GOOD ENOUGH TO EAT

Overview of chapter

Table 3.1 summarises the content and skills covered in this chapter, and Table 3.2 lists the learning outcomes required by the exam specification. The latter are also listed as 'Achievements' in the final section of the chapter in the Student Book.

Table 3.1 Summary of the chapter *Good Enough to Eat*

Outline and reference to student materials			Key points	Skills	Notes
Section 1.1 Physics in the food and confectionery industry	Read introductory article Use Internet for background information	Activity 1	Physics plays key role in aspects of food production	Use of ICT	
	Using gauges and callipers to measure dimensions Calculating total uncertainty	Activity 2 Additional Sheets 1 and 2	Uncertainty in measurement Combining uncertainties		
Section 2.1 Flowing chocolate	Identifying uses for physics in food industry	Activity 3	Applications and implications, benefits and risks	Communication	
Section 2.2 Viscosity	Using simple apparatus to compare viscosities	Activity 4	Idea of viscosity	Practical work	
	Defining and using viscosity, viscous drag, upthrust, terminal velocity	Additional Sheet 3 Activity 5	$F = 6\pi r \eta v$ Archimedes' principle	Application of number	Revision of density from GCSE
	Using falling ball method to measure viscosity	Activity 6 Additional Sheets 1 and 2		Practical work Application of number Communication	Core practical
	Discussing how to calibrate viscometer	Activity 7	Idea of calibration		
Section 2.3 More about flow	Demonstrating laminar and turbulent flow	Activity 8	Description of laminar and turbulent flow	Practical work	
	Demonstrating 'unusual' flow properties	Activity 9	Idea of thixotropy	Practical work	
	Deriving equations for fluid flow	Additional Sheet 4	Dimensional analysis	Application of number	Optional extension work
Section 2.4 Measuring and controlling flow rates	Explaining operation of flowmeters		Mass and volume flow rates Calibration	Practical work Application of number Use of ICT Communication	Possible assessment of experimental skills
	Reading about electro-rheological fluids		Idea of electro-rheology		
Section 2.5 Summing up Part 2	Summarising ideas about viscosity and flow	Activity 10 Activity 11	Application of knowledge and skills from Part 2	Study skills Communication Application of number	

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Outline and reference to student materials			Key points	Skills	Notes
Section 3.1 Good enough to eat?	Using star/spider diagrams to describe food	Activity 12	Importance of defining terms clearly	Communication	
Section 3.2 Crunching and chewing	Generating and interpreting force–extension graphs Using appropriate vocabulary to describe material behaviour	Activity 13 Activity 14 Activity 15	Meaning of: stiff, hard elastic, plastic, strong, ductile, malleable, tough brittle	Practical work Communication Application of number	
	Determining flexural modulus	Activity 16 Additional Sheets 1 and 2	Flexural modulus	Practical work Application of number	Optional extension work
Section 3.3 Summing up Part 3	Summarising ideas about mechanical properties	Activity 17	Application of knowledge and skills from Part 3	Practical work Study skills Communication Application of number	
Section 4.1 Refractometry	Relating observations of refraction to speed of light in materials	Activity 18	Definition of refractive index Snell's law $n_1 \sin \theta_1 = n_2 \sin \theta_2$	Practical work Application of number	Some GCSE revision
	Relating refractive index to total internal reflection	Activity 19 Activity 20	Partial and total internal reflection Critical angle $\sin C = \dfrac{1}{n}$ Measurement techniques and experimental uncertainty	Practical work Application of number	
	Determining refractive index. Relate to sugar concentration	Activity 21		Practical work Application of number	
Section 4.2 Polarimetry	Observing polarisation of transverse waves	Activity 22	Idea of polarisation Crossed polarisers	Practical work	
	Using polarimeter to measure rotation of plane of polarisation	Activity 23	Plane of polarisation	Practical work Application of number	
Section 4.3 Summing up Part 4	Reviewing and applying ideas about refraction and polarisation	Activity 24 Activity 25	Application of skills and knowledge from Part 4	Study skills Evaluation of experimental techniques	
Section 5.1 Food quality and safety	Reading about and discussing physical hazards in food production	Activity 26	Role of physics in ensuring safety	Communication	
Section 5.2 Packaging	Interpreting data on packaging materials	Activity 27	Physical properties related to use	Communication	
Section 5.3 The final product	Reviewing work on liquid and solid materials	Activity 28 Activity 29		Study skills Communication Use of ICT	
Section 5.4 Questions on the whole chapter	Questions and calculations			Communication Application of number	Consolidation and revision
Section 5.5 Achievements	Chapter test			Communication Application of number	Questions illustrate style of external test

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Table 3.2 Learning outcomes specified for *Good Enough to Eat*

Statement from Examination Specification		Section(s) in this chapter
1	know and understand the distinction between base and derived quantities and their SI units	2.2
2	demonstrate their knowledge of practical skills and techniques for both familiar and unfamiliar experiments	2.2, 3.2, 4.1, 4.2
3	be able to estimate values for physical quantities and use their estimate to solve problems	2.2, 5.4
4	understand the limitations of physical measurement and apply these limitations to practical situations.	1.1, 2.2, 3.2, 4.1, 4.2, 5.4
5	be able to communicate information and ideas in appropriate ways using appropriate terminology	2.5, 5.2, 5.3
49	be able to use the equation density $\rho = m/V$	1.1
50	understand how to use the relationship upthrust = weight of fluid displaced	2.2
51	(a) be able to use the equation for viscous drag (Stokes's law), $F = 6\pi\eta rv$.	2.2
	(b) understand that this equation only applies to small spherical objects moving at low speeds with *laminar flow* (or in the absence of *turbulent flow*) and that viscosity is temperature dependent	
52	CORE PRACTICAL 4: Use a falling ball method to determine the viscosity of a liquid	2.2
53	be able to use the Hooke's law equation, $\Delta F = k\Delta x$, where k is the stiffness of the object	3.2
55	(a) be able to draw and interpret force–extension and force–compression graphs.	3.2
	(b) understand the terms *limit of proportionality, elastic limit, yield point, elastic deformation* and *plastic deformation* and be able to apply them to graphs	
70	know and understand that at the interface between medium 1 and medium 2 $n_1 \sin \theta_1 = n_2 \sin \theta_2$, where refractive index is $n = c/v$	4.1
71	be able to calculate *critical angle* using $\sin C = 1/n$	4.1
72	be able to predict whether total internal reflection will occur at an interface	4.1
73	understand how to measure the refractive index of a solid material	4.1
81	understand what is meant by *plane polarisation*	4.2

Part 1 is a brief scene-setting introduction, after which Parts 2, 3 and 4 can be taught independently and in any order. Part 5 is a fairly short finale. Part 2 deals with fluid flow and its measurement, Part 3 with the behaviour of solid materials, and Part 4 with the refraction and polarisation of light. Most of the work in Parts 2 and 3 will be new, though there is some reference to work on forces and motion from *Higher, Faster, Stronger*. Part 4 introduces new material on wave speed and polarisation. The associated experimental work gives an opportunity to consider experimental uncertainties. Part 4 is the longest and Part 5 the shortest, so if the chapter is split between two teachers, it is probably best if one teacher takes Parts 2 and 3 while the other takes Parts 4 and 5.