

thinking
through
science

*Thinking
Through*
SCIENCE

2

JOHN MURRAY

teacher's book

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Thinking skills audit

QCA thinking skills	Investigative skills	Chapter coverage
Enquiry (planning)	a) Devise questions to be investigated b) Use of secondary sources c) Make predictions/preliminary work d) Controlling variables e) Decide extent and range of data f) Choose equipment and materials – accuracy and safety h) Choose sample size/repeat measurements	5, 6, 9, 12 4, 9, 12 2, 5, 8, 9, 11 1, 3, 5, 6, 12 3, 5, 6, 7, 11, 12 2, 3, 7, 12 2, 3, 5, 6, 11, 12
Obtaining evidence	g) Collect evidence to appropriate precision	7, 9, 10
Information processing	i) Present data – tables and graphs j) Interpret data – patterns	Introduction, 1, 2, 5, 6 Introduction, 2, 3, 5, 6, 8, 9, 10, 11, 12
Reasoning	k) Draw conclusions m) Explain conclusions	1, 3, 6, 7, 9, 12 1, 6, 7, 9
Evaluation	l) Conclusions support prediction? n) Anomalous results – explanation o) Evidence supports conclusions? – fair test; accurate; reliable; sample size p) Improvements to the investigation?	3, 6 Introduction, 1 1, 7, 9, 11 3, 6, 7, 9, 11, 12

CASE reasoning pattern	Chapter coverage
Control of variables	Introduction, 2, 3, 5
Classification	1, 2, 4, 5, 10
Ratios, scaling, proportionality	1, 2, 3, 6, 7, 8
Compound variables	Introduction, 1, 6, 10
Probability and correlation	6, 9
Formal models	Introduction, 3, 4, 5, 6, 7, 11, 12

Food and digestion

→ Rationale

This chapter provides 8 hours of teaching materials. Through Key Stages 1 and 2, pupils will have been introduced to food in terms of healthy diet and providing fuel to work the body systems. Balanced diet and healthy eating are topics that receive considerable attention in Key Stage 2. Pupils are also bombarded with information about healthy foods from the media and in children's television programmes and so their knowledge base is broad for this topic. They have ideas about healthy foods such as fruit and salad and lean meat, and unhealthy food such as chips, crisps and burgers. However, they are often uncertain of where most other foods lie in terms of being healthy and unhealthy, and find it difficult to assess their own diet and to suggest changes that are possible in the long term to promote health. Issues such as vegetarianism, slimming, and changing diet to meet change in lifestyle also need to be addressed so that young people are encouraged to make informed choices that will affect their well-being now and in the future.

Much of the early part of this chapter focuses on considering and comparing evidence about different food groups, and how foods can be shown, through food tests, to contain one or more of the food groups. This idea is then taken forward by exploring different types of diet and how a balanced diet can be achieved in a variety of ways. Pupils also look at their own diet and evaluate it in terms of ideas about balanced diet and healthy eating.

The chapter moves on to look in some detail at the parts of the gut involved in the digestion and absorption of food. This includes looking at both physical and chemical digestion and, in particular, the role that enzymes play in the digestion of food. This is approached in the Pupil's Book through analysing data and is supported through practical activities provided on the worksheets.

→ Overview

The textbook sections, activities and worksheets have been arranged into 1 hour blocks to aid lesson planning. Clearly several of the activities and worksheets could form part of a homework session. The planning includes reading time for individual sections but some teachers may prefer to organise this as homework preparation for the following lesson. Worksheets are of six types – extension (E), support for an activity (S), practical (P), key skills (K), developmental (D) and review (R) – to allow for differentiation and flexibility to accommodate teachers' preferred practice. The actual timing and emphasis on different sections will depend on the current knowledge base of the pupils, the ability of the teaching group and the preferences of the teacher.

Lesson	Worksheets
1 Food groups	Worksheet 1.1: Food labels (E)
2 Food tests	Worksheet 1.2: Food tests (P)
3 A balanced diet	Worksheet 1.3: Meal planning (D) Worksheet 1.4: Energy in food (P) Worksheet 1.5: Vitamins and mineral salts (E)
4 Analysing diets	Worksheet 1.5: Vitamins and mineral salts (E) Worksheet 1.6: Daily diets (D)
5 Digestion	Worksheet 1.7: The working gut (S)
6 Food and enzymes	Worksheet 1.8: Breakdown of starch (P)
7 Digestion and absorption	Worksheet 1.9: Biological washing powder (P) Worksheet 1.10: Model gut (P)
8 Absorption	
Review	Worksheet 1.11: Test on food and digestion (R)

→ Chapter plan

	Demonstration	Practical	ICT	Activity	Word play	Time to think	Ideas and evidence
Lesson 1				Display: Food lines		What do you know?	
Lesson 2	Food tests	Food tests					
Lesson 3	Food calorimeter	Energy in food	Presentation of menu and pie charts of food groups	Information processing: Meal planning Extension: Vitamins and mineral salts			
Lesson 4			Use of a CD-ROM for analysing diets	Evaluation: Advice for a healthy diet Reasoning: Diet diary		Concept map	
Lesson 5	Model torso		Presentation of gut facts and figures	Creative thinking: Gut facts and figures			Medical knowledge of the gut
Lesson 6		Breaking down starch		Reasoning: Starch breakdown			
Lesson 7		Biological washing powder Model gut		Information processing: Absorption		Summary of key ideas	
Lesson 8				Enquiry: Model gut	Word puzzle	Questions and answers	
Review				Review: Test on food and digestion			

Language for learning

By the end of this chapter pupils will be able to understand, use and spell correctly:

- words and phrases related to food and diet – amino acids, balanced diet, carbohydrates, proteins, fats, vitamins and mineral salts
- words associated with the gut – oesophagus, stomach, ileum, intestine, colon
- words linked to digestion – enzyme, digestion, peristalsis, muscle, amylase, carbohydrase, protease, lipase.

1 *Food groups*

Learning outcomes

Pupils:

- make a list of the key words known and write sentences to link some of these
- analyse food labels and bar charts to compare food group contents of some foods
- list the components of a balanced diet

What do you know?

→ *Pupil's Book page 16*

This initial activity provides an opportunity for pupils to discuss and refresh their knowledge of work on food and digestion covered at Key Stage 2. The photographs of meals and the word list should prompt discussion and aid revision of ideas. This activity will allow teachers to elicit prior knowledge and so help in making decisions about the pace and emphasis in this chapter.

Food groups

→ *Pupil's Book page 17*

→ *Worksheet 1.1: Food labels (E)*

Worksheet 1.1

This section provides a summary of what the main food groups are and their function in the human body. On page 18 the pupils translate given information into a table to demonstrate understanding and then add examples to the table to help contextualise the information. This activity might also provide opportunity for pupils to compare different ways of constructing tables and so support their skill development of this aspect. It would be useful at some point to collect ideas on the board or flip chart so that these can be shared and so broaden the class's knowledge of examples of foods containing specific food groups. You may wish the pupils to read the section on food labels (through to the middle of page 19) before answering Q1 and 2, as more examples of food content (e.g. sodium) are given on the baked beans label.

Questions 7 onwards look at the relative proportions of the food groups in different foods, and it is suggested that these are left until lesson 3.

Worksheet 1.1 provides extension work for this lesson, in the form of questions on four further food labels. These are more difficult questions than the ones in the Pupil's Book and so pupils should be grouped and support provided for those pupils who find the numerical work challenging. The use of calculators should be allowed where needed. Another option would be to set alternative questions using the labels that require less able pupils to select specific food groups or given amounts while other pupils complete the questions provided on the sheet.

Answers

→ *Pupil's Book pages 18–19*

1, 2

Food group	Examples
carbohydrates	bread, rice, pasta, potato
proteins	meat, fish, cheese, Quorn, pulses
lipids (fats)	dairy products, crisps, chips, meat
minerals and vitamins	iron in red meat calcium in dairy products vitamin C in citrus fruits
water	drinks, fruit and salad vegetables

Check that extra examples are in the appropriate row.

Reference to food labels or Worksheets 1.1 and 1.3 may be helpful here.

3 Carbohydrate.

4 0.6g

5 10.3g

6 1520kJ

→ *Worksheet 1.1: Food labels (E)*

1 Spaghetti in tomato sauce – carbohydrate.

Chicken Kiev – fat.

Smash with Smoked Bacon – carbohydrate.

Snack-a-Jacks – carbohydrate.

2 Pupils will either take this as $27.2 - 3.9 = 23.3$ g or $27.2/3.9 = 7$ times approx.

3 1116kJ

4 $1596 - 558 = 1038$ kJ or $1596/558 =$ almost 3 times.

5 Fat.

6 $27.7/75 =$ about $\frac{1}{3}$ of daily needs.

7 11.9g per 100g or 11.9%, or 20.1g per serving.

8 60mg

9 0.6%

10 86%

11 2.5g fat in 100g of food and so less than 3%.

12 1596 kJ + 578 kJ = 2174 kJ. Carbohydrate 39.5g, protein 20.1g, fat 31.4g.

13 a) Just over $\frac{1}{4}$. 40 Snack-a-Jacks.

b) More protein (0.7 g \times 40 = 28g).

Activity Display: Food lines

It is a good idea to get pupils to bring in food labels and then set up a display to help them compare the food group contents of different foods. This is best done by setting up three 'washing lines' labelled *carbohydrate*, *protein* and *fat*. If a few labels are placed in order of content from highest to lowest, then when pupils peg theirs to one of the lines they can see that crisps have more fat than chocolate, milk is relatively high on each food group line, and tinned spaghetti has more carbohydrate than tinned custard, for example. The process of doing this activity helps pupils to compare foods and hence make informed choices about diets and menus. The display can be added to over the next few lessons so that pupils are continually returning to think about food content, comparisons and choices.

This classification exercise links with CASE 6 and 7.

2 Food tests

Learning outcome

Pupils:

- carry out food tests on a selection of foods

Activity Practical: Food tests

Worksheet 1.2

→ *Worksheet 1.2: Food tests (P)*

This tends to be a messy and confusing practical and so requires careful organisation and introduction to help pupils make sense of the work. There are four basic food tests at this level – for starch, sugar, protein and fat. Each needs a different chemical to test it and in three there are colour changes to note. So this becomes a multivariable problem which needs a concrete approach to help the learners.

One way of doing this is to demonstrate each test on foods which give clear positive results (i.e. bread for starch, sugar for the sugar test, cooked chicken for the protein test and cooking oil for the fat test). Pupils, in groups, are given the cards provided on Worksheet 1.2 and they select these after seeing each test to create a flow chart for that food test. For starch, for example, they select the 'iodine solution' card, the 'no heat' card and the 'positive result: blue/black' card. By the end of the demonstration, each group of pupils will have the cards set out in four rows showing the method and results for each food test.

The next task is for them to create a table explaining how to do the four food tests and what results to look for. Some pupils may need help in deciding how to convert the information on the rows of cards into a table format. The table on page 20 of the Pupil's Book gives an example of how this table might be constructed. Pupils can then use their finished table to advise them on how to carry out the food tests themselves.

It is best to limit the number of foods being tested to five or six examples and to select those that give clear positive or negative results. If you want to collect data on more foods than this, you might want to give different groups different foods to

test and then pool the class results. Alternatively, you could allocate different groups one or two food tests to do and give them 10 to 12 food samples.

Equipment

Each group will need:

- food samples (e.g. bread, rice, milk, egg, margarine, meat, Quorn, crisps, biscuit, apple)
- boiling tubes
- white tile
- sharp knife (or provide food ready-chopped)
- tongs
- Bunsen burner
- heatproof mat
- Benedict's solution, iodine solution, Biuret A and B reagents, ethanol
- eye protection
- access to water bath at 50°C

3 *A balanced diet*

Learning outcome

Pupils:

- analyse data from food labels and bar charts to begin to compare the proportion of food groups in different foods

Food groups in the diet

→ *Pupil's Book page 19*

Ideas introduced in lessons 1 and 2 are picked up here and developed further to give an in-depth study of food groups and the contents of different foods. Pupils should continue adding food labels to the three food group 'washing lines' and developing their awareness of food contents and comparisons.

With Q8, there is opportunity for sharing and peer assessment of pupils' own questions on the food labels. Getting pupils to write their own questions gives an insight into their understanding of the work and also helps them begin to frame and understand what specific types of question are asking them to do. This is an important aspect of assessment for learning.

Answers

- 7 a)** Bread. **b)** Milk. **c)** Pineapple. **d)** Margarine. **e)** Milk.
- 8** Vitamin C.
- 9** Check that pupils' questions are appropriate.
- 10** Allows comparison with other foods because portions may have different masses.
- 11** Carbohydrate – chips, kidney beans, milk, cabbage.
Protein – cheese/chicken, kidney beans, chips, milk, cabbage.
Fat – cheese, chips, chicken, milk, kidney beans.
- 12** Kidney beans.

- 13** Chicken – lilac colour with Biuret, whitish oil drops when water and ethanol added for fat test, no change with iodine or Benedict's.
 Milk – lilac colour with Biuret, fat separates when water and ethanol added, orange colour with Benedict's, no change with iodine.
 Chips – blue/black with iodine, lilac colour with Biuret, whitish oil drops when water and ethanol added, no change with Benedict's.
 Cabbage – blue/black with iodine, lilac colour with Biuret, no change with Benedict's or water and ethanol.
 Cheese – lilac colour with Biuret, whitish oil drops when water and ethanol added, no change with iodine or Benedict's.
 Kidney beans – lilac colour with Biuret, whitish oil drops when water and ethanol added, blue/black with iodine, orange colour with Benedict's.

*Activity***Worksheet 1.3****Information processing: Meal planning**

→ *Worksheet 1.3: Meal planning (D)*

This activity could be linked with work pupils are doing in Food Technology. Pupils will need access to recipe books and the web to help them calculate the mass of a portion of the foods that they select. This could be set as a homework activity. Pupils need to show they have used the information on pages 18, 20 and 21 of the Pupil's Book to decide on what makes a healthy daily menu. They could use word-processing skills to present their menu in an attractive way. Alternatively, they could use a spreadsheet to make a pie chart summarising the total protein, fat and carbohydrate intake in one day (three meals). Bar charts can be done by hand; pupils could show each meal separately and do a summary bar chart.

*Activity***Demonstration: Food calorimeter**

To gain more insight into the energy in food, it might be useful to demonstrate the burning of bread and some type of high fat snack crisp (e.g. Wotsits) in a food calorimeter. 28g of bread will cause a litre of water to rise by about 2–3°C, releasing around 10000 joules of energy, while a snack crisp can make the same amount of water rise by 5–6°C, releasing over twice this amount of energy.

Equipment

- food calorimeter
- oxygen cylinder
- dried bread (microwaved or heated slowly in oven)
- Wotsits or similar savoury snacks/crisps
- power supply
- thermometer (0–100°C)

A food calorimeter is a specialised piece of equipment for measuring calorific values of food as accurately as possible. It has an inner chamber containing an electrical heating coil and is surrounded by a water jacket containing a known amount of water at a known temperature. A known weight of food sample is placed in the chamber, which is sealed and filled with oxygen. The food is ignited by the heating coil and burns completely in the oxygen. The new water temperature is recorded and the rise in temperature is used to calculate the calorific (energy) value of the food sample.