

Sample teaching unit 7.4, lesson 2, strategies for inclusion

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.

GROUP C/D

Break down the objectives, e.g.

- change variables in a model;
- create a rule;
- test a simple model.

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.

GROUP A: Support materials for technique of changing the cells.

GROUP B: Ask pupils to make predictions and test by changing variables in the model.

GROUP C/D: Simplify the model: fewer animals, number of animals column x2, x5, x10. Model the first few questions. Targeted support for calculations.

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 for

How

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.

GROUP C/D: Refer to wall display with key words and symbols, previous examples of the KS2 units of work involving models and use of spreadsheets. Check understanding of key words: variable, rule, input, output.

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.

Target questions

GROUP D:

accuracy

GROUP C:

speed

GROUP A:

flexibility

GROUP B:

adaptability

5 minutes

2 The idea of a model

GROUP C/D:

Share other examples – 'Does anyone have a games system?', 'Have you ever played on a racing game?'

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;

GROUP C: A visual display or demonstration of input/output.

GROUP D: Ask how this is done, follow up with 'Why? When?' questions.

GROUP B: Ask how the models could be used, identify advantages and limitations.

GROUP C/D: Use of a simpler model, e.g. 'Build a duck' model, free download from www.cgpbooks.co.uk/duck/duck.htm.

- 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.

GROUP A/B: Ask for further examples of the use of models.

10 minutes

3 Using a model to find information

GROUP C: Step-by-step modelling of the building of the formula within the model – allow time to predict each stage. Ask, 'What will it do?' Peer tutoring.

GROUP D: Structure the questions to draw out an understanding of the purpose of developing the model. Step-by-step breakdown of the questions.

GROUP A: Make support materials available on network/intranet, e.g. sort techniques.

GROUP C: Simplify the questions, e.g. 'If Bury win two matches how many points will be added to their total?'

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.

GROUP B/D: Model and demonstrate skills/techniques to the class or group.

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?

GROUP A: Extended questions, posing own questions, 'How would I find the answer by using a model?' Support material for absolute cell reference.

GROUP B: Justification of answers and investigations. Use of absolute cell reference and extension questions.

GROUP C: Split the question down into smaller steps. Support for techniques, e.g. sorting data.

GROUP D: Split questions into smaller steps. Supported peer group work. Use questions to draw out capability in relation to skills/techniques.

- 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?

ALL: Paired discussion to ensure understanding of the question and information needed. Teacher focuses on Group C discussions.

10 minutes

4 Interrogating a model to answer questions

GROUP A: Extension questions, 'How could the model be developed?' Hyperlinked support materials available.

GROUP C: Materials to support Literacy and Numeracy needs. Structure and support tasks. Group organisation to allow peer support. Teacher support targeted and planned for.

GROUP D: Split the questions into smaller steps, 'Which cells will you change? What happens?'

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.

Reset

Top team:
Bottom:

Focused group work. **GROUP C** with teacher and **GROUP D** with teaching assistant.

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.

Target questions
GROUP D: variables
GROUP C: changing cells
GROUP A: rules/formulae
GROUP B: output of the model

GROUP A/B:
 Independent activity with extension opportunities through questioning, 'How efficient is the model?'. Prepare to present to group during the plenary.
GROUP C/D: Simplify the model, e.g. using multiples of 2, 5, 10.
GROUP D: Ask an individual to model the activity to the rest of the group and highlight link to capability. Opportunity to ask 'What if ...?' questions.

GROUP C/D: Learning support/scaffolding to access mathematics and formulation of rules.

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?

Today's biscuits 200			
Enter number of biscuits required today in cell A2	Ingredient	Measure	Quantity for
	Wholemeal flour	grams	17.5
	Oatmeal	grams	5
	Butter	grams	11
	Soft brown sugar	teaspoons	
	Baking powder	teaspoons	
	Salt	teaspoons	

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.

Biscuit model **7.4P2d**

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

- How much would 500 biscuits cost?
- What would the butter for 750 biscuits cost?
- You have £10. How many biscuits can you make?
- 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		
G7		

GROUP D: Mini-plenary – draw out answers so far and scaffold further development of model. Intervention to bring out reasons for using the model. Reinforce the idea of 'What if?' developments.

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.

GROUP A: Check understanding of technique and support use of SUM function.
GROUP B: Justify use and choices of formula.
GROUP C: Check understanding of formula.
GROUP D: Introduce SUM and discuss reasons for using the function.

5 minutes

6 Plenary: Advantages of using a model

GROUP A/B: Present a reviewed model to class, identify rules and variables – purpose and audience.

GROUP C: Share answers through questions relating to differentiated resource. Draw out modelling information – ‘Rules are...? Variables...?’ Develop a ‘What if...?’ scenario based on simplified model.

GROUP D: Teacher intervention to include questions to draw out capability, e.g. use of ‘What if...?’ questions, reasons for 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.

- How much would 500 biscuits cost?
£60
- What would the butter for 750 biscuits cost?
£22.50
- You have £10. How many biscuits can you make?
83
- 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		
E40		

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.

GROUP A: Develop two examples, each containing a rule and a variable.

GROUP B: Develop three examples and start to develop own model.

GROUP C/D: Use scaffolded activity with annotated support.