

GCSE

Edexcel GCSE in Science

Designer Products

(Context approach)

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Support material

Edexcel GCSE in Science
Designer Products
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Scheme of work for Topic 8: Designer Products

LESSON 1: Which shampoo?							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1 b 8.12 C1 b 8.13	8F Compounds and mixtures. 9G Environmental chemistry. 9H Using chemistry.	Materials differ in their properties and so are suitable for different purposes. New materials are developed to meet specific requirements. Suggest how to test the claims of beauty products, such as shampoos with 'special ingredients'.	<p>Starter</p> <p>Display some shampoo bottles. Watch some shampoo adverts or look at some from magazines. Briefly survey shampoos used by the students. Get students to give reasons for using a particular brand.</p> <p>Main</p> <p>Students make a list of properties in a good shampoo. Students make shampoo. Get students to look at the ingredients of the shampoos and compare them to the one they made. In pairs get students to plan how they would test the claims of the companies promoting their expensive brand. Brainstorm ideas. Write up plans and produce suitable results tables. Include how to make it a fair test, what they will change and what they will keep the same.</p> <p>Plenary</p> <p>Explain the homework task. You may wish to start half the volunteers with the expensive shampoo or hand out sample A and B and not tell the class which is which. Supply Activity sheet 8.1.</p>	<p>Range of shampoos: some expensive, some cheap. Shampoo adverts. Instructions are found in RSC Contemporary Chemistry worksheet 5.08. Ingredients can be purchased from www.nealsyardremedies.com. Also available: worksheet 5.14 from RSC Contemporary Chemistry. Activity 8.1: Investigating shampoos.</p>	<p>Design a list of properties for a product, based on its end use. Suggest how to test the claims of beauty products, such as shampoos with 'special ingredients'.</p>	<p>C 21.2 WO 21.2</p>	<p>Do not try out class shampoo. Check HAZCARDS for all chemicals.</p>
<p>Homework: For four weeks wash your hair in a very cheap shampoo. Then for the next four weeks wash your hair in an expensive shampoo. Record the appearance of your hair before and after washes. You must bring your results to lesson 10 in this module.</p>							

Scheme of work for Topic 8: Designer Products

LESSON 2: Materials							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1 b 8.1 C1 b 8.2	9G Environmental chemistry. 9H Using chemistry. 8F Compounds and mixtures.	Materials differ in their properties and so are suitable for different purposes. New materials are developed to meet specific requirements.	<p>Starter</p> <p>Demonstrate and show some examples of smart materials eg thermostrip down the side of a battery.</p> <p>Main</p> <p>Provide students with pictures of materials in clothing, extreme sports and sports equipment. This can be done in pairs or groups.</p> <p>Ask pupils to write down the materials used in each picture and the characteristic of that material that makes it suitable for that purpose. Get students in groups to research the special properties of either carbon fibres, Thinsulate™, Lycra™, etc and make a poster that could be displayed on the walls for other students to look at and use to get information from.</p> <p>Plenary</p> <p>Explain what is meant by a ‘smart material’. List some examples of smart materials.</p>	Internet search engines and magazines. www.cms.3.com www.dupont.com	Given information, relate properties to some uses of the materials in clothing, extreme sports and sports equipment, including carbon fibres, Thinsulate™, Lycra™, etc. Explain that smart materials can change their properties in response to an external stimulus.	C ☑1.1 ☑1.2 ☑2.1 ☑2.2 ICT ☑1.1 ☑2.1 ☑2.2	
Homework: Design an outfit suitable for use by a mountain climber. Marks will be awarded for describing the type of material used to make at least three items of equipment or clothing, stating why that particular material is suited for use.							

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LESSON 3: Designed and accidental discoveries							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1 b 8.3 C1 b 8.4 C1 b 8.5	9G Environmental chemistry. 9H Using chemistry.	Materials differ in their properties and so are suitable for different purposes. New materials are developed to meet specific requirements.	<p>Starter</p> <p>Show a video clip or some pictures of people wearing Kevlar™ vests in a dangerous situation. Show some pictures of clothing made from Gore-Tex™.</p> <p>Main</p> <p>Get the students to write down what the properties of these materials are, which make them suitable for the use shown. Share these answers with the rest of the class.</p> <p>Give the names of the materials.</p> <p>Get the students to see how well their list matched up to the actual properties of Kevlar™ and Gore-Tex™.</p> <p>Plenary</p> <p>Display some Post-its® and Teflon™ coated objects.</p> <p>Discuss the uses of these two materials.</p> <p>Provide students with the story of the discovery of one of these two materials.</p> <p>Get students to write their own story of the other one in a similar style to the one you have given them.</p>	Suitable sites are: www.dupont.com www.teflon.com www.inventors.about.com www.ideafinder.com www.3m.com Demonstration 8.3: Materials.	Explain the breathability of fabrics like Gore-Tex™ in terms of their structure. Use the properties of Kevlar™ to suggest uses. Explore how scientists sometimes create new materials with novel properties, such as Teflon™ and Post-its®, where applications only emerge afterwards.	C 1.1 ICT 1.1	
<p>Homework: Complete the story of the discovery of Teflon™ or Post-its®. This should include the name of the inventor, time and place of discovery and what the inventor was working on when they discovered it.</p>							

Scheme of work for Topic 8: Designer Products

LESSON 4: Nanotechnology — 1							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1 b 8.6	9G Environmental chemistry. 9H Using chemistry. 7G Particle model of solids liquids and gases.	New materials are developed to meet specific requirements.	<p>Starter</p> <p>Display a number of items made by using nanotechnology, eg suncream and tennis balls. Get the pupils to try and identify the link between the objects. Explain that they are all made using nanotechnology and that nanotechnology is the manipulation of materials at an atomic level to engineer new materials with new properties, never before identified in nature.</p> <p>Main</p> <p>Demonstration 10.03: atomic paper clips from RSC Contemporary Chemistry for Schools and Colleges. Followed by Practical 10.04 Tasty particles.</p> <p>Plenary</p> <p>Open discussion on designer molecules.</p>	<p>RSC Contemporary Chemistry for Schools and Colleges.</p> <p>Paper clips, aluminium foil, plastic cup, straw, water, lemon juice, sugar, marker pen and a dropper.</p>	Compare the size of nanoparticles to those of conventional industrial produced materials and relate this to their present uses, such as suncreams and future applications.	<p>PS ☑1.2</p> <p>WO ☑1.2</p>	Wear eye protection for the practical.
<p>Homework: Use information sheet 10.05 to answer questions on sheet 10.06 of the RSC Contemporary Chemistry unit on nanochemistry.</p>							

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LESSON 5: Nanotechnology — 2							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1 b 8.6 C1 b 8.7	9G Environmental chemistry. 9H Using chemistry.	Materials differ in their properties and so are suitable for different purposes. New materials are developed to meet specific requirements.	<p>Starter Review answers to homework.</p> <p>Main Carry out exercise 10.14 in Contemporary Chemistry for Schools and Colleges. Higher-tier students could look at the article that appeared in Education in Chemistry, 40(4), 2003. Pupils could use search engines to find out about applications of nanotechnology already on the market.</p> <p>Plenary Discuss the way spin is used to advertise the product with the right image to appeal to the customers.</p>	RSC Contemporary Chemistry for Schools and Colleges. Suitable websites include: www.nanophase.com (transparent sun block) www.research.ibm.com www.esi-topics.com www.mb.tn.tudelft.nl (nanotubes) www.scripps.edu.html (nanotubes to kill bacteria).	Compare the size of nanoparticles to that of conventional industrially produced materials, and relate this to their present uses, such as sunscreens and future applications. Explore the risks and uncertainties of nanotechnologies, and how they are presented in the media.	C 1.1 1.2 2.1 2.2 ICT 1.1 2.1 2.2	
<p>Homework: Use material researched in the lesson to prepare a short talk (perhaps using a presentation package) to your peers about the current developments in nanotechnology.</p>							

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LESSON 6: Intelligent packaging							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1 b 8.10	9G Environmental chemistry. 9H Using chemistry.	New materials are developed to meet specific requirements.	<p>Starter</p> <p>Display a variety of food containers, eg tins, cardboard boxes, milk cartons, cans of drinks. Get students to write the advantages and disadvantages of each type of container.</p> <p>Main</p> <p>Project or hand out pictures of an expedition. Get the students to make a list of what the explorers today would need from the food packages that they take with them. Introduce the idea of intelligent packaging. Explain what this means. Emphasise the role of nanotechnology in the development of this packaging. Get students to think about the wider use of intelligent packaging.</p> <p>Plenary</p> <p>Get students to look at some pre-prepared foodstuffs such as bread left in environments with and without water and oxygen. Get students to make conclusions about how food is kept fresh.</p>	<p>Clean empty or full food containers with labels on. You can use parts of a PowerPoint presentation by www.cambridgeconsultants.com to illustrate this. Activities sheet 8.8 may be helpful here.</p>	Use information on intelligent packaging to explain ways of keeping food fresh such as by removal of water or preventing reactions with oxygen.	C 1.1 1.2	Ensure all containers are clean.
<p>Homework: Look at 10 different food packages and make a note of the sell-by date. Rank the products in order of their sell-by date, putting the shortest time first. Note the type of packaging. Which packaging keeps food freshest for longest?</p>							

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LESSON 7: Fermentation of ethanol							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1 b 8.8	9H Using chemistry.	Useful substances are made by chemical reactions.	<p>Starter</p> <p>Display some empty containers of alcohol. Discuss the origin of alcohol. Use some laminated cards to match the type of fruit with the alcohol.</p> <p>Main</p> <p>Explain that ethanol is produced by fermentation. Get students to carry out a fermentation reaction.</p> <p>Plenary</p> <p>Discuss the planning to monitor the fermentation over the coming week to gain extra scientific information. Give word and balanced formula equations.</p>	<p>Test-tubes. Fruit juice. Classic Chemistry Experiment 86, page 222. Experiment sheet 8.5: Fermentation.</p>	Describe how beer and wine can be made by fermentation reactions using yeast to convert sugars to alcohol.	<p>C 21.2 WO 21.2</p>	Students must not taste the mixture.
<p>Homework: Find an advert for alcohol. Describe where you found it and the type and age of person it was aimed at. If possible, note the alcoholic content of the product.</p>							

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LESSON 8: Harmful effects of alcohol							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1 b 8.9	9G Environmental chemistry.	Chemical processes use energy and have environmental consequences.	<p>Starter</p> <p>Get students to suggest one bad effect of indulging in too much alcohol.</p> <p>Main</p> <p>Watch a video.</p> <p>In groups get students to talk about some case studies of drinkers. Get one group to use the internet to get up-to-date statistics about the bad effect of alcohol abuse.</p> <p>Prepare a poster (A3 or A4 size) showing one or more of the possible consequences of excess alcohol intake.</p> <p>Find out how the police test the alcohol content of a suspected drink-driver's urine and blood.</p> <p>Plenary</p> <p>Get students to report back to the other groups about their case study.</p>	BBC Shortcut Video 2 Chemistry and Health. Breathalyser kit.	Discuss the social issues and possible harmful effects of ethanol in alcoholic drinks.	C 1.1 1.2 2.1 2.2 ICT 1.1 2.1	
<p>Homework: Write an article aimed at teenagers to highlight the dangers of drinking alcohol. Include ideas about coping with 24-hour pub opening.</p>							

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LESSON 9: Emulsifiers							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1 b 8.11	8F Compounds and mixtures. 9H Using chemistry.	Materials differ in their properties and so are suitable for different purposes.	<p>Starter</p> <p>Display two corked tubes of oil and vinegar. Shake one and leave it for a few minutes.</p> <p>Get pupils in groups to come up with ideas about what happens.</p> <p>Get a jar of mayonnaise and explain that this contains a mixture of oil and vinegar plus egg. Get the groups to try and explain how that can be.</p> <p>Main</p> <p>Carry out experiment 8.9: Making mayonnaise.</p> <p>Plenary</p> <p>Get each group to report back their findings and agree on a class explanation. Explain the terms 'hydrophilic' and 'hydrophobic'.</p>	Experiment 8.9 (Making mayonnaise) including the use of different emulsifiers such as egg white and egg yolk and dried egg separately for making mayonnaise and comparing the results.	Describe how emulsifiers that have a water loving (hydrophilic) part and an oil loving (hydrophobic) part, work in foods like mayonnaise.	C ☑1.1 ☑1.2 ☑2.1 ☑2.2 WO ☑1.2	Students must not taste the mayonnaise.
<p>Homework: Students to use a cookbook to find the recipe for mayonnaise. Copy a list of the ingredients. Identify the emulsifier in that recipe.</p>							

Scheme of work for Topic 8: Designer Products

LESSON 10: Which shampoo?							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1 b 8.12	8F compounds and mixtures. 9H Using chemistry.	Materials differ in their properties and so are suitable for different purposes. New materials are developed to meet specific requirements. Suggest how to test the claims of beauty products, such as shampoos with special ingredients.	<p>Starter</p> <p>Display samples of the shampoos including those on test. Listen to the reports from the volunteers who used different shampoos over the past few weeks using Activity sheet 8.1 and also reports from those who continued to use their own shampoo.</p> <p>Main</p> <p>Get students to complete the Wash in Style exercise on different shampoos. Students to write a conclusion based on their own results and also one on the class results. Also include the results from the investigation.</p> <p>Plenary</p> <p>Class discussion to produce a list of properties for a super shampoo based on the reports from the volunteers.</p>	<p>The Wash in Style activity can be found in RSC Contemporary Chemistry 5.03.</p> <p>There is a suitable shampoo test activity on: www.upd8.org.uk</p>	Design a list of properties for a product, based on its end use.	<p>C</p> <p>☑1.1 ☑1.2 ☑2.1 ☑2.2</p> <p>WO</p> <p>☑1.2</p>	Alert students to the risk of shampoo in eyes but safety goggles are probably not appropriate.
<p>Homework: Write a short report for a teenage magazine based on the results of the experiments. The title is 'The Best Shampoo'.</p>							

Activity 8.1: Investigating Shampoos

What you will learn from this activity

- 1 How to undertake consumer research.
- 2 The need for a control group or groups.

What you will know when you finish this activity

- 1 Whether expensive shampoos leave hair in better condition than less expensive ones.
- 2 Results that require human judgements are prone to have low reliability.
- 3 A large sample helps improve the overall reliability of the research.

What you do

- 1 If you have been given a shampoo to test use only the shampoo you have been supplied with and follow the instructions on the bottle.
- 2 If you are using your own shampoo stay with the same make for the period of the research.
- 3 Over the weeks wash your hair on the same regular basis that you have always done.
- 4 Describe the condition of your hair each time just before washing and as soon as it is dry after washing.
- 5 Use a table similar to the one shown below to record your research.

Date of hair washing	Description of hair before washing	Description of hair after washing	Other comments

- 6 Write a short, unbiased report about your shampoo, how well it cleans your hair, what your hair looks like after washing and any alteration over the period of the research.

Activity 8.1: Investigating Shampoos

Notes for teachers and technicians

Aim

The aim of this activity is to gather judgements about different shampoos.

Skills, knowledge and understanding to be gained

- 1 How to report information.
- 2 How to provide unbiased reports.

Equipment and chemicals required

- 1 Expensive commercial shampoo, labelled A.
- 2 Cheaper commercial shampoo, labelled B.

Links with key stage 3 (KS3)

This experiment builds on the following skills, knowledge and understanding from KS3:

- 9G Environmental chemistry
- 9H Using chemistry.

Demonstration 8.3: Materials

What you will learn from this demonstration

The physical properties of some materials make them much more useful than many materials for support and protection clothing.

What you will know after you see this demonstration

- 1 Lycra™ is elastic and returns to its original shape.
- 2 Lycra™ does not soak up water, it is hydrophobic.
- 3 Lycra™ is a poor conductor so keeps bodies warm.
- 4 Kevlar™ is extremely strong.
- 5 Kevlar™ can absorb the energy from impacts.
- 6 Gore-Tex™ allows air and water to pass through the material.
- 7 Gore-Tex™ can be used in surgery to support arteries.

What to do

- 1 Watch your teacher demonstrate properties of Gore-Tex™, Lycra™ and Kevlar™. Make notes on your observations.
- 2 Find out what Gore-Tex™ and Teflon™ are made from.

- 3 What other characteristics must new material for clothing have?

Demonstration 8.3: Materials

Notes for teachers and technicians

Aim

To show how some materials have special physical properties.

Equipment and chemicals required

- 1 Projection microscope to look at the fibres is ideal. If unavailable then a decent microscope will suffice.
- 2 Samples of smart materials including Gore-Tex™, Lycra™ and Kevlar™.
- 3 Samples of linen, cotton and woollen fabrics for comparison.

Delivery strategies

- 1 Pull, twist and stretch the fabrics to show their properties.
- 2 Add drops of water to see effect.

Links with key stage 3 (KS3)

This demonstration builds on the following skills, knowledge and understanding from KS3:

- 9H Using chemistry.

Experiment 8.5: Fermentation

What you will learn from this experiment

- 1 How to set up a fermentation apparatus.
- 2 What is formed during fermentation.
- 3 The optimum conditions for fermentation.

What you will know when you finish this experiment

- 1 In fermentation ethanol is formed and carbon dioxide evolved.
- 2 The best conditions are warm 40°C – 50°C; above 60°C the yeast is killed and below 40°C the reaction becomes much slower.

How you may be assessed

You may be assessed by:

- 1 the accuracy of your observations
- 2 your ability to evaluate results and draw conclusions.

What you do

- 1 In a conical flask, dissolve 10g sugar in 50 ml water.
- 2 Add 3 ml of yeast mixture.
- 3 Fit a bung with a delivery tube into the conical flask.
- 4 Place the outlet of the delivery tube into a test tube of lime water.
- 5 Place the apparatus in a warm place at 50°C.
- 6 Set up three more sets of apparatus in the same way.
- 7 Store the other sets at 20°C, 60°C and 40°C.
- 8 Look at the apparatus every day for a week, preferably twice a day.
- 9 Note which test tube turns milky first and if any then become clear as lots of carbon dioxide will then have bubbled through to dissolve the white precipitate.
- 10 If gas is bubbling through the lime water count how many bubbles are produced in a minute or if it is very slow how many bubbles are produced in a five minute period.
- 11 Record your results in the table below.
- 12 Draw conclusions about fermentation and temperature.

Temperature of fermentation	Rate of bubbling	Order lime water went milky	Tubes where lime water became clear again	Other observations

Experiment 8.5: Fermentation

Notes for teachers and technicians

Aim

The aim of this experiment is to study fermentation where ethanol is formed and carbon dioxide evolved.

Previous skills, knowledge and understanding required

How to test for carbon dioxide.

Skills, knowledge and understanding to be gained

How to make and record observations.

Equipment and chemicals required

- Conical flasks.
- Bungs containing delivery tubes.
- Thermometers to check the temperature where the apparatus is left.
- Sugar.
- Yeast mixture made up from dried yeast stirred into warm sugary water.
- Lime water.
- Test tubes.

Health and safety issues

Students must not attempt to taste the fermented brew.

Links with key stage 3 (KS3)

This experiment builds on the following skills, knowledge and understanding from KS3:

- 8F Compounds and mixtures
- 9G Environmental chemistry
- 9H Using chemistry.

Activity 8.8: Investigating sophisticated packaging

What you will learn from this activity

Packaging may be classified as active packaging, controlled packaging and intelligent packaging.

What you will know when you finish this activity

- 1 Active packaging includes oxygen scavengers and moisture absorbers which reduce pathogens and gases which cause food spoilage.
- 2 Controlled packaging includes aseptic and biodegradable packaging.
- 3 Intelligent packaging includes time and temperature indicators, embedded microchips or nanosensors in polymers, and radio frequency identification technology.

What you do

- 1 Use search engines to find websites giving specific packaging information.
- 2 Be cautious as many websites advertise the qualities of the material and therefore are biased.
- 3 Find examples of the different forms of active packaging, controlled packaging and intelligent packaging and what each may be used for.
- 4 Use a table similar to the one shown below to record your researches giving important details about each type of packaging. Remember some packaging may have more than one feature.

Example	Active packaging	Controlled packaging	Intelligent packaging

Activity 8.8: Investigating sophisticated packaging

Notes for teachers and technicians

Aim

The aim of this activity is to investigate sophisticated packaging using research from the internet.

Skills, knowledge and understanding to be gained

How to select information.

Links with key stage 3 (KS3)

This experiment builds on the following skills, knowledge and understanding from KS3:

- 9G Environmental chemistry
- 9H Using chemistry.

Experiment 8.9: Mayonnaise making

What you will learn from this experiment

- 1 How to make mayonnaise.
- 2 Which part of the egg is important for this process.

What you will know when you finish this experiment

- 1 The protein in egg yolk is an emulsifying agent.
- 2 The protein in egg yolk has a hydrophobic end and a hydrophilic end.
- 3 Emulsifiers allow immiscible liquids to remain mixed.

How you may be assessed

You may be assessed on:

- 1 the accuracy of your observations
- 2 your ability to evaluate results and draw conclusions.

What you do

- 1 Set up eight test tubes each containing 5 ml of vinegar and 5 ml of olive oil.
- 2 Add different quantities of egg to each tube (see table).
- 3 Put a cork in each tube and shake the tubes hard for 10 seconds.
- 4 Place the tubes in a rack and start timing to see if an emulsion remains or whether two immiscible layers reform.
- 5 Record your results.
- 6 Draw conclusions about the different ratios of egg to oil and vinegar.
- 7 Suggest a further range of experiments you could do to look at different variables.

Type of egg added	Amount of egg added	Stable emulsion formed? Yes/No	Time before separation occurred	Other observations
Whole egg	5 ml			
Whole egg	2ml			
Egg yolk	5 ml			
Egg yolk	2ml			
Egg yolk	1 ml			
Egg white	5 ml			
Egg white	2 ml			
Powdered egg mix	2ml			

Draw labelled diagrams to show how the molecules of oil and vinegar are held together by the egg with its hydrophobic and hydrophilic ends.

Experiment 8.9: Mayonnaise making

Notes for teachers and technicians

Aim

The aim of this experiment is to study what ratio of egg to vinegar and oil makes a stable emulsion.

Skills, knowledge and understanding to be gained

How to observe and record observations.

Equipment and chemicals required

- 1 Test tubes.
- 2 Bungs for test tubes.
- 3 Egg that that been stirred gently to mix white and yolk.
- 4 Egg yolk.
- 5 Egg white.
- 6 Powdered egg slurry.
- 7 Olive oil.
- 8 White vinegar or dilute ethanoic acid.

Health and safety issues

Students must not attempt to taste the mayonnaise.

Links with key stage 3 (KS3)

This experiment builds on the following skills, knowledge and understanding from KS3:

- 8F Compounds and mixtures
- 9G Environmental chemistry
- 9H Using chemistry.

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