

# Teaching notes: Protein digestion and absorption

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These teaching notes relate to section 3.3.3 of our AS and A-level Biology specifications. This resource describes key teaching points in the accompanying PowerPoint presentation.

## Key points

- Proteins are hydrolysed to amino acids, which can be absorbed in the ileum of the small intestine.
- Different types of proteases are involved in the hydrolysis of proteins, including endopeptidases, exopeptidases and membrane-bound dipeptidases.
- Proteins are hydrolysed in the stomach. Since proteins form the major organic component of cells, early digestion of proteins ensures other organic molecules are accessible to digestive enzymes in the small intestine.
- Protein digestion begins with endopeptidases. The action of endopeptidases increases the number of 'ends' that can be hydrolysed by exopeptidases. This speeds the rate of protein digestion.
- Absorption of amino acids involves co-transport with sodium ions.

## PowerPoint presentation

### Protein digestion (slide 2)

This slide introduces the terms: endopeptidases, exopeptidases and dipeptidases.

### Exopeptidases and endopeptidases (slide 3)

This slide shows a diagrammatic representation of the action of endopeptidases and exopeptidases.

Note: the terms endopeptidase and exopeptidase describe groups of enzymes, rather than individual enzymes. Individual enzymes within each group hydrolyse the peptide bonds between different (specific) amino acids. This explains why the diagram shows exopeptidases producing dipeptides *or* individual amino acids.

## Pause for thought (slide 4)

This slide poses a question to encourage students to think about the advantage of the action of endopeptidases in speeding up digestion by providing more 'ends' for the action of exopeptidases. You could link this to the more familiar concept of surface area to volume ratio (section 3.3.1); the principle is similar.

## Dipeptidases (slide 5)

This slide confirms that dipeptidases are membrane-bound.

If you have already covered carbohydrate digestion, you can link this back to the membrane-bound disaccharidases, such as maltase.

## Summary of protein digestion (slide 6)

This slide provides a summary of protein digestion.

It introduces the terms gastric juice and pancreatic juice and refers to the pH of these juices.

The students' question sheet includes questions that relate back to this slide, testing their understanding of enzyme action.

Note: the specifications do not include the names of any endopeptidase or exopeptidase, so students need not recall names such as pepsin or trypsin.

## Amino acid absorption (slide 7)

### Uptake by co-transport (slide 8)

These two slides contain a summary of amino acid absorption involving co-transport with sodium ions. If you have already covered carbohydrate digestion, you can link this back to the absorption of glucose.

You might question students about where the sodium ions and glucose go once through the base of the epithelial cells. 'Into the blood' is a simple answer, but if you have already covered tissue fluid formation, 'into the tissue fluid' is a better answer.

## Questions for students

1. Distinguish between an endopeptidase and an exopeptidase.

[1 mark]

2. Protein digestion begins in the stomach. Suggest **one** advantage for **each** of the following statements about digestion in the stomach of humans.

- 2.1. In humans, food spends about 2 hours in the stomach, during which time most of the protein is hydrolysed.

[2 marks]

2.2. An endopeptidase (pepsin) is the only protein-digesting enzyme secreted into the stomach.

[2 marks]

2.3. The endopeptidase is secreted in an inactive form (called pepsinogen).

[2 marks]

2.4. The stomach lining secretes hydrochloric acid, lowering the contents to about pH 2.

[1 mark]

2.5. The muscles of the stomach wall create strong churning movements.

[1 mark]

3. The pancreatic juice of each human contains many different protein-digesting enzymes, including chymotrypsin, elastase, glutamyl endopeptidase and trypsin.

Use your knowledge of enzyme action to suggest the advantage of the presence of many different protein-digesting enzymes in the pancreatic juice.

[2 marks]

4. In some species, newborn mammals are able to absorb antibodies from their mother's milk. They do this when cells lining their small intestines engulf the antibodies into small vacuoles; a process called endocytosis. The pancreatic juice of these newborn mammals does not contain protease and their stomachs do not secrete hydrochloric acid. Suggest how this helps them absorb antibodies.

[2 marks]

5. Describe how amino acids are absorbed in the small intestine.

[5 marks]

The guide mark scheme for these student questions is available in [e-AQA](#) through Secure Key Materials.