CONTENTS

Electives

- Revise your chosen elective on **www.moresuccess.ie**:
  - **Elective 1:** Home Design and Management
  - **Elective 2:** Textiles, Fashion and Design
  - **Elective 3:** Social Studies
- **Chapter 3:** Extra revision on **Food Studies** builds your confidence in this extensive topic

Just search for Home Economics Leaving Cert and look under 'Additional Resources'.

Week	Revision	LINKS – examples	Links and/or revision – examples
1	Food choice, protein, dietary guidelines, vegetarian diets	Meat, poultry, eggs, food preparation and cooking (meal management and planning), the Irish diet	Components of management, consumer choice
2	Lipids, dietary requirements, energy requirements, obesity, CHD, diabetes	Fats, oils, storage of lipid foods, food additives, food preparation and cooking methods	Consumer choice
3	Carbohydrates, dietary requirements, energy, coeliac disease, diabetes, obesity	Cereals, fruits vegetables, food preparation and cooking (sauce making, pastry making)	Management of household finances, consumer choices
4	Vitamins, minerals, dietary guidelines	The Irish diet, food additives, nutritional supplements	Household technology, consumer studies
5	Food profiles, alternative protein foods	The Irish food industry, food processing and packaging	Family resource management
6	Microbiology, food spoilage and preservation	Food preparation and cooking (yeast), food safety and hygiene, HACCP	Consumer responsibility, consumer protection
7	Aesthetic awareness of food	Food agencies and food legislation	Housing
8	Resource management	*Revise any topics not covered*	Textiles
9	The family	Family resource management	Family resource management
10	Marriage	The family, functions and legislation	
11	Family as a caring unit	Food requirements of different family members Meal management and planning	Family resource management, household financial management, housing
12	Elective 1 or 2 or 3 – *List the topics*		
13	Elective 1 or 2 or 3 – *List the topics*		

1 Food Science and Nutrition

aims

To learn and revise:

- Food choices
- Nutrients
- Water

Food choices

Factors affecting food choices:

1. Specific countries, cultural beliefs and traditions.
2. Availability, convenience and access to food.
3. Nutritional awareness and health status.
4. Sensory aspects and food presentation.
5. Financial resources.
6. Eating patterns, lifestyle and preferences.
7. Cookery and health TV programmes.
8. Advertising and marketing campaigns.

LINKS

- Individual dietary requirements (p. 55)
- The Irish diet (p. 75)
- Meal management and planning (p. 123)

Nutrients

Macronutrients	Micronutrients
• Protein • Lipids (fats/oils) • Carbohydrates	• Vitamins – fat-soluble – water-soluble • Minerals

exam focus

Nutrients may be included in questions on dietary requirements, food commodities, methods of cooking or methods of processing.

exam focus

You must *understand* and *be able to explain* what is meant by these **nutritional terms**:

- Macronutrients
- Micronutrients
- Elemental composition
- Chemical formula or equation
- Classification
- Sources
- Properties
- Reference intake
- Biological functions
- Biological value
- Energy value
- Digestion
- Absorption and utilisation of digested nutrients
- Enzymes
- Substrate

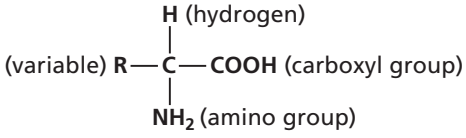
Protein

Elemental composition

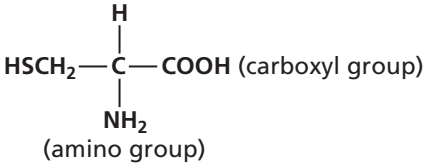
- Carbon (C), hydrogen (H), oxygen (O) and nitrogen (N).
- Some contain sulphur (S), iron (Fe) and phosphorus (P).

Chemical structure

- Proteins are made up of chains of amino acids.
- Amino acids contain carbon, hydrogen, a variable (R), an amino group (NH_2) and an acidic carboxyl group (COOH).



Basic amino acid



Cysteine showing the R (variable) group

Practise drawing and labelling the chemical structure of an amino acid.

Essential and non-essential amino acids

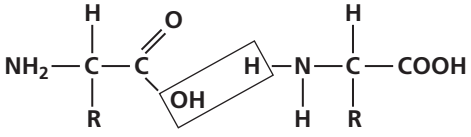
HL

- There are 20 common amino acids.
- Eight are essential for adults (these cannot be made by the body).
- Children need these eight plus two more (ten in total).

Essential amino acids	Non-essential amino acids
• Cannot be made by the body • Must be supplied by food	• Can be made by the body
Examples: isoleucine, leucine, lycine, methionine, phenylalanine, threonine, tryptophan, valine *For children:* histidine, arginine	*Examples:* alanine, aspargine, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, tyrosine

Peptides and peptide bonds

Amino acids are linked by a peptide bond. A carboxyl group (COOH) of one amino acid combines with an amino group (NH_2) of the next amino acid. A molecule of water (H_2O) is released (condensation) during this process. A dipeptide is formed.



Removal H_2O → Condensation

Addition H_2O → Hydrolysis

Hydrolysis

During digestion the reverse of the condensation process happens. Peptide bonds are broken by the addition of water, producing single amino acids. This is called hydrolysis.

exam focus

Practise drawing and labelling a peptide bond/link showing condensation and hydrolysis.

key point

- Two amino acids linked by peptide bond = **dipeptide**.
- Three amino acids linked = **tripeptide**.
- Many amino acids linked = **polypeptide chain**.

LINKS

- Digestion of protein (p. 9)
- Absorption of amino acids/ proteins (p. 10)

exam Q

Exam question and sample answer

HL

Higher Level 2014, Section B, Q1 (d)

LINK

- Classification of protein (p. 6)

(d) Give a detailed account of protein and refer to:
Classification (simple and conjugated)

(3 groups × 4 marks = 12 marks and 6 points × 2 marks = 12 marks = 24 marks)

Classification	Group	Sub-group	Examples	Food sources
Simple	*Animal*	*(a) Fibrous*	*Collagen, elastin, myosin*	*Connective tissue (meat)*
		(b) Globular	*Myoglobin* *Lactalbumin* *Ovalbumin*	*Meat* *Milk* *Eggs*
	Plant	*(a) Glutelins*	*Glutenin* *Oryzenin*	*Wheat* *Rice*
		(b) Prolamins	*Gliadin* *Zein*	*Wheat* *Maize/corn*
Conjugated (protein + non-protein)	*Lipoproteins* *Phosphoproteins* *Nucleoproteins* *Chromoproteins*		*Lecithin* *Casein* *Chromosomes* *Myoglobin*	*Egg yolk* *Milk* *Cell nuclei/DNA* *Meat*

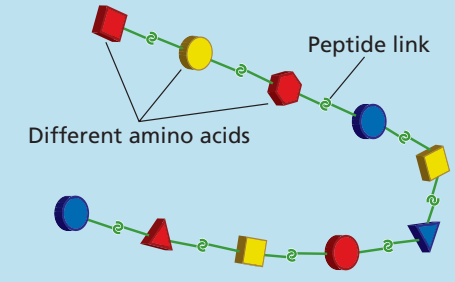
Supplementary value or complementary value (2 points × 4 marks = 8 marks)

- *Protein foods deficient in one or more amino acids can make up for the deficiency by being combined with foods rich in that amino acid at the same meal.*
- *A full complement of essential amino acids can be provided by serving (a) beans on toast (b) dhal and chapatti or (c) hummus and pitta bread. For example: Beans are high in lysine and low in methionine and toast is low inlysine and high in methionine.*

Structure (primary, secondary and tertiary) (3 points × 5 marks = 15 marks)

Primary structure:

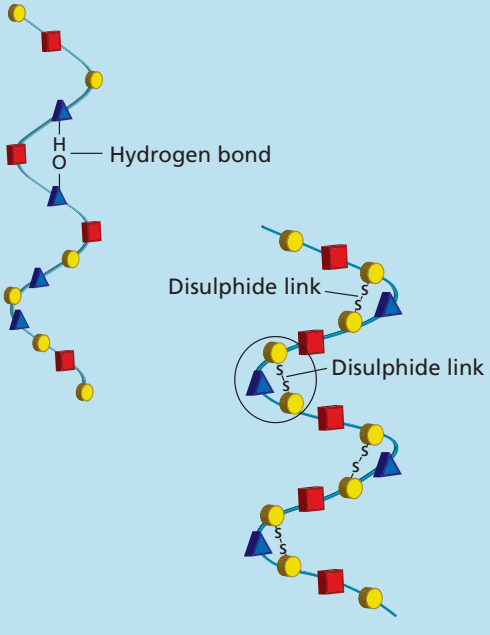
- *The sequence of amino acids in a polypeptide chain.*
- *The chain is formed by peptide links.*
- *The OH from the carboxyl group of one amino acid joins with the H of an amino group of another amino acid and water (H_2O) is released (condensation reaction).*



-Ala-Ser-Val-Tyr-Gly-Val-Ser-Cys-Ile-Ala-Val-Ser-

Secondary structure:

- *Amino acids in polypeptide chains are further folded and cross-linked to create definite shapes and structures.*
- ***Disulphide links** occur when two sulphurs are linked together on a polypeptide chain or across two polypeptide chains e.g. two cysteine amino acids (contain SH group).*
- ***Hydrogen bonds** occur in polypeptide chains when hydrogen in one chain links with oxygen in a nearby chain, e.g. collagen.*



Tertiary structure:

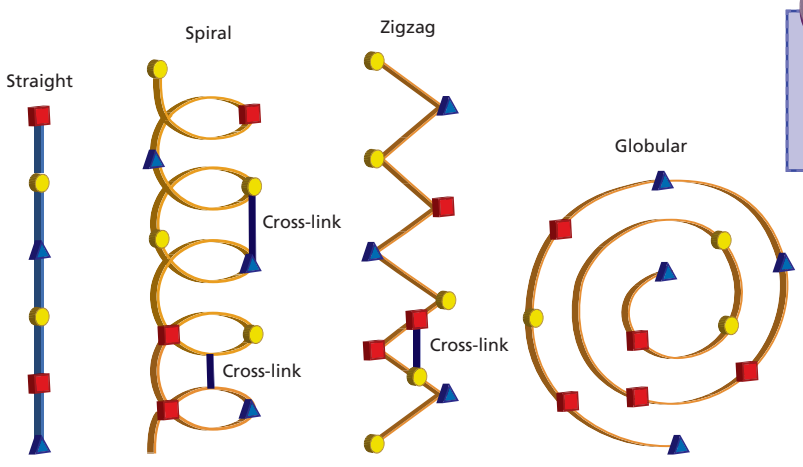
- *Refers to the pattern of folding polypeptide chains into three-dimensional shapes.*
- *Chains are held in place by cross-links and to form fibrous (straight, coiled or zigzag) or globular (ball-shaped) structures.*

LINK

- Tertiary structure diagrams (p. 6)

Tertiary structure

- Pattern of folding polypeptide chains into three-dimensional shapes.
- Shapes are held in place by cross-links and may be fibrous (straight, coiled or zigzag) or globular (ball-shaped).



exam focus

Practise drawing and labelling all diagrams.

Fibrous shapes	Globular shapes
Insoluble in water – difficult to denature *Examples:* gluten (wheat), elastin (meat)	Soluble in water – easily denatured *Examples:* myoglobin (meat), haemoglobin (blood)

Classification of proteins

1. **Simple proteins:** contain amino acids.
2. **Conjugated proteins:** amino acids and a non-protein component.
3. **Derived proteins:** formed from chemical/enzymatic actions on the protein itself, e.g. rennin acts on caseinogen.

Simple proteins – amino acids only

Types	Examples	Sources
Animal		
Classified according to shape	HL (a) Fibrous	Collagen Elastin – connective tissue
	(b) Globular	Albumin – egg white
Plant		
Classified according to solubility	HL (a) Glutelins: • insoluble in water • soluble in acids and alkalis	Glutenin – wheat Oryzenin – rice
	(b) Prolamins: • insoluble in water • soluble in alcohol	Gliadin – wheat Zein – maize/corn

HL

Conjugated proteins (protein + non-protein molecule)

Types	Examples	Source
Lipoprotein	Lecithin	Egg yolk
Phosphoproteins	Casein	Milk
Chromoproteins	Haemoglobin Myoglobin	Blood Meat
Nucleoproteins	Chromosomes	DNA (Deoxyribonucleic Acid)

Sources of protein – classification

Animal proteins	Plant proteins
Meat, fish, poultry, eggs, milk, cheese	Soya beans, whole cereals, nuts, pulses

Biological value (BV) – classification

- Measures the quality of a protein as a percentage.
- Is determined by how many essential amino acids a food has in proportion to the body's needs.

LINK
- Food commodities (p. 81)

High biological value (HBV) proteins or complete proteins:
- Contain all the essential amino acids.
- Come mainly from animal sources (*exception*: soya beans – source of HBV protein).

Low biological value (LBV) proteins or incomplete proteins:
- Lack one or more essential amino acids.
- Come mainly from plant sources (*exception*: gelatine – source of LBV protein).

Biological value of foods and distribution of proteins

Foods	Biological value	Distribution of proteins
Eggs	100%	Ovalbumin, vitelin, livetin
Milk	95%	Casein, lactalbumin, lactoglobulin
Meat	80–90%	Elastin, gelatine, collagen, myosin
Fish	80–90%	Actin, myosin, collagen
Soya Beans	74%	Glycinin
Rice	67%	Oryzenin
Wheat	53%	Gluten
Maize	40%	Zein
Gelatine	0%	

Supplementary role of protein

If a protein is deficient in one amino acid the deficiency can be overcome by eating a food rich in that amino acid at the same meal, e.g. beans on toast:

- Beans are **high** in lysine and **low** in methionine.
- Toast is **low** in lysine and **high** in methionine.

LINK
- Vegetarianism (p. 66)

key point

The complementary role of proteins ensures that vegans and vegetarians can get all their essential amino acids from plant-based foods.

Properties of protein

1. Denaturation and coagulation	• Protein chain unfolds and its structure changes – loss in structure cannot be reversed. • Sequence of amino acids is the same. The change may be due to: (a) **Agitation** – mechanical action, e.g. whipping or whisking an egg white (forming a foam) or cream. (b) **Chemicals** – adding acids, alkalis, enzymes, e.g. lemon juice causes milk to curdle. (c) **Heat** – causes protein to coagulate and set, e.g. albumin in eggs. (d) **Enzymes** – rennin coagulates caseinogen to casein.
2. Solubility	Most proteins are insoluble in water. Exceptions: (a) Collagen is soluble in hot water. (b) Albumin (egg white) is soluble in cold water.
3. Maillard reaction (dry heat)	Non-enzymic browning results when an amino acid reacts with carbohydrate in dry heat, e.g. toast, roast potatoes, breads.
4. Elasticity	Gluten (wheat) is very elastic – it allows breads and cakes to rise during baking.
5. Moist heat	During stewing, boiling and steaming, connective tissue changes to gelatine, making foods more digestible.
6. Gel formation	A gel is a semi-solid viscous solution with a three-dimensional network in which molecules of water can become trapped. *Gel formation process:* (a) Gelatine absorbs water and swells to form a gel. (b) When heated the gel becomes liquid and forms a sol. (c) On cooling, the sol sets and becomes solid. *Uses:* jellies, soufflés, cheesecakes

HL

exam focus

Practise drawing and labelling a diagram showing gel formation.

7. Foam formation	• Whisking egg whites causes protein chains to unfold and air bubbles to form, which trap air (foaming). • Whisking produces heat, which lightly sets the egg white. Foam will collapse unless heated. *Uses:* meringues, pavlova

LINKS
- Food commodities (p. 81)
- Food preparation and cooking processes (p. 123)

Biological functions of protein

Type	Functions	Deficiency
Structural proteins	• Growth and repair • Production of cells, muscles and skin	• Stunted growth • Delayed healing of wounds
Physiologically active	• Production of antibodies, enzymes, hormones, blood proteins and nucleoproteins	• Illness and infections • Malfunction of body systems and organs
Nutrient proteins	• Provide essential amino acids • Excess converted to energy	• Lack of energy • Marasmus and kwashiorkor

Energy value: 1 g protein = 4 kcal/17 kJ energy.

Reference Intake* – how much protein do I need?

1 g of protein a day is required for each 1 kg of body weight. (Children and adolescents need more for growth and development.)

Group	RI per day
Children	30–50 g
Adolescents	60–80 g
Adults	50–75 g
Pregnant women	70–85 g

Digestion of protein

Hydrolysis and digestion of protein – a summary

Proteins are hydrolysed with the help of protein-splitting enzymes and water.

HL

DEAMINATION

1. Excess proteins are deaminated by the liver.
2. The amino group (NH_2) of the amino acids is converted into ammonia and then urea. Urea is excreted from the body in urine.
3. The carboxyl group (COOH) is oxidised (used for heat and energy). Excess is stored in the body as glycogen (energy source).

** Reference Intake (RI) was previously known as Recommended Daily Allowance (RDA).*

Organ/gland	Secretions	Enzymes	Substrates	Products
Stomach	Gastric juice	Pepsin Rennin	Protein Caseinogen	Peptones Casein
Pancreas	Pancreatic juice	Trypsin	Peptones	Peptides
Small intestine (duodenum)	Intestinal juice	Peptidase	Peptides	Amino acids

Absorption of amino acids/proteins

Amino acids are absorbed by the blood vessels in the villi of the small intestine and transported to the liver via the hepatic portal vein.

HL

Utilisation of amino acids

Amino acids in the liver are used to:

- Repair and maintain liver cells.
- Form new cells, repair damaged tissues and make antibodies, enzymes and hormones.

Excess amino acids are deaminated in the liver.

exam Q

Exam questions and sample answers

HL

Higher Level 2017, Section A, Q1 (6 marks)

Amino acids are the building blocks of proteins. Explain **and** give an example of **each** of the following terms.

- Essential amino acids:
  Cannot be manufactured by the body and must be supplied by the diet. 8 are essential for adults, 10 are essential for children. Examples: Isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine.
- Non-essential amino acids:
  Can be manufactured by the body and do not need to be supplied by the diet. Examples: alanine, asparagine, aspartic acid, cysteine, glutamic acid, glutamine, glycine, proline, serine, tyrosine.

Higher Level 2016, Section A, Q1 (6 marks)

Name **one** food source of **each** of the proteins listed below.

Proteins	Food source
Casein	*Milk*
Actin	*Meat*
Albumin	*Eggs*

Higher Level 2015, Section A, Q1 (6 marks)

Explain protein **deamination**.

Excess proteins are broken down by the liver. The amino group (NH_2) of the amino acids is converted into ammonia, then urea and excreted by the kidneys as waste product in urine. The carboxyl group (COOH) is oxidised and used to produce heat and energy. Excess is stored in the body as glycogen.

Higher Level 2013, Section A, Q1 (6 marks)

Complete the table below in relation to the **biological functions** of protein.

Type	Biological functions
Structural proteins	*Growth and repair of body cells, skin and muscles.*
Physiologically active proteins	*Production of antibodies, enzymes, hormones, blood proteins.*
Nutrient proteins	*Provide essential amino acids, excess is used for heat and energy.*

Ordinary Level 2017, Section A, Q3 (3 ticks × 2 marks = 6 marks)

Indicate with a tick (✓) which of the protein foods listed below are of high biological value and which are of low biological value.

Protein foods	High biological value	Low biological value
Eggs	✓	
Peas		✓
Fish	✓	

Ordinary Level 2016, Section A, Q1 (3 ticks × 2 marks = 6 marks)

Indicate with a tick (✓) whether each of the following statements is true or false.

	True	False
Protein is the only nutrient that contains nitrogen.	✓	
Excess protein is stored as adipose tissue.	✓	
Protein is necessary for growth of body cells.	✓	

Ordinary Level 2015, Section A, Q2 (6 marks)

Using the words listed, **complete the statements** in relation to the effect of heat on protein foods:

Maillard reaction **coagulate** **opaque**

- Heat causes the protein in eggs to *coagulate*.
- The non-enzymic browning of protein foods is called the *Maillard reaction*.
- Fish flesh changes from translucent to *opaque* during cooking.

Ordinary Level 2013, Section B, Q1 (b), (c)

(b) Give an account of protein under **each** of the following headings:

Composition (4 points × 1 mark = 4 marks)

- *Protein contains carbon, hydrogen, oxygen and nitrogen.*
- *Protein is the only nutrient that contains nitrogen which is essential for growth.*
- *Small amounts of sulphur, phosphorus and iron.*
- *Elements are arranged into basic units called amino acids.*

Classification (2 classes × 4 marks = 8 marks)

- ***Simple proteins:*** *animal and plant source.*
- ***Conjugated protein:*** *Protein combined with a non-protein unit, e.g. haemoglobin, myoglobin.*
- ***Derived proteins:*** *formed due to chemical or enzymic action on a protein itself, e.g. high biological value proteins come from animal sources, low biological value proteins come from plant sources.*

Include examples from both animal and plant sources – choose **two** sources from each group.

Dietary sources (4 sources × 3 marks = 12 marks)

- ***Animal:*** *meat, poultry, fish, eggs, milk, cheese (dairy product).*
- ***Plant:*** *soya beans, TVP, nuts, legumes (peas, beans, lentils).*

Functions in the body (2 functions × 4 marks = 8 marks)

- *Growth and repair of body cells.*
- *Formation of muscles, skin and cell membranes.*

(c) Explain the following properties of protein and give an example of each. (12 marks)

Denaturation

LINK
- p. 8

Coagulation

LINK
- p. 8