

Sample teaching unit 7.4, lessons 1 and 2, starting points

Lesson

1

Using a spreadsheet

ICT Framework objectives

DEVELOPING IDEAS AND MAKING THINGS HAPPEN

Models and modelling

- Use software to investigate and amend a simple model by:
 - formatting and labelling data appropriately;
 - entering rules and formulae.

Key vocabulary

From Year 6: cell, column, cut, data, drag, formula, graph, label, model, paste

From Year 7: address, cell reference, value, variable

From Year 8: absolute cell reference, relative cell reference

Preparation and planning

- Find out about the achievement of the pupils in your class in mathematics, including the extent to which they can create formulae, their use of spreadsheets in mathematics and their familiarity with graphs and charts of different types.
- Ensure that you are familiar with the spreadsheet software and the pupil and teacher resources you will be using.
- Check that all the equipment is working.
- Ensure that:
 - teacher resources 7.4T1d Table square.xls, 7.4T1e Teachers' football league.xls, and 7.4T1c Presentation.ppt are available electronically;
 - pupil resources 7.4P1f Football league table.xls, 7.4P1a Zoo activity.doc and 7.4T1b Zoo activity.xls are available electronically in the shared area.
- If necessary, prepare guidance for the pupils to support the software being used, either as a handout or available on the school's intranet.
- Create a key vocabulary wall display for the unit which will be added to each week as lessons progress.
- Display the objectives for the lesson, phrased so that all pupils will understand them.

Resources

- Large computer screen display
- Calculators (one per pair)
- Sufficient computers for pupils to work in pairs or in small groups
- Spreadsheet software
- Shared network area, or alternative way to pass spreadsheet data to pupils
- Whiteboard or flipchart
- Resource files:
 - 7.4P1a Zoo activity.doc
 - 7.4T1b Zoo activity.xls
 - 7.4T1c Presentation.ppt
 - 7.4T1d Table square.xls
 - 7.4T1e Teachers' football league.xls
 - 7.4P1f Football league table.xls
 - 7.4P1g Football league table workings.xls

Lesson outline

60 minutes

1	Starter: Problem-solving using a table and paper-based resource	Problem-solving Whole class Paired work	10 minutes
2	Using a formula in a spreadsheet	Demonstrating software Whole class	10 minutes
3	Creating a times-table square	Using software Paired work	10 minutes
4	Setting up a simple spreadsheet	Demonstration Whole class	10 minutes
5	Using formulae to enter information into a spreadsheet	Using software Paired work	15 minutes
6	Plenary: Advantages and disadvantages of using a spreadsheet	Discussion Whole class	5 minutes
	Homework	Individual work	

Activities

10 minutes

1 Starter: Problem-solving using a table and paper-based resource

Explain that pupils are going to learn how to use spreadsheets effectively. Discuss the lesson objectives with the class.

Ask pupils to work in pairs. Distribute resource sheet **7.4P1a Zoo activity.doc**. Check the vocabulary with the pupils. Explain any unfamiliar words, such as 'underspend'. Ask pupils to do the first example on the resource sheet, working out the cost of feeding all of the animals.

Zoo activity
First example

Animal	Cost per week for each animal	Number of animals	Total cost per week for animals
Lion	£25	10	
Tiger	£30	8	
Zebra	£5	9	
Elephant	£20	9	
Penguin	£5	8	
Sea lion	£20	3	
Alligator	£5	4	
Eagle	£1	5	

Encourage pupils to calculate products such as $£25 \times 10$ and $£20 \times 3$ mentally. They may need calculators when they total the columns.

After 3 to 4 minutes, refer pupils to the second example. Say that there will be twelve more lions and four more penguins. Ask 'How does this affect the totals?'

Discuss the changes they will need to make, and which figures they will need to alter, then let them recalculate and find the new total. Ask what might happen to the number next to the word 'Underspend'.

After 6 to 7 minutes, display **7.4T1b Zoo activity.xls**. Make the appropriate alterations to the relevant cells and highlight how the values in other cells change automatically. Draw attention to the use of * for multiplication.

Animal	Cost per week to feed each animal	Number of animals	Total cost per week for animals
Lion	£25	10	£250
Tiger	£30	8	£240
Zebra	£5	9	£45
Elephant	£20	9	£180
Snake	£5	8	£40
Penguin	£5	12	
Sea lion	£20	3	
Alligator	£5	4	
Eagle	£1	5	
		Total	
		Allowed	
		Underspend	

Ask pupils to identify what is represented by the values in individual cells, if they can, and to say what happens to the numbers in the cells. Draw out responses such as:

- the total cost for penguins has changed;
- the cost for lions has changed;
- the values in E3 and E8 have increased;
- the total, E12 has increased;
- the underspend, E14 has decreased;
- there is less money left.

Ask pupils to identify the benefits of using a spreadsheet for the task on the resource sheet. Draw out responses such as:

- the ease of making changes;
- the spreadsheet does the calculations;
- you can quickly see if you have any money left.

10 minutes

2 Using a formula in a spreadsheet

Show **7.4T1c Presentation.ppt** on the large screen display. Point out and identify each of the main parts of a spreadsheet. Open a blank spreadsheet page and use 'alt-tab' to switch between the presentation and the spreadsheet so that you can demonstrate features. Highlight one cell of the spreadsheet and ask, 'What is this?' Explain that each cell has an address or cell reference and ask pupils to give the address of the highlighted cell. Highlight a row and then a column and ask pupils to name each of them correctly.

Show pupils that the spreadsheet has many more rows and columns than they can see on the screen. Ask them to suggest how many there are altogether. (A typical spreadsheet has 65 536 rows and 256 columns, making over 16 million cells altogether.) Explain that we normally use a very small part of a much bigger sheet. Illustrate this by pointing out a small poster or picture on a large wall.

Ask pupils what problems might arise if they forget how big the spreadsheet really is. Draw out points such as:

- not selecting the correct area to print;
- printing out unnecessary cells.

Ask pupils to suggest types of information that may be entered in a spreadsheet, for example, numbers, text, labels and formulae. Use the example on the screen to highlight types of data and other information.

Move the cursor to the bottom right of a cell and point out the small black dot in the corner. Explain that this is the fill handle. Enter a number into each of six consecutive cells in two adjacent columns on the spreadsheet (twelve numbers, two columns of six rows).

Demonstrate how to construct a formula to add two numbers across a row, using '=A4+B4'. Ask pupils to describe what happens to the data in the spreadsheet. Make sure they know that the formula is a rule and that this rule is being applied to the numbers being entered, which are called the variables.

Now demonstrate how to edit the formula and how to subtract and multiply, using – and *. Stress that * is used for multiplication in this application. Demonstrate the effect on the address elements of a formula when it is copied and pasted, or dragged by means of the fill handle. Discuss what happens to the cell reference as you copy down. The cell is not copied exactly but relative to the row or column you are moving to. This is called relative cell referencing.

10 minutes

3 Creating a times-table square

Use **7.4T1d Table square.xls** to demonstrate the effect on numbers, months and days of the week when the cells are dragged by means of the fill handle. Drag down from 'Wednesday' to get days. Drag down from 'Mar' to get months.

Monday	Jan					
Tuesday	Feb	Table Square				
Wednesday	Mar	X	2	3	4	5
		2	4	6		
		3	6	9		
		4	8	12		
		5	10	15		
		6				

Emphasise the need to select more than one cell when pupils want to produce a sequence of numbers. For example, if they drag from the 6, they will get a row of 6s. The software needs to know at least two numbers to recognise the sequence. Highlight 5 and 6 and, using the fill handle, drag across the row. This produces 7, 8, 9, Make sure that 7.4T1c Presentation.ppt is available on the shared area for pupils to use as support material. Demonstrate how pupils can copy the file 7.4T1d Table square.xls into their work area from the shared area. Tell pupils they are going to create a times-table square. Tell them that the table square should go up to the 12 times table but could go further.

Differentiation

Some pupils may start the times-table square from scratch, while others may use the file 7.4T1d Table square.xls from the shared area. When checking, expect pupils to know by heart tables to 10×10 , although they may not know all multiples of 11 or 12. Tell pupils to use the fill handle to click and drag. Remind them that they must select more than one cell to drag, as this will extend the sequence of numbers and not just copy a single value.

Encourage pupils who manage the task quickly to add colour or shading to the table to make it easier to use. If appropriate, suggest pupils make printouts of the table to help them in mathematics with multiplication by 11 or 12.

10 minutes

4 Setting up a simple spreadsheet

Show pupils **7.4T1e Teachers' football league.xls**. Explain that they will:

- use a spreadsheet to display data about football teams;
- use the spreadsheet to calculate which team has the most points;
- update the table as the teams play more games;
- add their own teams if they wish.

Team name	Won	Lost	Drawn	Played	Points
Ipswich Town	3	3	5	11	11
Manchester City	5	4	3	12	15
Oldham Athletic	4	4	3	11	13
Crewe	2	8	0	10	6
Plymouth Argyle	2	0	10	12	6
Birmingham City	1	4	5	10	4
Bury	4	4	4	12	16

Ask pupils to suggest how they could use the spreadsheet to calculate the total number of games played and the total number of points gained. Demonstrate how to enter and copy formulae to do this.

If it is appropriate, extend the demonstration by showing pupils how to sort the data. Explain the problems that may occur if the entire table is not highlighted when sorting. Ask pupils to suggest reasons for sorting data of this kind.

15 minutes

5 Using formulae to enter information into a spreadsheet

Show pupils how to copy **7.4P1f Football league table.xls** into their workspace. Tell them to create, enter and copy a formula for the number of games played and a formula for the number of points gained. Check that pupils understand that they will need to multiply for the points won and then add the draw points. Check the position of the 'multiply' operator.

Ask pupils to save their spreadsheets into their own work areas as they will need them at the start of the next lesson.

Differentiation

Pupils who manage the task quickly could be asked to sort the table.

Pupils working at higher levels could set up two cells giving the number of points for a win and the number of points for a draw, then incorporate these into their formulae instead of the numbers 1 and 3.

Show pupils how they could use one cell to hold either the win or draw information to use in their formula. What happens when they copy or drag down the formula? What is needed? Show absolute referencing using the \$ sign in front of each cell reference, for example, \$H\$4. This makes it possible to change the points awarded easily and efficiently.

7.4T1g **Football league table workings.xls** demonstrates this and shows the formula with the answers that pupils will work out in lesson 2.

Pupil's name Form/Class					
Team name	Won	Lost	Drawn	Played	Points
West Ham United	8	0	3	11	30
Leeds United	6	1	4	11	22
Liverpool	5	2	5	12	17
Newcastle United	5	3	2	10	15
Manchester United	3	5	6	14	12
Arsenal	2	6	5	13	11
Everton	2	7	4	13	10
Norwich City	1	6	6	13	7
Southampton	0	9	3	12	3

5 minutes

6 Plenary: Advantages and disadvantages of using a spreadsheet

Ask pupils to compare the method of using a spreadsheet for recording football results with using a pen, paper, ruler and, perhaps, calculator to do the same thing.

Draw out advantages such as:

- speed, and the ease of correcting mistakes;
- the possibility of making multiple copies.

Ask them what was difficult about the task. Draw out disadvantages such as:

- the coordination needed to use the mouse;
- the need to work out what the formula should be rather than just adding or multiplying numbers together;
- the possibility of highlighting the wrong cells.

Homework

Ask the pupils to think how they would use a spreadsheet in real life. Ask them to apply the ideas suggested in the plenary and to identify two advantages and two disadvantages for their real-life examples.

Lesson

2

Modelling using a spreadsheet

ICT Framework objectives

DEVELOPING IDEAS AND MAKING THINGS HAPPEN

Models and modelling

- Use software to investigate and amend a simple model by:
 - formatting and labelling data appropriately;
 - entering rules or formulae and checking their appropriateness and accurate working;
 - explaining the rules governing a model.
- Test whether a simple model operates satisfactorily.

Key vocabulary

From Year 6: output, predict, simulate

From Year 7: variable

From Year 8: interrogate

Preparation and planning

- Ensure that 7.4T1e Teachers' football league.xls and 7.4T2c Biscuit model.xls are available electronically and that 7.4P1f Football league table.xls and 7.4T2c Biscuit model.xls are available in the shared area.
- Ensure that 7.4P2a Zoo activity.xls is available in the shared area for the start of the lesson.
- Copy 7.4P2b Football league question sheet.doc and 7.4P2d Biscuit question sheet.doc for all the pupils.
- Review 7.4T2e Biscuit answer sheet.doc.
- Print 7.4T2e Biscuit answer sheet.doc, as answer sheets for 7.4P2d Biscuit question sheet.doc, if required.
- Ensure that the Internet is working and models from:
 - <http://www.metoffice.com/weather/charts/animation.html>
 - <http://www.metoffice.com/research/ocean/operational/wave/swellanim.html>
 are available.
- Write the task for activity 1 on the whiteboard or flipchart.
- If necessary, prepare guidance for the pupils to support the software being used, either as a handout or available on the school's intranet.
- Add new key vocabulary to the wall display.
- Display the objectives for the lesson, phrased so all pupils will understand them.

Resources

- Large computer screen display
- Sufficient computers for pupils to work in pairs or small groups
- Shared network area, or alternative way to pass spreadsheet data to pupils
- Spreadsheet software
- Whiteboard or flipchart
- Resource files:
 - 7.4T1e Teachers' football league.xls
 - 7.4T1g Football league table workings.xls
 - 7.4P2a Zoo activity.xls
 - 7.4P2b Football league question sheet.doc
 - 7.4T2c Biscuit model.xls
 - 7.4P2d Biscuit question sheet.doc
 - 7.4T2e Biscuit answer sheet.doc
 - 7.4P1f Football league table.xls

Lesson outline

60 minutes

1	Starter: Problem-solving using a simple spreadsheet	Reviewing Paired work	10 minutes
2	The idea of a model	Discussion and demonstration Whole class	5 minutes
3	Using a model to find information	Demonstration Whole class	10 minutes
4	Interrogating a model to answer questions	Using software Paired work	10 minutes
5	Using and interrogating a different model	Demonstration Whole class Using software Paired work	20 minutes
6	Plenary: Advantages of using a model	Checking work Whole class	5 minutes
	Homework	Individual work	

Activities

10 minutes

1 Starter: Problem-solving using a simple spreadsheet

Refer pupils to the objectives for this lesson. Remind them that in lesson 1 they used a spreadsheet to display data and to carry out simple calculations. Tell them that in this lesson they will use the spreadsheet as a model to answer 'What if...?' questions.

Display **7.4P2a Zoo activity.xls** on the large screen display and explain that it is also available on the shared area. Ask pupils, in pairs, to complete the activity, using the 'What if...?' questions on the spreadsheet. If there is time, ask pupils to suggest their own 'What if...?' questions. Pupils can extend these by changing variables.

Animal	Cost per week to feed each animal	Number of animals	Total cost per week for animals
Lion	£25	10	£250
Tiger	£30	8	£240
Zebra	£5	9	£45
Elephant	£20	9	£180
Snake	£5	8	
Penguin	£5	12	
Sea lion	£20	3	
Alligator	£5	4	
Eagle	£1	5	
Totals			
Budget allowed			
Overspend / underspend			
What if you ...			
had only 5 sets of animals, and a budget of £1000			
had all 9 sets of animals			
had to pay £1000			
How many sets of animals could you have?			

Explain that you have set up a model that will allow pupils to ask questions and solve problems. Ask them to compare this with the pencil-and-paper model they developed in lesson 1. Ask what advantages the spreadsheet has. Draw out responses such as:

- accuracy;
- speed;
- flexibility;
- adaptability.

Review how the model is working, identify the formula or rules, and the variables (input and output). Remind pupils that * is used as a multiplication sign in formulae.

Explain that they are now going to look at other examples of models, where they cannot identify what is actually happening to the data – 'blackbox' models.

5 minutes

2 The idea of a model

Explain that a model is not just a pencil-and-paper table or a spreadsheet. Say that:

- a model is like a simulation, for example, a Formula 1 motor racing computer game;
- models can be used to answer 'What if...?' questions;
- once a model has been set up, it is possible to input different data and see how this affects the outcome or output;

- the input and output data are called variables – the input data can be changed and the output will change correspondingly;
- we often model events that would be difficult or costly to try out in reality, for example, testing orbital paths of rockets, testing how different designs or models of car behave in serious accidents, investigating mass production of a new line of cosmetics.

Demonstrate some ways in which models are used, referring to the sites below or other similar examples:

- in weather forecasting <http://www.metoffice.com/weather/charts/animation.html>;
- for predicting ocean wave swell
<http://www.metoffice.com/research/ocean/operational/wave/swellanim.html>.

Say that models are used in many other ways, for example to:

- predict profits in business;
- find out how buildings will be affected by earthquakes;
- test escape routes from buildings if they are on fire;
- test new car designs for aerodynamics;
- predict how a disease or virus might spread.

10 minutes

3 Using a model to find information

Display 7.4T1e Teachers' football league.xls and use it to remind pupils how to:

- create a formula to work out the number of games played by Ipswich;
- copy a formula to work out the number of games played by each team;
- create a formula to work out the number of points gained by Ipswich;
- copy this formula to work out the number of points gained by all the teams;
- sort the league table, in order of points.

Explain the meaning of these terms:

- rule (how different quantities can be combined or manipulated to find a new quantity);
- formula (a mathematical way of writing a rule in symbols);
- variable (a quantity that can change its value).

Ask pupils to identify these in 7.4T1e Teachers' football league.xls. The variables include the number of games won, lost or drawn. How points are awarded and games played are the rules. Demonstrate how 'What if ...?' questions can be answered, using the spreadsheet model. Use this example.

- Suppose there are only two games next week, Bury v Manchester City and Ipswich v Plymouth Argyle. Which team could be at the top of the league? How could this happen?
- If draws were worth 2 points rather than 1, which team would become top of the league?

- In the next round of matches, Oldham and Plymouth both win, Ipswich and Crewe lose, Bury and Manchester City draw and Birmingham does not play. Which team will be top of the league? What positions in the league will the rest of the teams hold?

Depending on the ability of the class, decide whether to use a simple formula, as in F7 in 7.4T1g Football league table workings.xls, or an absolute reference for the win and draw cells, as in F8 to F15.

Stress the need to reset values after each question by reloading the original file or using the 'undo' function. Encourage pupils to ask other 'What if...?' questions. Extend the more able pupils by questioning them about the model structure and its operation. Ask these questions:

- How are absolute cell references used?
- How is the sort function used to indicate league positions?
- How could you change the model if 4 points were given for a win?
- How could you extend the model to include goal difference if two teams have the same number of points?

10 minutes

4 Interrogating a model to answer questions

Ask pupils to use the version of 7.4P1f Football league table.xls they set up in lesson 1 to answer the questions on **7.4P2b Football league question sheet.doc**. Circulate and monitor, assisting pupils where necessary. Make sure they reset values after each question. Encourage pupils who have answered the questions on the sheet correctly to devise their own questions to ask each other.

Use peer groups to check answers against the answer sheet.

Football league question sheet 7.4P2b

Use the league table spreadsheet to answer these questions.

1 Matches this week finish with these results

Liverpool	2	Norwich City	1
Arsenal	0	West Ham United	0
Leeds United	3	Newcastle United	4
Manchester United	1	Everton	1

Southampton didn't play this week

Update the league table by entering these results.

Save the updated league table.

2 Sort your updated table to find out which team has the most points.
Which team is top of the league? Which team is bottom?

Save your sorted league table.

Spreadsheet models allow you to predict what questions you can predict what questions.

Reset

20 minutes

5 Using and interrogating a different model

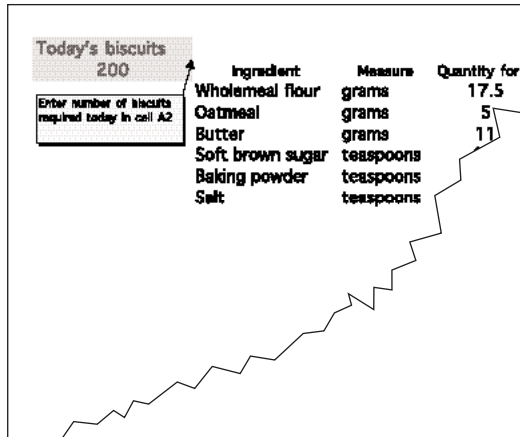
Discuss the process of producing biscuits. Ask pupils what information they would need to find the cost of making biscuits. Answers should include:

- list of ingredients;
- numbers or quantities of ingredients;
- the price of ingredients;
- possibly other factors such as equipment or cooking costs.

Use a diagram to illustrate that the ingredients are the inputs, the amounts or quantities are the variables and the cost is the output.

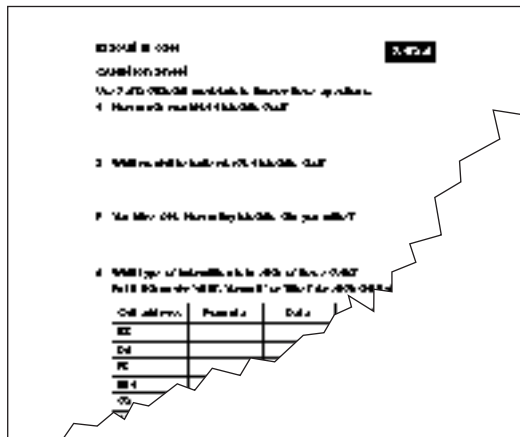
Use **7.4T2c Biscuit model.xls** to demonstrate the biscuit-making model. Ask pupils these questions.

- Which cells contain variables? (A2 and D3 to E8)
- Which of these are most likely to be changed by the user? (A2)
- Which cells contain rules or formulae? (F3 to G8 and E10 and G10)
- What is the output of the model? (G10)
- What does each formula in the model do?



Demonstrate how unit costs can be changed and how the model immediately recalculates to take account of the change(s).

Give pupils **7.4P2d Biscuit question sheet.doc** and ask them to use 7.4T2c Biscuit model.xls to answer the questions.



Differentiation

Circulate, asking pupils whether they can remember where they might find the answers. (They are in the presentation from lesson 1 on the shared area.)

Ask if there are other ways of producing the formula for question 6. Three ways are:

- =G3+G4+ ...
- use autosum
- =SUM(G3:G8)

although there may be others.

5 minutes

6 Plenary: Advantages of using a model

Remind the class about the objectives for this lesson and discuss whether they have been met.

Ask all pupils to have their answer sheets for 7.4P2b Football league question sheet.doc and 7.4P2d Biscuit question sheet.doc ready. Ask selected pupils to give their answers to the questions. Use **7.4T2e Biscuit answer sheet.doc** to check and discuss answers with the class. Ask pupils to explain what the rules of the football league model are and draw out what they see as the advantages of using the biscuit production model.

Biscuit model 7.4P2e

Answer sheet

Use 7.4T2c Biscuit model.xls to answer these questions.

1 How much would 500 biscuits cost?

£60

2 What would the butter for 750 biscuits cost?

£22.50

3 You have £10. How many biscuits can you make?

83

4 What type of information is in each of these cells?
Put a tick under 'data', 'formula' or 'label' for each cell.

Cell address	Formula	Data
B3		
D4		
F3		
E10		

Homework

Ask pupils to identify the rules and variables for one of these examples:

- the total points for a team playing football for a whole season;
- the total costs of producing biscuits;
- the difference between the numbers of points gained by the team at the top of the league and the team at the bottom of the league;
- the goal difference for a football team.