Section Three — Knowledge Organiser

Grab your lab coat and put on your safety goggles — this hefty spread recaps the section on food science...

Why Food is Cooked

Makes it safe to eat
Improves shelf life
Develops flavours
Improves texture
Gives more variety in diet

Heat Transfer

Heat energy moves and cooks food in three ways:

Conduction	Convection	Radiation
In solids, particles vibrate when heated and collide with nearby particles, transferring heat energy — e.g. a pan on a hob heats the food that's touching it when frying.	In gases & liquids, particles rise when heated and cooler particles take their place — they get heated in turn & rise, forming convection currents.	There's no direct contact between the heat source and the food. Heat is transferred through waves of radiation.

Dry Cooking Methods

Baking	Quite healthy (no extra fat added) & adds a crisp texture but can take lots of time.
Roasting	Extra fat is added so is unhealthier, but it tastes great because the outside crisps up while the inside is moist.
Dry frying	Healthier than other frying methods (no extra fat added). It also releases oils (e.g. from nuts), which brings out more flavour.
Grilling	Quick, creates good colour & texture. It is fairly healthy, but can cook food unevenly.

Fat-Based Cooking Methods

Stir-frying: Food is cooked very quickly — more nutrients are kept. Often in a wok with a little bit of oil.

Shallow frying: Food is cooked with more fat / oil than stir-frying — so it's unhealthier but gives a crispier texture.

Cooking food in fat / oil increases its flavour, as the fat is absorbed.

Water-Based Cooking Methods

- These methods don't involve adding fat, so are healthier.
- But some nutrients are lost in the water:

Fewer nutrients lost →→→ More nutrients lost

Steaming   Blanching   Poaching   Simmering   Boiling

- Blanching is when food is briefly boiled then put in cold water. You can prep veg for freezing this way.
- Braising cooks food in an oven, in a covered pot with liquid in. It's gentle so food becomes tender & takes on the flavours of the liquid, e.g. stock, wine.

Changing Properties — Proteins

Denaturation is when the structure of a protein breaks down. This can be caused by physical agitation, temperature change or acids.

Coagulation is when denatured proteins join together and water becomes trapped between molecules. Changes the food's texture / appearance.

Foams form when a liquid is agitated & proteins inside denature. They stretch, then coagulate & air is trapped in the liquid.

Gluten is a wheat protein. When a wheat-based dough is kneaded, the gluten becomes stronger & stretchier. It stays stretched when the bread is baked, giving the bread a light, airy texture.

Raising Agents

A few ways to make foods rise when you cook them:

Chemical — breaks down & produces carbon dioxide when heated, e.g. bicarbonate of soda, baking powder.

Biological (yeast) — releases carbon dioxide when left in a warm place. Gas is trapped in the dough & expands when baked.

Steam — when mixtures with a lot of liquid are heated, water leaves as steam, causing the mixture to rise.

Mechanical — air added into mixtures by folding, beating, whisking, sieving, creaming or rubbing in.

Changing Properties — Carbohydrates

Carbohydrates can change in three ways:

1. Gelatinisation — starch granules in a liquid swell and soften when heated between 62-80 °C. The starch bursts & thickens the liquid, which sets as it cools.

2. Dextrinisation — dry heat causes starch molecules to break down into dextrins. Makes food browner and crispier.

3. Caramelisation — at high temperatures, sugar molecules break down and turn brown. Used to make some foods, e.g. onions, sweeter.

Changing Properties — Fats & Oils

Aeration — adding air into mixtures makes them light & fluffy, e.g. cupcakes.

Shortening — adding fat to flour makes it waterproof, so when water is added, long gluten molecules don't form. This makes doughs crumbly, e.g. shortbread.

Plasticity — the more plasticity a fat has, the easier it is to spread. Unsaturated fats have more plasticity then saturated fats.

Emulsification — mixing oil & water. Adding an emulsifier stops them from separating, e.g. egg yolks in mayonnaise.

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Uses of Microorganisms

Moulds
- Used to make blue cheese, e.g. Stilton. Gives it a creamy texture & sharp, tangy taste.

Yeasts
- Ferment the sugar in bread dough to produce carbon dioxide, making bread rise.
- Fermentation also produces ethanol, used to make alcoholic drinks, e.g. wine from grapes.

Bacteria
- Ferment lactose (milk sugar), making lactic acid. Used to turn milk into yoghurt / cheese.
- Also used to make fermented meats, e.g. salami & chorizo.

Critical Temperatures

1. **Cooking/reheating (above 75 °C)**
   High temperatures kill bacteria. Reheat for at least 3 minutes.

2. **Danger zone (5 °C to 63 °C)**
   Bacteria multiply quickly. Optimum temperature for bacterial growth is 37 °C.

3. **Chilling (0 °C to 5 °C)**
   Slows bacterial growth.

4. **Freezing (below −18 °C)**
   Bacteria are dormant, but become active again when food defrosts.

Preparing Food Safely

Avoid cross-contamination, e.g. other contaminated food, utensils, people, pests. Follow safety & hygiene procedures:

Preparing
Have good personal hygiene, separate raw & cooked foods, wash veg, clean equipment, sanitise work surfaces, defrost food fully.

Cooking
Cook at right temperature for right amount of time, cook all the way through, use a temperature probe.

Serving
Serve hot food straight away or keep it above 63 °C for up to 2 hours, cool food down within 90 mins, keep food covered (ideally in the fridge).

Food Spoilage

Microorganisms

Most microorganisms are harmless, but pathogenic ones spoil food and cause food poisoning.

They need five things to grow:

1. Warm temperature
2. Lots of moisture
3. Lots of food
4. Right pH
5. Enough time

You can slow growth by changing one of these conditions.

Bacteria: Ready-to-eat foods are at high risk of bacteria — they're moist, high-protein & have a short shelf life. They need to be stored correctly.

E.g. cooked meat & fish, dairy products, gravies, shellfish, cooked rice.

Moulds can spoil bread, cheese & fruit, and can cause food poisoning. They make food look 'fuzzy' and change the food's smell & taste too.

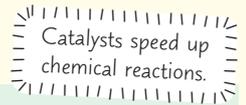**Yeasts** can spoil fruit by fermenting sugars into alcohol & carbon dioxide.

Chill & freeze food properly:

Fridges should be set at 0 °C to 5 °C. Keep food covered to avoid contamination. Store raw meat on the bottom shelf.

Freezers should be around −18 °C. Label food clearly with date frozen. Defrost meat completely in a fridge (so it cooks properly).

Date Marks

Must be printed on food packaging.

Use By — on products with short shelf life. Food may not be safe to eat after this date.

Best Before — on products with longer shelf life. Food is still safe to eat after this date, but might be poorer quality.

Enzymes

Catalysts speed up chemical reactions.

Enzymes — proteins that act as biological catalysts:
- Make fruit ripen, e.g. bananas become soft / sweet
- Cause food to brown, e.g. sliced apples

Slow enzymes by adding an acid (to stop browning) or destroy enzymes by blanching (before freezing).

Storing Food

Lots of foods don't need to be stored in a fridge / freezer.

They should be stored in a sealed container in a cool, dry place.

Preservation methods:
1. Freeze-drying
2. Canning / bottling
3. Vacuum packing
4. Pickling
5. Jam-making

Food Poisoning

From eating contaminated food. Four examples of bacteria:

Bacteria	Where it's found	Symptoms
Campylobacter	Raw / undercooked poultry	Diarrhoea, cramps, fever
E. coli O157	Raw beef, unwashed veg	Can cause kidney damage & in rare cases be fatal
Staphylococcus aureus	Animals / people, e.g. skin, hair	Diarrhoea, cramps, vomiting & mild fever
Salmonella	Raw poultry, eggs	Diarrhoea, cramps, vomiting

Milk is pasteurised (heated to 72 °C for 15 seconds) to kill bacteria. Chickens are vaccinated against salmonella to avoid contaminating eggs.