

Biological catalysts, food tests and energy in food

Revision notes · The importance of enzymes in making and breaking down carbohydrates, proteins and lipids; food tests and calorimetry (Triple only).

For Edexcel GCSE Biology 1BI0 and Combined Science 1SC0. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Biological catalysts, food tests and energy in food **Spec 1.12-1.14B**

The importance of enzymes **Spec 1.12**

Chemical reactions in living things would be far too slow to keep us alive without enzymes. Enzymes are **biological catalysts** that speed up reactions in cells. They are needed both to build large molecules and to break them down.

Enzymes in synthesis and breakdown		
Large molecule	Made (synthesised) from	Broken down into
Carbohydrates	Sugars	Sugars
Proteins	Amino acids	Amino acids
Lipids	Fatty acids and glycerol	Fatty acids and glycerol

Different enzymes catalyse each of these reactions, because enzymes are specific. Breaking down large molecules into small ones is a vital job, and so is building the carbohydrates, proteins and lipids the body needs.

Exam tip: If asked what a catalyst does, say it **speeds up a reaction** and is **not used up**.

Core practical: food tests **Spec 1.13B** **Triple only**

Triple only

You can use chemical reagents to identify the main biological molecules in a food. If the food is a solid, crush it with a little water and use the liquid; for the fat test, shake the food with ethanol instead. Always wear eye protection.

Triple only

Core practical: A negative result means the reagent keeps its original colour. Learn the start colour as well as the positive result.

Triple only**Food tests**

Biological molecule	Reagent	Method	Positive result
Starch	Iodine solution	Add a few drops of iodine solution to the sample	Orange-brown to blue-black
Reducing sugars	Benedict's solution	Add Benedict's solution and heat in a hot water bath for a few minutes	Blue to green, yellow, orange or brick-red, depending on the amount of sugar
Protein	Biuret reagent	Add biuret reagent to the sample and mix	Blue to purple (lilac)
Fats	Ethanol	Shake the sample with ethanol, then pour the mixture into water	A cloudy white emulsion forms

Triple only

In a negative result, iodine stays orange-brown, Benedict's solution and biuret reagent stay blue, and the ethanol test stays clear. Ethanol is flammable, so keep it away from naked flames, and Benedict's solution is heated in a water bath, not directly over a flame.

Measuring the energy in food

Spec 1.14B

Triple only**Triple only**

Food contains stored chemical energy. Energy can be measured using **calorimetry**: the food is burned and the energy it releases is used to heat a known mass of water.

Triple only

1. Measure a known volume of water into a boiling tube and record its starting temperature. 1 cm³ of water has a mass of 1 g.
2. Weigh a small piece of food and hold it on a mounted needle.
3. Set fire to the food and hold it under the boiling tube until the food stops burning.
4. Record the highest temperature of the water and work out the temperature change.

Triple only

$$\text{energy released (J)} = \text{mass of water (g)} \times 4.2 \times \text{temperature change (}^{\circ}\text{C)}$$

Triple only

$$\text{energy per gram of food (J/g)} = \text{energy released} \div \text{mass of food (g)}$$

Triple only

Calculating the energy in food

Burning 0.5 g of a snack raises the temperature of 20 g of water by 12 °C. Calculate the energy released per gram of the snack.

1. energy released = $20 \times 4.2 \times 12 = 1008 \text{ J}$
2. energy per gram = $1008 \div 0.5 = 2016 \text{ J/g}$

Answer: 2016 J/g

Triple only

The result is usually lower than the real value because heat is lost to the surroundings and the food may not burn completely. Surrounding the boiling tube with a draught shield, putting the flame close to the tube and stirring the water improve the results. Wear eye protection, take care with the burning food, and do not use foods such as nuts that people may be allergic to.

Quick check

1. What are proteins broken down into?
2. What does a catalyst do?
3. Which reagent turns purple when protein is present?
4. How can the energy in food be measured?

Quick check answers

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1. Amino acids.
2. It speeds up a reaction and is not used up.
3. Biuret reagent (Triple only).
4. By burning it to heat water and using the temperature change (calorimetry) (Triple only).