

## 5. Micronutrients: vitamins and minerals

- 1) i) Colour-code the fat-soluble vitamins given below with four different colours, then match these up with their *functions*, *sources* and *effects of deficiency* given in the table below (note that some may require more than one colour).

Vitamin A

Vitamin D

Vitamin E

Vitamin K

Functions			
Ensures proper growth of sperm cells	Lowers the risk of type 2 diabetes and cancer	Maintains healthy skin, nails and hair	Prevents depression
Crucial for good eyesight	Prevents haemorrhages	Necessary for proper bone and teeth growth and development	Necessary for proper growth and development of the foetus during pregnancy
Necessary for proper blood clotting	Antioxidant		
Effects of deficiency			
Tiredness	Dry and flaky skin	Depression	Rickets
Osteoporosis	Wrinkled, thin skin	Brittle hair and nails	Night blindness
Excessive bleeding	Muscle degeneration	Decreased immunity	Low immunity
Sources			
Fish and fish oil	Broccoli	Carrots	Spinach
Cheese	Liver	Kale	Pumpkin
Sunflower oil	Blueberries	Egg yolk	Gut bacteria

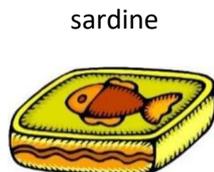
- ii) Complete the table below to identify the different types of water-soluble vitamins, their main functions and sources of micronutrients in the human body, and effects of deficiency in the diet.

Name	Function	Effects of deficiency	Sources
Vitamin B1 (thiamine)			<ul style="list-style-type: none"> <li>• wholegrains</li> <li>• yeast (including Marmite™)</li> <li>• liver</li> <li>• lean meat</li> </ul>
Vitamin B2 (riboflavin)	Important part of enzymes, takes part in creating haemoglobin		<ul style="list-style-type: none"> <li>• yeast</li> <li>• liver</li> <li>• cheese</li> <li>• green leafy vegetables, such as spinach or cabbage</li> </ul>
Vitamin B3 (niacin)		<p>4D syndrome – dermatitis (inflammation of skin), diarrhoea, dementia (loss of memory), death</p> <p>Low concentration (inability to focus), irritability</p> <p>Increased sensitivity of the skin to sunlight</p>	
Folate / folic acid (Vitamin B9)	Important in the process of DNA synthesis, takes part in creating red blood cells, reduces the risk of spinal cord diseases in newborns		<ul style="list-style-type: none"> <li>• yeast</li> <li>• wholegrains</li> <li>• fortified cereals and flour</li> <li>• spinach</li> <li>• broccoli</li> </ul>
Vitamin B12 (cobalamin)			
Vitamin C (ascorbic acid)	Takes part in collagen synthesis, helps with ingestion of iron, increases immunity, strengthens blood vessels		

- 2) i) Put a symbol next to the functions, effects of deficiency and sources below to match them to each of the given minerals: calcium (Ca), iron (Fe), sodium (Na), fluoride (F), iodine (I), and phosphorus (P). Some of them may be used more than once.

Functions		Effects of deficiency		Dietary Reference Values	
Helps build red blood cells		Tiredness, pale complexion, anaemia		1 mg	
Balances fluids in the body, keeps the blood pressure stable		Soft enamel, tooth decay, improper growth of teeth		700 mg to 1,000 mg	
Helps build strong bones and teeth		Nausea, diarrhoea, goitre		11 mg for boys, 14 mg for girls	
Builds the thyroid gland hormones and coordinates metabolic rate		Rickets and osteoporosis		130 mcg	
Builds tooth enamel, prevents tooth decay		Low blood pressure, headache, dehydration		Up to 6 g	






salmon and seafood




salt




red meat




- ii) Identify which main mineral is provided by the sources below.

- 3) Describe a meal that would support bone health in teenagers. For each ingredient used, justify your choice.

.....

.....

.....

.....

.....

.....

.....

.....

## Exam-style Question



People who eat a vegan diet do not consume any products of animal origin. Name **two** micronutrients which might be missing (or present only in very low quantities) in a vegan diet.

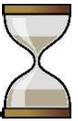
(2 marks)

## Extension Task

Excessive consumption of sodium can lead to a number of health issues; therefore, specialists recommend limiting consumption of sodium to less than 6 g a day.

- 1) List herbs and spices that could replace salt in recipes.
- 2) Research the Reference Nutrient Intake for all of the fat-soluble and water-soluble vitamins for teenagers. Use the British Nutrition Foundation website as a source. Can you explain why the RNI values for girls and boys differ?

*Use Extension Task worksheet to help you.*



# Extension Task worksheet

Herbs which could replace salt:

.....  
.....

Spices which could replace salt:

.....  
.....

Reference Nutrition Intake for vitamins

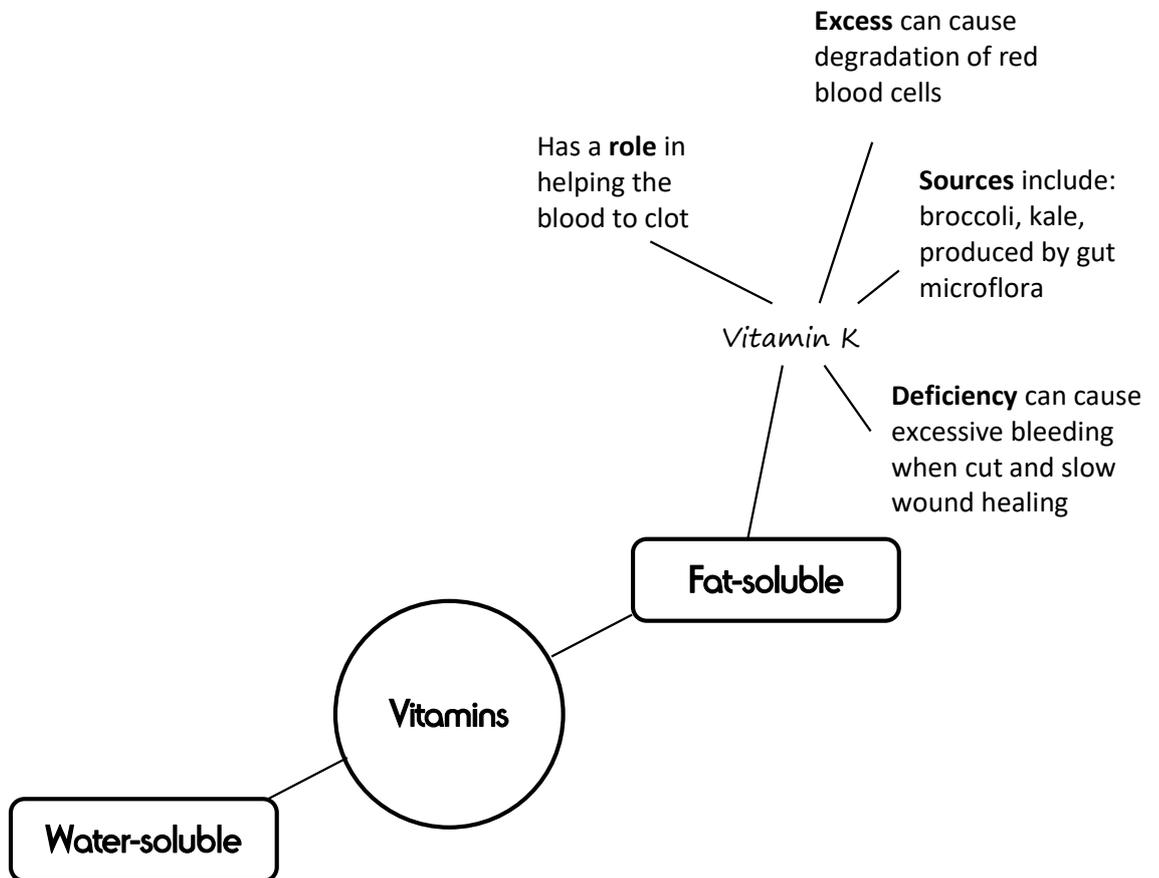
	Teenage boys (14–16-year-olds)	Teenage girls (14–16-year-olds)
<b>Vitamin A</b>		
<b>Vitamin D</b>		
<b>Vitamin E</b>		
<b>Vitamin K</b>		
<b>Thiamine</b>		
<b>Riboflavin</b>		
<b>Niacin</b>		
<b>Folic acid</b>		
<b>Vitamin B12</b>		
<b>Vitamin C</b>		

Why do the RNI values for boys and girls differ?

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....

## 5. Micronutrients: vitamins and minerals

- 1) Complete the spider diagram to identify the different types of vitamins, their main functions, effects of excess and deficiency, and sources in the human body. (One has been given for you.)



- 2) i) Discuss the *functions* of the different minerals found in our body and the *effects of deficiency* of each, stating their *Dietary Reference Values*.

**Calcium and Phosphorus:** .....

.....

.....

.....

.....

.....

.....

**Fluoride:** .....

.....

.....

.....

.....

.....

.....

**Sodium:** .....

.....

.....

.....

.....

.....

.....

**Iodine:** .....

.....

.....

.....

.....

.....

.....

**Iron:** .....

.....

.....

.....

.....

.....

.....

ii) Identify one source of each of the minerals listed below.

Calcium	Phosphorus	Fluoride	Sodium	Iodine	Iron

3) Assess the impact of diet on bone health. Give examples to support your answer.

.....

.....

.....

.....

.....

.....

.....

.....



### Exam-style Question

People who eat a vegan diet do not eat any products of animal origin.  
Give two reasons why a vegan should increase the amounts of vitamin B12 and iron in their diet.

*(2 marks)*

### Extension Task

Excessive salt consumption can lead to a number of health issues.

- 1) Research and list various herbs and spices which could substitute salt in recipes for savoury meals.
- 2) Research Reference Nutrient Intake values for all vitamins and minerals you learnt in this chapter. Write an essay in which you explain potential discrepancies between various groups of people.

**5. Micronutrients: vitamins and minerals**

1) i) ●

Functions			
E: Ensures proper growth of sperm cells	D: Lowers the risk of type 2 diabetes and cancer	A: Maintains healthy skin, nails and hair	D: Prevents depression
A: Crucial for good eyesight	K: Prevents haemorrhages	D: Necessary for proper bone and teeth growth and development	E: Necessary for proper growth and development of the foetus during pregnancy
K: Necessary for proper blood clotting	A and E: Antioxidant		
Effects of deficiency			
E: Tiredness	A: Dry and flaky skin	D: Depression	D: Rickets
D: Osteoporosis	E: Wrinkled, thin skin	A; Brittle hair and nails	A: Night blindness
K: Excessive bleeding	E: Muscle degeneration	A, E and K: Decreased immunity	D: Low immunity
Sources			
A and D: Fish and fish oil	A and K: Broccoli	A: Carrots	A and K: Spinach
D: Cheese	A: Liver	K: Kale	A and E: Pumpkin
E: Sunflower oil	A and E: Blueberries	A and D: Egg yolk	K: Gut bacteria

1) i) ■

Fat soluble vitamins A, D, E and K

Name	Function	Effects of deficiency	Sources
Vitamin A (retinol and beta carotene)	<ul style="list-style-type: none"> <li>Maintains healthy skin, nails and hair</li> <li>Crucial for good eyesight</li> <li>Antioxidant</li> </ul>	<ul style="list-style-type: none"> <li>Night blindness</li> <li>Brittle hair and nails</li> <li>Dry and flaky skin</li> <li>Decreased immunity</li> </ul>	<ul style="list-style-type: none"> <li>Fish and fish oil</li> <li>Liver</li> <li>Carrots, pumpkin, spinach, broccoli</li> <li>Blueberries</li> <li>Egg yolk</li> </ul>
Vitamin D (cholecalciferol)	<ul style="list-style-type: none"> <li>Necessary for proper bone and teeth growth and development</li> <li>Prevents depression</li> <li>Lowers the risk of type 2 diabetes and cancer</li> </ul>	<ul style="list-style-type: none"> <li>Rickets</li> <li>Osteoporosis</li> <li>Depression</li> <li>Decreased immunity</li> </ul>	<ul style="list-style-type: none"> <li>Fish, fish oil</li> <li>Liver</li> <li>Cheese</li> <li>Egg yolk</li> </ul>
Vitamin E (tocopherol)	<ul style="list-style-type: none"> <li>Antioxidant</li> <li>Necessary for proper growth and development of the foetus during pregnancy</li> <li>Ensures proper growth of sperm cells</li> </ul>	<ul style="list-style-type: none"> <li>Tiredness</li> <li>Wrinkled, thin skin</li> <li>Muscle degeneration</li> <li>Low immunity</li> </ul>	<ul style="list-style-type: none"> <li>Spinach, kale, blueberries</li> <li>Vegetable oils such as sunflower oil</li> <li>Pumpkin (especially seeds)</li> </ul>
Vitamin K	<ul style="list-style-type: none"> <li>Necessary for proper blood clotting</li> <li>Prevents haemorrhages</li> </ul>	<ul style="list-style-type: none"> <li>Excessive bleeding</li> <li>Slow wound healing</li> <li>Decreased immunity</li> </ul>	<ul style="list-style-type: none"> <li>Produced by gut bacteria</li> <li>Kale, spinach, broccoli</li> </ul>

1) ii) ●

Water soluble vitamins B group and C

Name	Function	Effects of deficiency	Sources
Vitamin B1 (thiamine)	Takes part in carbohydrate metabolism; is an important part of numerous enzymes	Beriberi disease, which shows as nerve and muscle cell degeneration	<ul style="list-style-type: none"> <li>- wholegrains</li> <li>- yeast (including Marmite™)</li> <li>- liver</li> <li>- lean meat</li> </ul>
Vitamin B2 (riboflavin)	Important part of enzymes; takes part in creating haemoglobin	Cracked and dry lips (especially in the corners of the mouth), dry skin	<ul style="list-style-type: none"> <li>- yeast</li> <li>- liver</li> <li>- cheese</li> <li>- green leafy vegetables, such as spinach or cabbage</li> </ul>
Vitamin B3 (niacin)	Helps release energy from food, takes part in red blood cells production, has a positive effect on the performance of the nervous system, extends blood vessels which helps deliver oxygen to the tissues	4D syndrome – dermatitis (inflammation of skin), diarrhoea, dementia (loss of memory), death Low concentration (inability to focus), irritability Increased sensitivity of the skin to sunlight	<ul style="list-style-type: none"> <li>- meat</li> <li>- nuts and seeds</li> <li>- wholegrains</li> <li>- fortified cereals and flour</li> <li>- fish (e.g. tuna, mackerel)</li> <li>- eggs</li> <li>- cottage cheese</li> <li>- yeast</li> <li>- broccoli</li> </ul>
Folate / folic acid (vitamin B9)	Important in the process of DNA synthesis, takes part in creating red blood cells, reduces the risk of spinal cord diseases in the newborns	A disease called spina bifida in newborns Anaemia (lack of red blood cells)	<ul style="list-style-type: none"> <li>- yeast</li> <li>- wholegrains</li> <li>- fortified cereals and flour</li> <li>- spinach</li> <li>- broccoli</li> </ul>
Vitamin B12 (cobalamin)	Together with folic acid takes part in creating red blood cells	Anaemia (lack of red blood cells) might occur in vegans if not supplemented	<ul style="list-style-type: none"> <li>- liver</li> <li>- milk</li> <li>- meat</li> <li>- eggs</li> <li>- cheese</li> <li>- fish (e.g. salmon or cod)</li> </ul>
Vitamin C (ascorbic acid)	Takes part in collagen synthesis, helps with the ingestion of iron, increases immunity, strengthens blood vessels	Decrease in immunity A disease called scurvy, which shows as bleeding, receding, weak gums leading to the loss of teeth Anaemia (due to impaired iron ingestion) Slow wound healing, excessive bleeding	Fruits and vegetables, such as: <ul style="list-style-type: none"> <li>- potatoes</li> <li>- bell peppers</li> <li>- tomatoes</li> <li>- strawberries</li> <li>- blackcurrants</li> <li>- citrus (oranges, lemons, etc.)</li> <li>- parsley</li> <li>- cabbage and sour cabbage</li> </ul>

- 2) i) ● Lower ability to match up  
 i) ■ Higher ability to construct sentences with main points included.

Mineral	Functions	Effects of deficiency	Dietary Reference Values
Calcium (Ca) and phosphorus (P)	Helps build strong bones and teeth	Rickets and osteoporosis	700 mg to 1,000 mg
Fluoride (F)	Builds tooth enamel, prevents tooth decay	Soft enamel, tooth decay, improper growth of teeth	1 mg
Sodium (Na)	Balances fluids in the body, keeps the blood pressure stable	Low blood pressure, headache, dehydration	Up to 6 g
Iodine (I)	Builds the thyroid gland hormones and coordinates metabolic rate	Nausea, diarrhoea goitre	130 mcg
Iron (Fe)	Helps build red blood cells	Tiredness, pale complexion, anaemia	11 mg for boys, 14 mg for girls

- ii) ● ■ Any of the following sources or suitable alternatives:

- Calcium and phosphorus – milk, sardines
- Fluoride, sodium – sardines
- Sodium – kitchen salt
- Iodine – salmon and seafood, kitchen salt
- Iron – red meat, salmon and seafood

- 3) ● Students should apply their knowledge and understanding of the functions of vitamins and minerals for bone health. The designed meal should include:

- at least one source of calcium, e.g. milk, cheese, sardines, almonds
- at least one source of vitamin D, e.g. eggs, oily fish
- at least one source of phosphorus, e.g. wholemeal bread, cereals
- at least one source of vitamin K, e.g. green leafy vegetables (spinach, kale)

- 3) ■ Students apply their knowledge and understanding to assess the role of a balanced diet for bone health.

- A balanced diet provides all the required macronutrients and micronutrients in the correct amounts. It is crucial to support growth and development, and to perform all bodily functions.
- An imbalanced diet can provide either too many or too few nutrients. Neither of these is beneficial as it can impair absorption and affect health.
- The most important nutrients for bone health are calcium, phosphorus, vitamin D and vitamin K. Vitamin D is necessary for the absorption of calcium in the intestine – vitamin D deficiency will, therefore, affect calcium absorption and lead to its deficiency. Vitamin D can be produced in the skin, but is also provided by oily fish, fish oil, some types of mushroom, egg yolk, milk and dairy products. It is important to provide sufficient amounts of vitamin D to prevent calcium deficiency.
- Eating too little calcium can cause health issues. Calcium is necessary for building strong bones, controlling muscle contractions and regulating blood pressure. We can obtain calcium from various foods, such as milk and dairy, fish, almonds and leafy green vegetables.
- Phosphorus is required for the absorption of calcium. It can be found in various foods, such as meat and cold cuts, bread and cereals. Phosphorus deficiency affects mineralisation of bones, causing them to become soft – this is known as osteopenia.
- Vitamin K is needed for the mineralisation of bones, increasing their density and strengthening them. It can be found in egg yolks and leafy green vegetables, but can also be produced by probiotic bacteria in the gut.
- An imbalanced diet could provide too many or too few of any of these micronutrients, and result in poor bone health. Deficiency of calcium and vitamin D is especially important, as it can lead to osteoporosis – a condition in which bones lose their density, become porous and fracture-prone.

Other suitable answers can be accepted.

### Exam-style Question

- 1) ● 2 marks

The answer could include any two from:

- vitamin D (although it can be manufactured in the skin, it is usually not sufficient)
- vitamin B12
- iron (plant foods only provide non-haem iron, which is difficult to digest and absorb for humans)
- calcium (although many plants are rich in calcium, a large amount of dietary fibre affects its absorption)

Do NOT accept protein as an answer (since it is not a micronutrient).

2) ■

Indicative content:

- A vegan diet provides no **vitamin B12**, which is present only in products of animal origin. Vitamin B12 is necessary for building red blood cells. Vitamin B12 deficiency will affect red blood cell production, leading to pernicious anaemia, so vegans must supplement this vitamin in the form of pills, and choose fortified foods to prevent anaemia.
- A vegan diet provides little **iron**. Although iron is present in plant foods, it is in the non-haem form, which is absorbed less effectively by the body. Iron is necessary for building haemoglobin, which binds and carries oxygen around the body. Without iron, haemoglobin cannot be built, and oxygen cannot be transported in the body. Also, red blood cells cannot be built, and the number of them in the blood drops drastically. Vegans should increase the amount of iron they consume, and seek ways of improving its absorption (in order to absorb as much as is needed by the body).

Other suitable answers may be accepted.