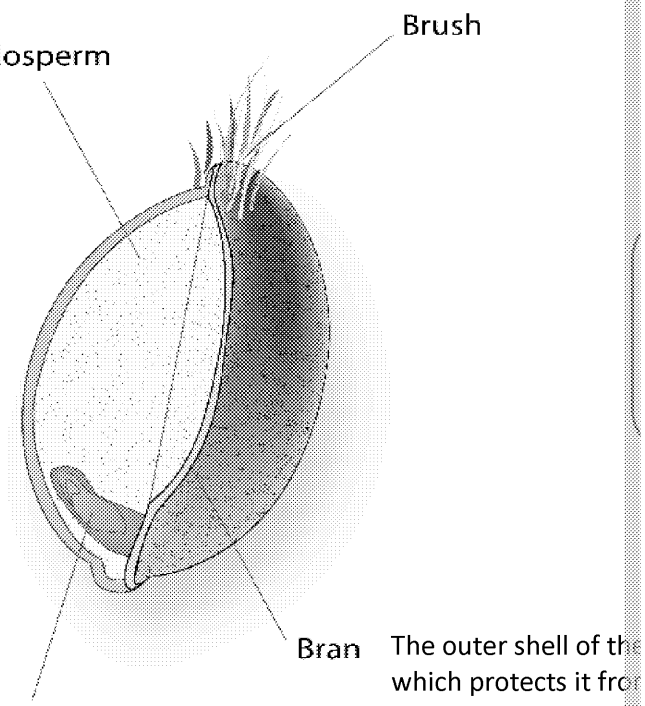
Another way of reducing the amount of water in food is **freeze-drying** (lyophilisation). In this technique, food is first frozen (e.g. in liquid nitrogen) and only then is water removed from it under low pressure (usually in vacuum). The effect is a powder or granules – like instant coffee. Freeze-drying is also used to dry herbs and fruit. Drying and freeze-drying may lower the amount of water-soluble vitamins in the final product, as they may be evaporated together with water.

Storing the food usually means keeping it in coolers, fridges, freezers or other kin
prolonged period of time. Storage conditions are very important and have to be
product. During storage, the proper temperature, lighting, air quality and protect
ensured, as otherwise the food could be spoiled and lose its nutritional value, as

Primary processing also includes **milling** – turning grains into flour, which then ca
during secondary processing – refining of sugar or extraction of corn kernels fro

How is flour made?

Flour is a powder obtained as a result of milling grains, such as wheat, barley, rye,



Contains mostly starch and is the main ingredient of flour

The outer shell of th which protects it fro factors, and accumu and group B vitamin

Provides nutrients, such as vitamins and minerals, to the growing plant, and adds nutritional value to flour

After the grains have been harvested, they are sieved to separate dirt, stones, little pieces of metal and other possible contaminants. That stage is called 'purification'.

After the grain has been purified, it is washed in warm water and dried in a centrifuge. This usually increases the amount of water in the grain and makes it easier to peel.

Afterwards, the grain is ground – it goes through breaker rolls, which open it and **bran**. As a result, a 'first break flour', semolina and large pieces of wheat grain a

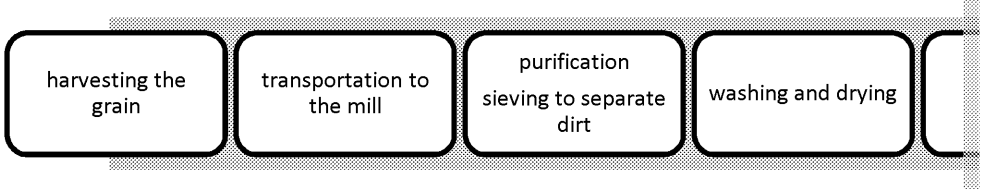
The 'first break flour' is then removed, and semolina and large pieces of wheat grain are rolled repeatedly a few times (usually up to five) to produce fine flour.

After each reduction roll, the flour goes through metal sieves, which sort the final product into plain flour and germ. If the flour is not separated, it is called wholemeal flour.

Since most of the micronutrients in grains are located close to the bran, white wheat flour is fairly poor in them, and, therefore, is obligatorily fortified in iron, thiamine, nicotinic acid and calcium carbonate.

The germ that's left from milling can be used to produce wholemeal flour, bran cereals, animal feed or even edible plates!

The main stages of flour production are presented in the diagram below.

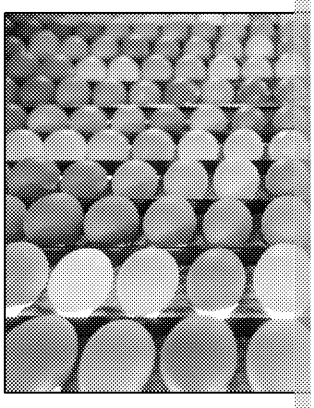


There are many varieties of flour available on the market – many of them are ma
other kinds of flour. They differ in gluten content, micronutrient content and us

Type of flour	Description and
Strong flour	As it is high in gluten, it is best for making
Plain flour	Low in gluten, it is best for shortcrust and in baking (biscuits, cakes, scones, doughn
Self-raising flour	Contains a raising agent, so can be used w scones and biscuits
Wholemeal flour	High in fibre; usually added to bread to in
Semolina	Coarse flour used to make pasta
Gluten-free flour (i.e. corn starch)	As it has no gluten, it is not ideal for maki and crumbly) but can be used as a thicker free pasta
Rye flour	High in gluten; can be used to prepare a s

Primary processing of animal foods includes all actions taken to prepare the rear for further processing, such as draining blood from killed animals, skinning, remo of the carcases (which can also be left whole), plucking feathers, filleting, or rem raw animal foods edible, eggs are washed (and labelled) and milk is pasteurised.

Feathers are plucked and chicken is portioned

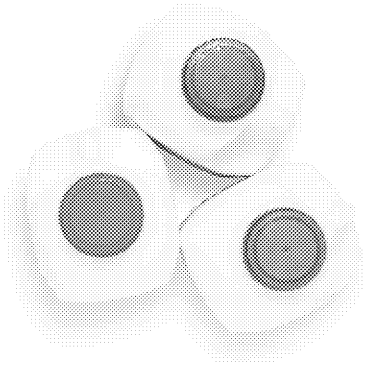


Eggs are washed and sor through quality control and pa

Primary processing of milk

After the milk has been collected from cows, it is transported to dairy factories, where it can be **pasteurised**, **sterilised**, **homogenised** and even turned into other products such as yogurt or cheese.

1. **Pasteurisation** of milk is a process in which the milk is heated to 72 °C for 15 seconds and then cooled. This process kills harmful bacteria and extends shelf life. It doesn't usually affect nutritional value or any other features of the milk.
2. Ultra-high temperature (UHT) processing of milk is a process in which milk is quickly heated to 135 °C for one second and immediately cooled. As a result, all the bacteria are killed (also the good ones) and the milk can b ambient temperature. Since the process is very short, it doesn't affect the n of milk in a significant way.
3. Milk is an emulsion in which fat particles float in water. To prevent them fro through **homogenisation**. Homogenisation forces the milk under very high p Consequently, fat particles become very small and, therefore, create a stable or use. Homogenisation doesn't affect the nutritional value of milk, but can molecules are dispersed more evenly in the mixture and can reflect the light look whiter).
4. **Sterilisation** is a process designed to kill all microorganisms present in raw m heated to 110 °C for 30 minutes. Sterilisation inactivates enzymes and dam temperature also causes complex reactions to happen between molecules of a result, brown pigments and aromatic agents are produced. Therefore, ste flavour, colour or smell. Also, the temperature and length of sterilisation wi B vitamins in milk.
5. Milk can also be microfiltered. During microfiltration, milk passes under low fine membranes, which collect bacteria and some fat. For that reason, micro amount of fat in milk in order to obtain semi-skimmed or skimmed milk. Se be poorer in fat-soluble vitamins, since they are removed, together with the change the flavour of the milk, which may become more watery and provide whole milk. Microfiltration helps to extend milk's shelf life by up to 45 days



Depending on the amount of fat in milk, it can be labelled blue (full fat), green (semi-skimmed) or red (skimmed)

Exa

Drying o usually d sensory f for steri

Research

Visit the website **http://www.bbc.co.uk/programmes/articles/xF8zVbpw have-thought-it-surprising-facts-about-our-favourite-foods** to discover and consumed in Great Britain.

Primary processing of meat

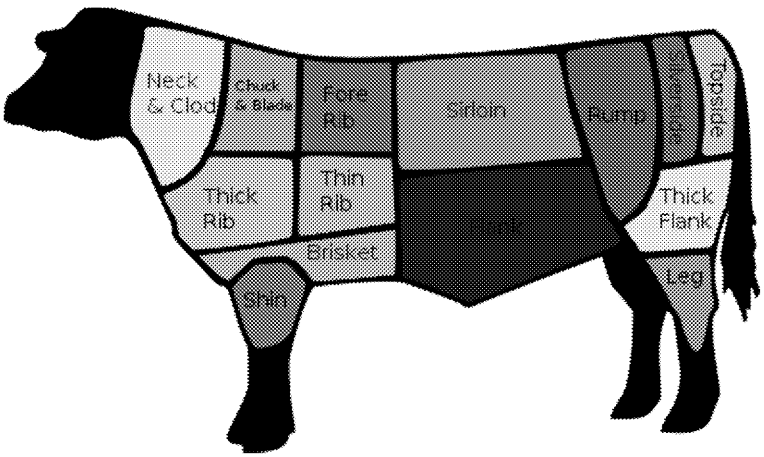
Meat is obtained from the muscle tissue of animals, such as cows, lambs, pigs an
built of:

- two types of proteins (myosin and actin) which make the muscle fibres and e
  and stretch; during cooking, the protein in meat will denature, and the fibre
  piece of meat to become smaller and leak some meat juice.
- connective tissue (made of collagen and elastin) which surrounds the fibres a
  attaches it to the bones, forming tendons
  - When the meat is cooked, the collagen dissolves and softens, and cre
    extracted and used to set savoury and sweet dishes.
  - The elastin builds mainly the tendons and ligaments which join the bo
    even after cooking.
- fatty tissue, which is located both in the muscle structure (intramuscular fat
  around it (visible fat); during cooking, the fat will melt and make the meat n

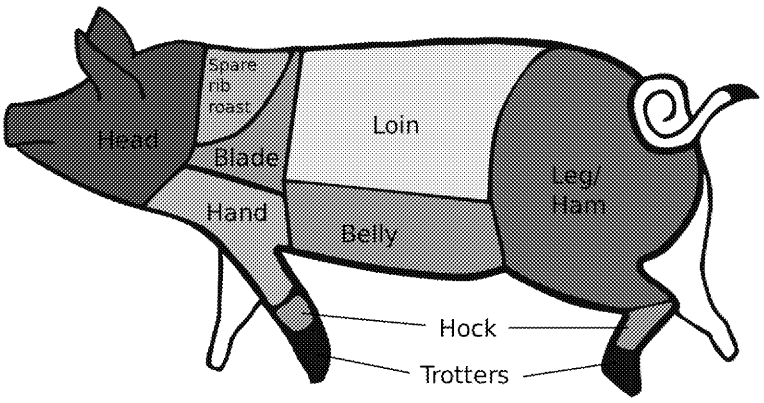
After the animal has been killed, it has to be shaved or plucked, skinned and divi
differ between countries).

The animals are cut into various pieces depending on the muscle structure and p
tender parts, such as sirloin, are low in connective tissue and usually require a sh
be used for steaks). Tougher cuts are high in connective tissue and require long c
parts, such as the hocks and trotters of the pig, are very high in elastin, and can b
savoury jelly made with meat and vegetables). The less-popular cuts, such as the
minced to produce various kinds of sausages.

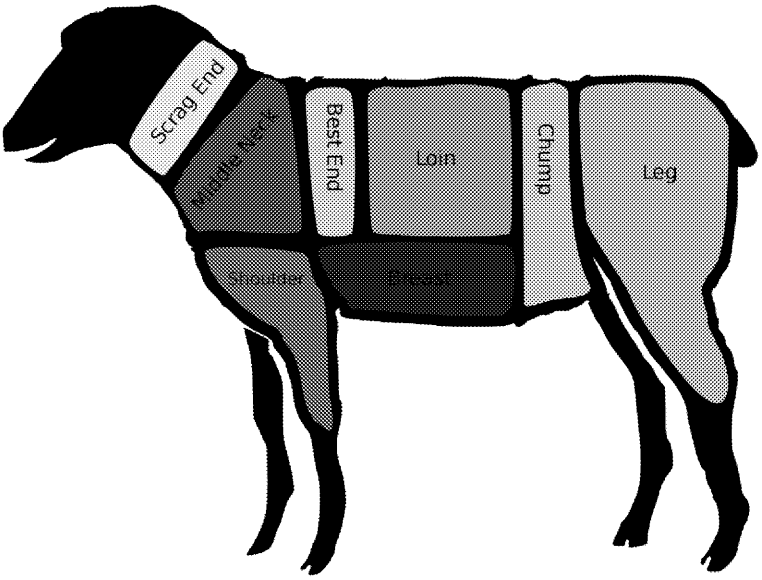
The different cuts of beef, pork and lamb, and their culinary uses, are shown in t



Chuck and braising
Fore rib – r
Sirloin – st
also used i
Rump – sti
Silverside a
Flank (skirt)
Leg and sh
Thin rib – m
Thick rib –
Brisket – m



Head – slo
Spare rib –
Blade – slo
Loin – grilli
Leg (ham)
braising, ro
Belly – bac
roasting, b
Hand – slo
Hocks and



Scrag end a
braising, ro
Best end (r
Loin – grilli
Chump – g
Leg – roast
Breast – ro
Shoulder –
slow cooki

After being killed, the body of an animal goes through many chemical changes. T improve the tenderness of the meat, it can be hung. Hanging requires low temp and a certain length of time (at least seven days for red meat, around two days f proteins in the meat relax and are partially broken down by the enzymes presen meat softer and easier to digest. Also, during that time, certain aromatic compo of the meat becomes dark red.

Other primary processes applied to meat can include:

Chilling	Usually applied to separate cuts, which can be then shipped to s
Freezing	To extend shelf life
Mincing	To improve the texture, especially of very tough meat cuts Minced meat can be sold, or can be used in the factory to make products

Primary processing of fish

The primary processes applied to fish differ depending on various factors, such a

- whether the fish is to be sold fresh, frozen, smoked, or canned
- whether the fish is to be sold whole, in fillets, or in pieces

Fish for culinary purposes can be divided into subgroups depending on:

- their natural environment – saltwater fish or freshwater fish
- their shape – flatfish or roundfish
- their fat content – lean fish (less than 5% fat), mid-fat fish and oily fish (mor

The examples of each are shown in the table below.

Type of fish	E
Saltwater fish	Cod, Mackere
Freshwater fish	Car
Flatfish	Sea bre
Roundfish	Carp,
Lean fish	Cod,
Mid-fat fish	Hali
Oily fish	Herrin

The muscles of fish are built of short fibres separated by connective tissue built o
collagen are very thin, it softens and dissolves quickly during cooking – for this re
cooking time. Collagen from the connective tissue and bones releases some gela
prepare aspic.

The primary processing related to fish usually involves:

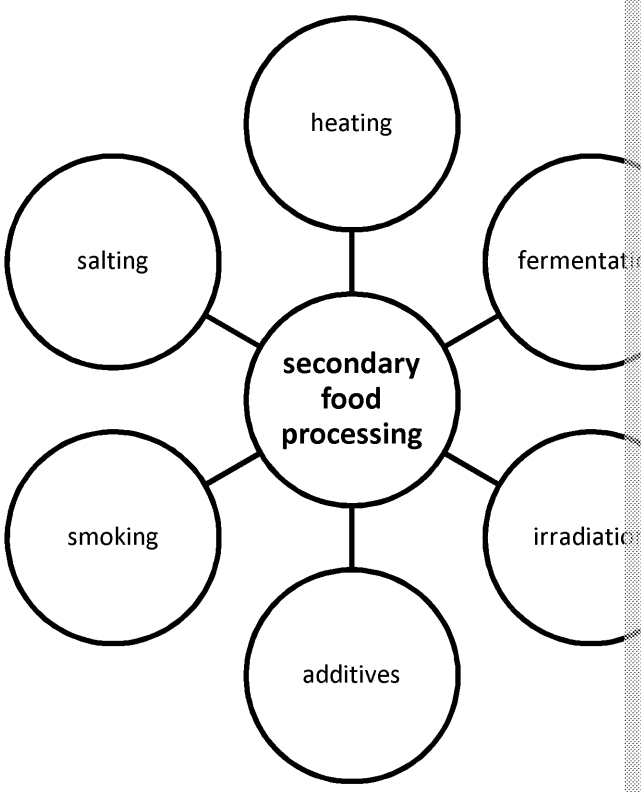
- trimming – removing the fins
- cleaning – removing dirt and sand
- removing scales
- cutting – usually into fillets (tender meat blocks with no bones) or steaks (ch
  (which may be used to prepare fish preserves or sold in packets for prepara
- chilling or freezing – depending whether the fish is to be sold fresh or frozen

Fresh salmon prepared to be frozen in the factory

Secondary processing of food

Secondary processing of food allows it to be used to make new products, which a
the ingredients they were made from. This may be turning flour and eggs into a c
turning milk into yogurt.

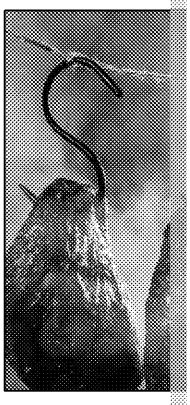
The main methods of secondary food processing include:



Heating is about cooking food in order to kill pathogenic microbes, changing its te
more convenient and appealing to consumers. Heating increases the shelf life of
package remains closed. Heating also includes **pasteurisation** and **sterilisation** o
meat and vegetable preserves.

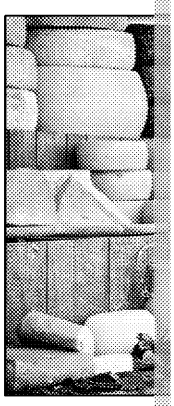
Salting usually is applied to meats and fish. This is a very old technique, which wa
the food before fridges were invented. Salting changes the structure of the food,
significantly extends the shelf life. An example of a salted food is beef jerky.

Smoking is a process applied mainly to cheese, fish and meats. It is carried out in specially designed smoking chambers. Smoke preserves the food and changes its flavour, so it is important to use the right kind of wood – e.g. oak, beech, alder or maple, with addition of other kinds of wood (such as juniper), herbs and vegetables (such as garlic) to alter the flavour and obtain the desired product. Smoking can be conducted in cool temperatures (around 30 °C) or in warm conditions (up to 90 °C), and usually takes from a couple of hours to as much as a month.



Ham and sa

Fermentation is a process in which microorganisms – such as bacteria, mould or yeast – turn sugars into carbon dioxide and other substances, such as lactic acid or alcohol. Fermentation is used to obtain yogurt, kefir, cheese, wine, beer, bread, and even cold cuts such as salami.



Cheese is

Another way of preserving the nutritional value of foods and extending their shelf life is **irradiation**. In this process, ionising radiation is applied to foods in order to kill harmful bacteria and reduce the need to use preservatives. The World Health Organization states that such foods as raw chicken, cocoa beans, dates, mango, papaya, potatoes, onion, legumes, spices, strawberries, raw fish, fish preserves and grains can be irradiated without harm, although countries can state their own law in the matter. In the U seven food groups is legal, and includes fruit, vegetables, cereals, bulbs and tube and shellfish, and poultry. It is mandatory to include proper information on the p ingredients were irradiated.

The addition of food **additives** changes its flavour, colour, and/or texture and extends shelf life. This will be discussed in more detail later.

Apply M
using

How pasta is made

Flour is a product of primary processing of grains. It can be used later to produce bread, pasta, cakes, shortbread, pizza, sauces, waffles, muffins and pancakes.

The basic recipe for pasta includes flour and warm water. To change the flavour, eggs, spices and colourants (natural or artificial) can be also added. First, flour is other ingredients are added (such as eggs, colourants and herbs). Once the doug is pressed between large cylinders, changing the dough into a thin sheet, which i microorganisms and pasteurise the dough. Afterwards, the sheet can be cut into pasta can then be cooked, refrigerated, frozen or dried.

A pasta maker can be used for both pressing the dough and cutting it – and the width

How bread is made

Bread, in many different forms, is known in various countries all around the worl bread is most popular in many countries such as Great Britain or the USA, more a breads from different cuisines, such as naan bread from India or South American

The main ingredients of bread include flour, water and salt. Depending on the co be sourdough or yeast.

Flour is necessary to make the structure and bulk of the bread. When the flour i
in it combine and form gluten. Gluten has the form of a net, which creates the s
The quality of the flour plays a vital role in the final texture and taste of the brea

Water helps to develop gluten in the dough.

Salt is used for many reasons. It improves the flavour of the bread, strengthens the gluten, slows down the growth of microorganisms and prevents the dough from overgrowing. Since it competes with sugars from flour for water, it also helps to make the brown crust during baking, as the sugars caramelise.

The last ingredient – either sourdough or yeast – is used in bread as a leavening agent. In the presence of warmth, water and food (sugar), the microorganisms ferment the sugar and produce carbon dioxide. The gas expands and rises, and is trapped in the gluten net, which helps to obtain the final structure and volume of the bread.

The stages of bread making are shown in the diagram below.

First, all the ingredients are mixed together and kneaded until the mixture is made int

The dough can be divided into separate portions to make multiple loaves or bread roll

The dough is left for proving in a warm room – during this stage the yeast ferments su
carbon dioxide, thanks to which the dough rises.

The dough is kneaded again, shaped and placed in baking tins or on a baking tray.

The dough is left for final proving – during this stage the dough rises even more, and obtai

Now, the bread can be egg-washed or sprinkled with water and baked.

Baking usually takes around 30 minutes, depending on the size of the loaf.

Various producers may also choose to add:

- seeds, nuts, herbs or spices – to improve the taste, aroma and nutritional va
  the bread; they can be both added to the dough and sprinkled on top
- vinegar – to preserve the bread and extend its shelf life
- vegetable fat – to make the dough lighter due to aeration and to extend the

How yogurt is made

Yogurt is a result of milk **fermentation**, conducted by the **probiotic** bacteria. Dur into lactic acid. Depending on the species of bacteria and fat content in the milk more liquid, and will have a tangy or more delicate flavour. Ready-to-eat yogurt which are advantageous for health.

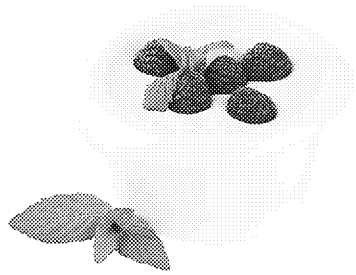
First, milk has to be **pasteurised** to kill all the harmful bacteria and protect it from spoilage. It is also filtered and **homogenised**, to obtain a smooth texture. Next, bacteria are added and stirred into the milk, which then spends some time in warm conditions – around 40 °C to allow the bacteria to grow and process the sugar. Since acid causes proteins to denature and coagulate, yogurt is much thicker than milk and has a sour taste.

Once the yogurt is set, various **additives** may be added to it – most popular yogurts contain fruits or jams, cereals, sugar, coffee extracts or toffee sauce.

There are various types of yogurt available, depending on the quality of ingredients used and details of the production process.

Yogurt type	D
Natural full-fat yogurt	Made of whole milk w The most basic type of Creamy and tangy
Low-fat yogurt	Made of semi-skimme Usually runnier than fu Can contain starch, ge
Greek yogurt	Thick and creamy High in fat **Whey** is drained off du
Live yogurt (bio yogurt)	Less acidic than 'norm Contains various bacte the digestive system

Yogurt is a source of **probiotic** bacteria and high biological value proteins. Since it can also be considered as part of a diet for lactose-intolerant people.



Did you know?

Probiotic bacteria are beneficial

- They limit the growth of patho
- They boost the immune system
- They regulate bowel movemen
- They help fight off diarrhoea ar
- They improve ingestion of mac
- They produce vitamins!

Apply

You can make a yogurt yourself!

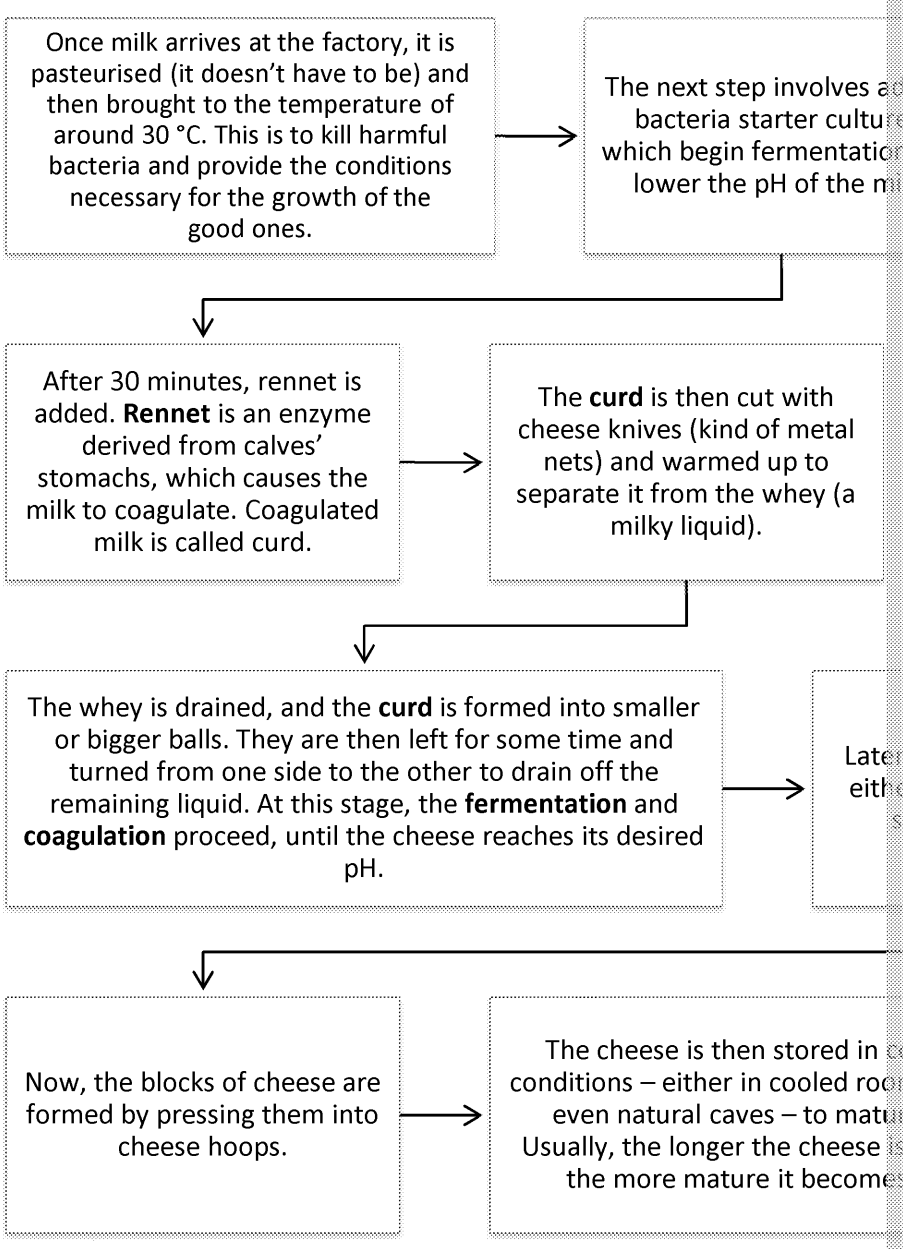
1. Heat up 1 litre of milk until it reaches 80 °C.
2. Cool it down to 42 °C.
3. Add 60 g of natural yogurt with live bacteria (check the label!) and stir.
4. Keep the container in warm conditions for a couple of hours.
5. Once the yogurt is ready, put it in the fridge and eat within a few days!

How cheese is made

Cheese is a nutrient-rich product made of milk. Its look, flavour, smell, nutritional value and other features depend on many factors, such as:

- what kind of milk was used to make the cheese
- what type of coagulant was used to process the milk (bacteria, mould, rennet…)
- whether any additives were added, such as herbs or leaves
- how long the cheese was processed
- what the processing conditions were
- and even what the cow (or sheep, or goat, or buffalo…) ate

Cheese can be made from either raw or pasteurised milk – and that also affects i factories is always pasteurised, but the milk in small family production doesn't ha



There are many various types of cheese – soft, firm, hard, fresh and smoked. Th texture or have big holes inside. All these features depend on the bacteria speci sometimes mould such as *Penicillium* is added too (usually to obtain blue-or gree in milk include *Lactococcus*, *Lactobacillus*, *Streptococcus*, *Propionobacterium* and

Cheese is an important source of calcium, phosphorus, proteins, fats and fat-soluble vitamins. It is an important part of cuisines in various countries all around the world.

Since the **lactose** in it is usually processed by the microorganisms, it can also be eaten by lactose-intolerant people.

Various types of cheese

Cottage cheese can be eaten on toast, in pancakes, or can be used to make a cheesecake

Research

Learn more about cheese at

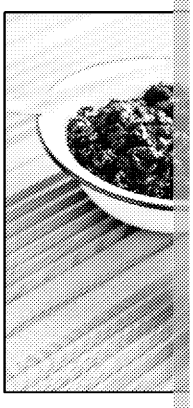
http://www.britishcheese.com/userfiles/file/How_Cheese_Is_Made_0

Secondary processing of fruit

Fruit is produced by bushes and trees and is designed to protect the seeds and provide them with nutrients until the time the seed can be planted and grown into another bush or tree. For that reason, they are full of micro- and macronutrients. Since fresh fruit is available for a short time only (usually from early spring to autumn), people have learnt to make fruit preserves, which can be stored for a later use. Fruit is used to make:

- marmalade
- fruit butter
- jam
- jelly
- fruit **curd**
- juice
- compote
- cider
- chutney
- confiture
- sauce
- dried fruit
- frozen fruit
- candied frui
- wine
- and many ot

The final product – again – depends on the quality and quantity of ingredients used, the method and length of cooking, and any additives, such as sugar, cloves, lemon juice or gelling agents.



Before cookin

Jam, fruit butter and confiture are made from whole or cut fruit, while jelly is made from fruit juice only. Fruit butter is usually made from thick (not watery) fruit such as plums, confiture is usually made from cherries, and jam can be made from soft fruit such as raspberries or strawberries.

The process of making jam is shown in the diagram below.

1
- fruit such as quinces, apples, gooseberries and currants is high in water, acid a suitable for jam making
- wash, cut or crush the fruit

2
- add water
- this is important, especially if fruit used has a low water content (e.g. plums), e in the fruit and ensure proper texture

3
- add acid, e.g. lemon juice
- acid helps to release pectin from the fruit cells, and this helps to thicken and s

4
- add sugar
- sugar acts as a preservative in jam
- special jam sugar contains also pectin and acid, which help to thicken and set t

5
- simmer
- the jam needs to be clear and very hot before being poured into jars

6
- sterilising the jars and lids in boiling water helps to ensure that no microorgan spoil the jam

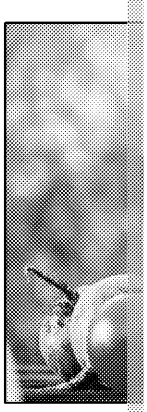
Marmalade is kind of a jam made from citrus juice, fruit and peel. For this reason, popular in countries in which oranges or lemons can be grown, such as Portugal or Spain.

Secondary processing of vegetables

Vegetable preserves are indispensable, especially during long winter months, wh fresh produce is barely available. Secondary processing of vegetables may inclu such processes as cooking, canning, juicing and pickling.

Cooking of vegetables softens the fibre in them and helps to gelatinise the starch the vegetables become soft and tender. Cooking allows us to obtain a wide rang food products, from steamed to roasted. Depending on the cooking method, th nutritional value of cooked vegetables may be preserved (e.g. when stir-frying o poaching), lost (boiling and draining especially decrease the amount of water-sol vitamins), or even worsened (e.g. in deep-frying the amount of fat rises dramatic

Juicing is applied to many vegetables, such as carrots, beetroots and tomatoes. The juice can be pressed from both cooked and raw vegetables. It can also have all the bits filtered out to make it more palatable. The most popular vegetables used for juicing include tomatoes and carrots. In recent years, food processors and blenders have become very popular, which has increased the number of people making juices at home from various ingredients, such as kale, cucumber, celery and beetroot. Juicing can lower the amount of fibre if the bits are removed from the juice, and can speed up enzymic browning of the juice. For this reason, commercially available juices are often pasteurised or contain preservatives. Juices can also be evaporated to obtain concentrates (which will lower the amount of water-soluble vitamins in them).



Vegetab

The most popular canned vegetables include peas, sweetcorn, beans and tomatoes

During **canning**, the vegetables are submerge sugar and other ingredients, then sealed in th decreases the amount of vitamins in vegetab amount of sugar and salt. Canned products c to extend their shelf life even more.

Pickling can be done with the use of brine (so vinegar. Pickled vegetables will have differen fresh ones, depending on the ingredients use often undergo bacterial fermentation, which bacteria – an example of such a product is sa

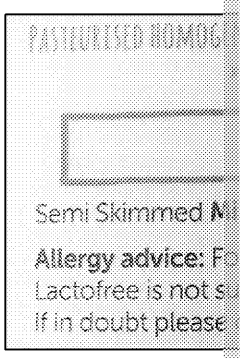
Loss of nutritional value during food processing

The choice of preparation and cooking methods is important in maintaining the n
some of the processes are beneficial, others lead to vitamin and mineral loss.

Primary processing of foods usually doesn't change the structure of a given food

Milling wheat leads to vitamin and mineral loss because the inside of the grain is
of the vitamins in grains are located close to the bran, so they are lost during the
either choose wholemeal flour or fortify the plain white flour.

Another example of how primary processing affects food is sterilisation of milk. Sterilisation is conducted under very high temperatures, which kill all the bacteria and spores in the milk. During the process, proteins begin to denature and, if the milk is heated for too long, the Maillard reaction can occur. The Maillard reaction takes place between particles of sugar and protein, and as a result, so-called Amadori compounds are created. The Maillard reaction can, therefore, change the colour, smell and flavour of milk. The same process occurs when sugar is removed to make **lactose**-free milk.



Also, cutting fruit and vegetables to make them more convenient for customers
because of oxygen exposure.

Secondary processing of foods includes the use of very high and very low tempe
significantly affects the nutritional value of foods. Water-soluble vitamins are ve
are washed out of food. The loss of certain vitamins is shown in the table below

Vitamin or mineral	Freezing	Drying	Cooking	C
Vitamin A	5%	50%	25%	
Vitamin C	30%	80%	50%	
Vitamin B1	5%	30%	55%	
Vitamin B2	-	10%	25%	
Folic acid	5%	50%	70%	
Vitamin B12	-	-	45%	
Calcium	5%	0%	20%	
Iron	-	-	35%	
Magnesium	-	-	25%	
Sodium	-	-	25%	

Prolonged heating, especially at very high temperatures (such as in deep frying) a
fats. Trans fats are a form of unsaturated fats, which are very harmful for health
can increase the risk of atherosclerosis (blocking of veins and arteries by choleste
disease, heart attack and stroke.

[18] *http://nutritiondata.self.com/topics/processing*

Research

Read the document at **https://www.bda.uk.com/foodfacts/TransFats.pdf** a
which usually contain trans fats.

Also, grilling can lead to a change in the nutritional value of foods; first, because o
second, because during grilling carcinogenic substances are released. This mean
increase the risk of cancer – especially bowel cancer.

On the other hand, drying and freeze-drying do not affect nutritional value of foo
remove the water necessary for the growth of microorganisms and thereby redu
extend shelf life of foods.

Also, **irradiation** does not affect the nutritional value of foods.

Things to think about

Discuss how primary and secondary food processing affects the nut
consider ways of preventing this.

3.6.2.2 Technological developments associ
health and food productio

You already know that the processing of foods leads to (sometimes significant) changes in their nutritional value and quality. Low intake of vitamins and minerals, along with high intake of calories, can lead to diet-related diseases, such as anaemia, atherosclerosis, or beriberi. For that reason, in many countries in the world vitamins and minerals are added to foods to increase their nutritional value and reduce the risk of such diseases.

Cholesterol-lowering spreads

Cholesterol is a fatty substance necessary to build cell membranes, bile acid and s
transported in the blood by lipoproteins.

Low-density lipoproteins (LDL) transport fat from the liver to the cells; they increase the levels of blood cholesterol and are, therefore, called 'bad'.

High-density lipoproteins (HDL) transport fat from the blood to the liver, where it is stored or removed from the body; they reduce the amount of cholesterol and fat in the blood and are, therefore, called 'good'.

High levels of LDL cholesterol are linked to increased risk of cardiovascular diseases, such as atherosclerosis, heart attack, hypertension and stroke.

Did you know?

Natural vegetable oils do not contain any cholesterol!

To prevent these, especially among t
spreads are produced. They are usua
as rapeseed oil, sunflower oil and oliv
and/or stanols are added. Also, speci
no **trans fats** are released during pro

Studies have shown that an intake of 1.5–2.4 g of these substances lowers the le
thereby decreases the risk of death from heart attack.

The producers of such spreads have also introduced other products containing st
milk drinks and yogurt.

Such products are especially beneficial for people at risk of overweight, obesity, i
blood cholesterol levels. These conditions often occur together.

35% low fat vegetable spread with added plant sterols

Ingredients: Water, vegetable oils in varying proportions (30%) (sunflower, palm, rapeseed), plant sterol esters (12.5%), BUTTERMILK, modified waxy corn s salt (1%), emulsifiers (mono- and diglycerides of fatty acids, sunflower lecithin), prese (potassium sorbate), citric acid, flavourings, colour (carotenes), vitamin A and D.

† A daily consumption of 1.5 - 2.4g plant sterol can lower cholesterol by 7-10% in 2-3 as part of a healthy diet and lifestyle with sufficient fruit and vegetables. Plant sterols been shown to lower blood cholesterol. High cholesterol is a major risk factor in the development of coronary heart disease. As heart disease has multiple risk factors, you need to improve more than one to reduce your overall risk. Check with your doctor firs are already taking cholesterol lowering medication, or if you have special dietary needs. Not suitable for pregnant or breast-feeding women and children under 5. This product is not intended for people who do not need to control their blood cholesterol level.

Low-fat vegetable spread with added plant sterols, wi
health claims included on the label

Fortification of foods and its impact on health

Fortification of foods is a process in which certain vitamins and/or minerals are added in order to:

- increase its nutritional value
- restore its nutritional value which has been lost during processing
- make it more suitable for certain consumer groups (e.g. children)
- prevent diseases caused by lack of these vitamins and minerals

According to the Food and Agriculture Organization of the United Nations (FAO), 'fortification' is applied to foods whether or not they contain a given micronutrient, while foods that have lost their nutritional value during processing are 'enriched'.

There are two important rules about food fortification:

1. Fortification cannot be applied to unprocessed foods.
2. If micronutrients are added, it is obligatory to list the amount on the label.

Foods can be fortified obligatorily or voluntarily.

The
thiami

Did you know?

In some countries it is mandatory to add iodine to salt to prevent thyroid gland diseases.

Mandatory fortification	Volun
Wheat flour and bread iron, vitamin B1, niacin, calcium carbonate	Bre Calcium, iron, vitam
Fat spreads (margarine) Vitamins A and D	
Semi-skimmed and skimmed milk Vitamin A	Whole milk a Vi

Nutrient deficiency can cause many different health conditions. Mandatory forti increase the intake of certain vitamins and minerals among the population and t diseases as beriberi (caused by lack of vitamin B1), anaemia (caused by lack of iro calcium and vitamin D).

[19] *https://www.food.gov.uk/sites/default/files/multimedia/pdfs/breadflourguide.pdf*
[20] *https://www.food.gov.uk/sites/default/files/multimedia/pdfs/yellowfatguidance0610.pdf*

Voluntary fortification of foods is designed to make foods more suitable for certain consumer groups; for example, the addition of calcium makes cereals better for children, who need it to grow healthy bones and teeth. The addition of vitamin C increases the intake of this vitamin and is a way of enhancing shelf life – because vitamin C works as a preservative.

Apply

Whi
prod
addi
are

Tropical fruit juice drink
sweetener and vitamin

Ingredients

Water, Fruit Juices from Conc
(Orange, Pineapple, Lemon, M
Lulo), Sugar, Fruit Purées (1%
Mango, Banana, Guava), Citri
Flavourings, Colour (Mixed C
Sweetener (Sucralose).

V **Suitable for vegeta**

A label of a fruit beverag
vitamins and food a

Apply

Find five products in your home that have been fortified. Which micronutrient
Was this mandatory or voluntary fortification?

Additives in foods

There are various additives added to food, and their use is strictly regulated by E
Union law. The use of them has to be clearly stated on the food label, together w
function and E number.

Food additives are grouped by their function in the food.

The safety of additives is assessed by European Food Safety Authority, which sta
whether a given additive can be used in food and in what amount. However, the
remains controversial.

One of the most controversial food additives is aspartame. It is a very sweet, lov
Since its discovery in the 1980s, it has been believed to cause brain tumours and
recent study shows no link between aspartame intake and such diseases, and, th
consume. However, since it is broken down to phenylalanine in the body, it cann
from PKU (phenylketonuria).

Use of additives can be harmful to people suffering from food allergies, such as sulf
used in dried fruits and many other products, so it is important to read the label car

Did you know?

Phenylketonuria is a genetic disease in which one of the am
acids – phenylalanine – cannot be broken down and used o
removed from the body (like other amino acids). Instead it
accumulated in the body, which leads to brain damage. Peo
suffering from phenylketonuria need to avoid high-protein
foods throughout their lifetime.

The functions, advantages and disadvantages of using food additives are present

Group	Function/Advantage	Disadvantage
Colourants	• Enhance the colour • Change the colour • Make food more appealing • Make food more appetising • Improve appearance of food • Some of them are natural	• Can be used to hide poor quality of ingredients • Can increase consumption, leading to obesity • Tartrazine is linked to lethal asthma attacks and other allergic reactions, such as skin rashes, thyroid tumours and ADHD • Some of them are artificial
Emulsifiers, stabilisers, gelling agents and thickeners	• Prevent mixtures from separating • Keep emulsions and other mixtures stable • Prevent crystallisation of mixtures	• Can be used to hide poor quality of ingredients • Can damage the lining of the intestines, and cause bloating and flatulence • Some emulsifiers are linked to causing *leaky gut syndrome*
Flavour enhancers and sweeteners	• Substitute for sugar • Have a lower calorific value than sugar • Enhance the flavour • Change the flavour • Add new flavour to a food • Make food more appealing and appetising	• May increase consumption, leading to obesity • MSG can cause allergic symptoms such as itching or sweating • Aspartame is a source of phenylalanine, so can't be eaten by people suffering from phenylketonuria
Preservatives and antioxidants	• Enhance shelf life • Prevent bacterial growth • Prevent growth of moulds and yeast • Prevent food spoilage • Lower food waste	• Sulfites can cause allergic reactions, including anaphylactic shock • Nitrates used in cold cuts can cause stomach cancer • Benzoates can cause asthma, skin rashes and other allergic reactions • Sorbates can cause dermatitis (skin inflammation)

Genetically modified foods and their impact on hea

The development of modern technologies has allowed scientists to manipulate the DNA of living organisms, such as viruses, bacteria, plants and animals. There is a strong correlation between diet, nutrition and health, and it is no surprise that genetically modified foods also have an impact on human health.

Introducing new genes to DNA or removing faulty ones has many advantages for human health and well-being.

- The food is more nutritious – in fact, crops can produce more vitamins and a
  fatty acids, thanks to which the food we eat (cereals, vegetables, fruit, eggs a
  nutrients
- Higher nutrient content can help to prevent malnutrition, especially in poore
- Higher nutrient content can help to prevent and cure the effects of deficien
  macro- and micronutrients
- Higher content of antioxidants may be beneficial in prevention of many dise
  heart disease
- High-yield crops can help to fight off hunger, as more food can be produced a

Genetically modified organisms have been in use since the 1980s. During this time, many people have raised many concerns about using them – due to both the environmental and health-related problems they may pose. In fact, there is no sufficient data to prove or disprove how GM foods affect the health, but the main arguments include:

Maize is o

- Higher incidence of allergies – this is usually linked to GM soybeans, which cause many more allergic reactions than non-modified crops
- Fear of new diseases, which can be caused by creating new bacteria species that are resistant to all known antibiotics
- A belief that GM foods contribute to the growing rates of obesity in developed countries, such as the USA
- A belief that GM foods increase the risk of cancer in those eating them
- Fear of antibiotic resistance developing in animals and in people eating them

In Great Britain, it is obligatory to state that a food contains GM ingredients if the higher than 0.9%.

3.6.2.2 Check your understa

1. Which of the following statements about food fortification is UNTRU

   a. It increases nutritional value of food
   b. It restores the nutritional value in processed foods
   c. It is used to prevent certain diseases
   d. It is unhealthy to eat fortified products

2. Mandatory fortification is applied to…? *(1 mark)*

   a. vegetable fat spreads ☐ b. breakfast cere
   c. fruit juice ☐ d. whole milk

3. Which statement about food additives is TRUE? *(1 mark)*

   a. They increase nutritional value of food. ☐ b. They prevent
   c. They can cause health issues. ☐ d. Their use is n

4. Which of the following is TRUE? *(1 mark)*

   a. All cholesterol is harmful. ☐
   b. Plant sterols decrease LDL level in blood. ☐
   c. Plant sterols decrease HDL level in blood. ☐
   d. Cholesterol level is not important for health. ☐

5. Common problems linked to food additives include… *(1 mark)*

   a. allergies ☐
   b. nervous system disorders ☐
   c. asthma ☐
   d. all of the above ☐

6. Flour is mandatorily fortified with… *(1 mark)*

   a. iron ☐ b. magnesium ☐ c. iodine

7. Explain the need for mandatory fortification of milk. *(4 marks)*

.....

.....

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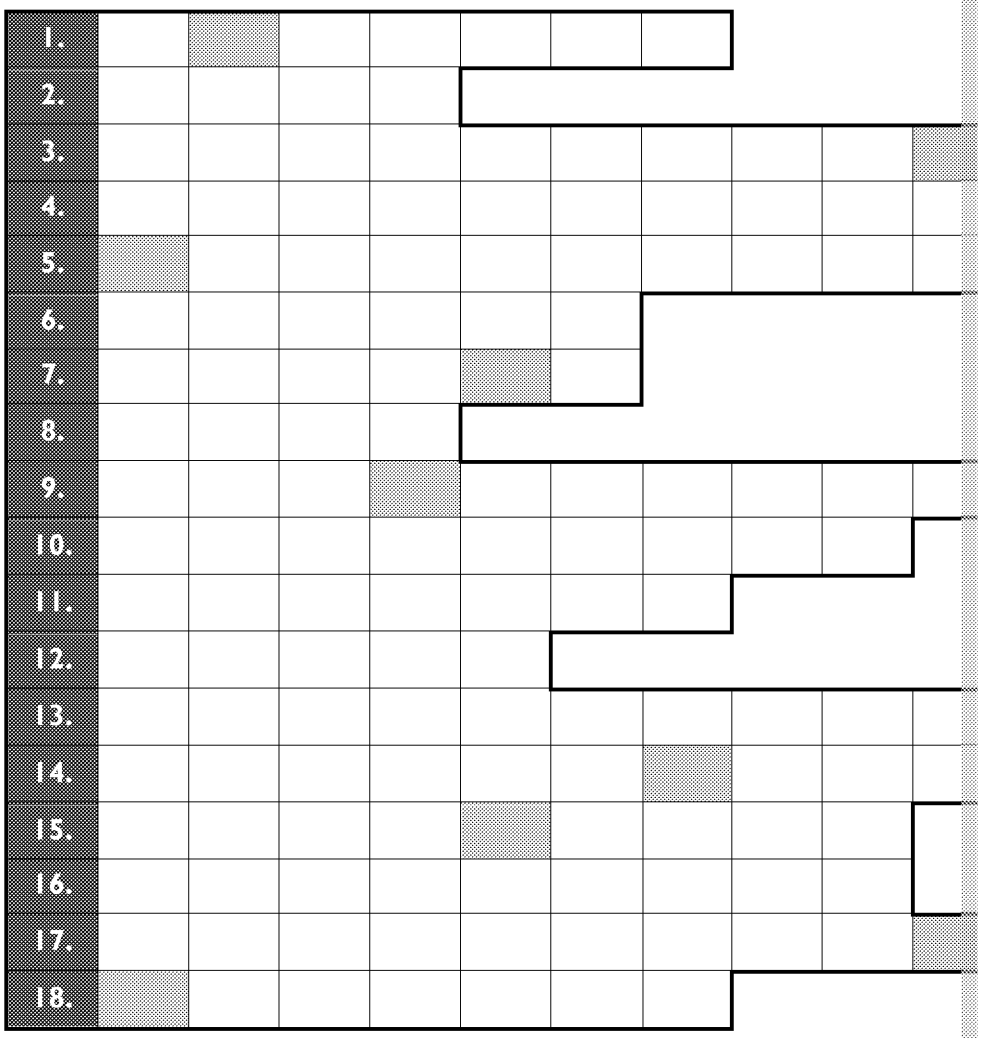
3.6.2 Quiz-ine

Fill in the answers to the questions below and then use the letters from the grey squares to reveal a word related to food production.



1. The process of turning grain into flour (7)
2. The external part of a grain (4)
3. Heating raw milk to 72 °C (14)
4. Freeze-drying (14)
5. Process conducted by probiotic bacteria (12)
6. The acid in yogurt (6)
7. An enzyme which turns cheese into curd (6)
8. By-product of cheese production (4)
9. Kind of mould used in cheese making (11)
10. Preserve made from citrus fruit (9)
11. Condition caused by lack of iron (7)
12. Flour made from this grain has to be fortified (5)
13. Vitamin B2 (10)
14. Used to conserve food and enhance its shelf life (12)
15. A sugar substitute (9)
16. Sugar substitute which cannot be eaten by people with phenylketonuria (9)
17. LDL or HDL (11)
18. Added to fat spreads (7)

The shaded squares reveal this word:

_ _ _ D _ D D _ _ _ _

Answers

Chapter 1

3.6.1.1

Things to think about:

PRO: allows producers to grow foods over large areas; allows the foods to grow in n
sunlight and with microorganisms and insects that improve growth (such as b

ANTI: vermin; floods and droughts; unpredictability; need to use pesticides; contami
lead)

Things to think about:

- Oceans cover 70% of Earth
- Diversity of life in oceans helps them clean themselves from human-borne pollu
- Diversity of life helps maintain species and lowers the risk of extinction (becaus
biodiversity means that there are various species of animals, which together for
they multiply/reproduce evenly so that the animals higher in the chain can eat t
them is extinct, it means no food for the other.
- Oceans provide people and animals with food (fish, shellfish and seaweed)
- Sustainable fishing prevents extinction of species
- Sustainable fishing is friendly for all the other oceans life forms that people don

Check your understanding

Q1: d
Q2: b
Q3: d
Q4: c
Q5: d
Q6: c
Q7: Any three for for and any three for against:

FOR	
Increase crops and prevent shortages and famine	No proof that they ar
Increase the amount of nutrients and prevent deficiencies	May increase the risk
Lower the need of antibiotics and herbicides	May increase the risk
Allow growth of foods where they couldn't be grown before	Haven't been eaten f consequences of mo

3.6.1.2

Check your understanding

Q1: c
Q2: d (for treatment, not for prevention)
Q3: d
Q4: b
Q5: d
Q6: b
Q7: Four marks for:

- Trees and plants use carbon dioxide and release oxygen into the atmosphe
- Trees and plants decrease the amount of carbon dioxide in the air and, the
global warming
- Globalisation includes global production and transportation of goods
- Production and transportation use a lot of resources and release a lot of gr
amount of carbon dioxide in the air and, therefore, increase the speed of gl

3.6.1.3

Things to think about: (example arguments)

- Food production: use of water, fossil fuels, fertilisers; transportation to factories
- Transportation: use of fossil fuels; food miles
- Packaging: use of water, fossil fuels, natural resources; transportation to factori
- It all creates food miles and carbon footprint. The more greenhouse gases are p footprint. Increased amount of carbon dioxide in the air accumulates and traps atmosphere. Therefore, the air and Earth's surface heat up. Water in oceans eva occur more often. People suffer from either drought or floods. Foods shortages lack of water.

Check your understanding

Q1: a
Q2: b
Q3: d
Q4: d
Q5: d
Q6: Two from:

- Planting GM seeds and rearing GM animals to increase the amount of food
- Planting GM seeds to overcome weather changes (e.g. lack of water or too
- Sustainable farming
- Using resources such as water only in the amount needed
- Using fertilisers or crop rotation to support soil quality
- Limiting food waste
- Or any other suitable answer

Two from:

- Global warming
- Droughts
- Floods
- Vermin
- Pests
- Poor soil quality
- Crop failure
- Lack of water to grow plants and rear animals
- Or any other suitable answer

Quiz-ine

1. Animals reared to provide food or other goods (livestock)
2. The distance travelled between a farm and a plate (food miles)
3. Grown or reared without the use of chemicals or GM products (organic)
4. Long plastic construction for growing plants in (polytunnel)
5. The most popular grain in the world (rice)
6. The meat of a deer (venison)
7. Eggs that are labelled with number 1 (free-range)
8. Bacteria species found on raw eggs (salmonella)
9. The most widespread genetically modified crop (soybean)
10. The practice of reusing items that would otherwise be discarded as waste (recy
11. An artificial product that never decomposes (Styrofoam)
12. When they melt, the sea level rises (glaciers)
13. Food that provides no nutrients (empty calories)

PASSWORD: fairtrade

Chapter 2

3.6.2.1

Things to think about: (example arguments)

- and secondary processing decrease the nutritional value of foods. Such process
  cooking, draining and reheating decrease the amount of vitamins and minerals i
- Also, oxygen is harmful because it leads to oxidation
- To prevent micronutrient loss:
- Fresh foods should be sold whole, not cut
- Foods should be stored in dry, dark conditions to protect them from moisture a
- Foods should be stored in correct temperatures to prevent bacteria growth
- Cooked foods should not be drained if possible
- Appropriate cooking techniques should be chosen, e.g. steaming instead of boili
- The time and temperature of cooking should be adjusted and reduced where po
- Raw fruit and vegetables should be eaten more often

Check your understanding

Q1: c
Q2: d
Q3: d
Q4: d
Q5: b
Q6: d
Q7: Four marks for:

- During cooking, high temperature is applied to food
- High temperature causes a breakdown of vitamins
- Also, water-soluble vitamins dissolve in water
- If the water is drained from food, the vitamins are lost with it

3.6.2.2

Check your understanding

Q1: d
Q2: a
Q3: c
Q4: b
Q5: d
Q6: a
Q7: Four marks for:

- Only semi-skimmed and skimmed milk has to be fortified
- Mandatory fortification of milk with vitamin A
- Vitamin A is fat-soluble
- Vitamin A level in semi-skimmed and skimmed milk is reduced because it w

Quiz-ine

1. The process of turning grain into flour (milling)
2. The external part of a grain (bran)
3. Heating raw milk to 72 °C (pasteurisation)
4. Freeze-drying (lyophilisation)
5. Process conducted by probiotic bacteria (fermentation)
6. The acid in yogurt (lactic)
7. An enzyme which turns cheese into curd (rennet)
8. By-product of cheese production (whey)
9. Kind of mould used in cheese making (penicillium)
10. Preserve made from citrus fruit (marmalade)
11. Condition caused by lack of iron (anaemia)
12. Flour made from this grain has to be fortified (wheat)
13. Vitamin B2 (riboflavin)
14. Used to conserve food and enhance its shelf life (preservative)
15. A sugar substitute (sweetener)
16. Sugar substitute which cannot be eaten by people with phenylketonuria (aspart
17. LDL or HDL (cholesterol)
18. Added to fat spreads (sterols)

Password: food additives