BOWLAND MATHS
Assessing the Case Studies

Save a Baby Kangaroo
Assessing the learning

Case Study description

Pupils identify a feeding programme for a baby kangaroo. In the trials, most schools concluded with pupils making oral presentations of their findings.

Suitability   National Curriculum levels 4 to 6. An optional assessment activity is
provided which is suitable for pupils working at levels 6 to 8.

Time   The assessment activities are part of the case study and can be completed within the lesson and homework time given for the case study. The optional assessment activity, which is linked to, but not part of, the case study, will be useful for pupils working at higher levels of the national curriculum; its timing is flexible.

Resources   The optional assessment activity can be found on the Excel spreadsheet, *Kangaroo feeding*. Teachers may wish to use a whiteboard to introduce this activity.

Opportunities to assess the Key Processes

- **Representing**: during the optional activity

- **Analysing**: during lessons 1, 2, 3 to 5 and the optional activity

- **Interpreting and evaluating:** during lessons 1, 2 and the optional activity

- **Communicating and reflecting**: during lesson 3 and the optional activity

In addition to assessment of the Key Processes, there are opportunities to assess Range and Content (detail is within the case study) and some of the other personal, learning and thinking skills, particularly for 'team working'.

Lesson 1: So what is so different about a joey?

Pupils learn about marsupial birth and development, comparing these with other animals.

Teacher guidance

Observe how well pupils:

- Use their mathematical understanding when completing the worksheet in task 1.2

- Interpret the data, comparing different animals to draw reasoned conclusions

Worksheet from task 1.2
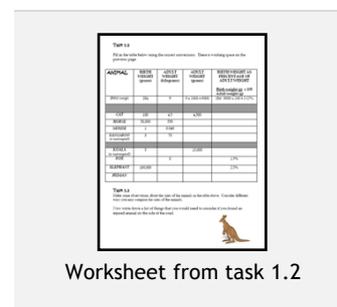
Questions to ask:

- *How did you work out your answers? What accuracy did you work to and why?*
- *How did you find the birth / adult) weight for a fox / elephant?*
- *Did any of the percentages surprise you? Why? Is the table written in any special order?*
- *Could you group the data? How?*

Assessment guidance: Progression in Key Processes

	Analysing (i)	Analysing (ii)	Interpreting and evaluating
P R O G R E S S I O N	Uses the given method to complete the first 5 rows, mostly working accurately	Is confident in converting gms to kgs and kgs to gms	Notes simple relationships, eg 'The marsupials have lower percentages'
	Uses realistic figures (estimated or researched) to find a value for humans (likely to be 3 to 5%)	Rounds up where appropriate Pupil A	Recognises distinct groups, eg marsupials and other animals
	Uses inefficient methods, eg trial and improvement, to find solutions for fox and elephant Pupil A	When asked, can explain why the ratio for dog should be 3.16% rather than 3.15% as shown on the worksheet	As above, and that the horse is greater than might be expected in comparison with the other mammals Pupil A
	Uses efficient methods to find solutions for fox and elephant	Is confident about the level of accuracy to use, and can justify decisions	As above, and categorises groups effectively, eg marsupials as less than 1% and others as 1 to 10%

Sample response: Pupil A

ANIMAL	BIRTH WEIGHT (grams)	ADULT WEIGHT (kilograms)	ADULT WEIGHT (grams)	BIRTH WEIGHT AS PERCENTAGE OF ADULT WEIGHT $$\frac{\text{Birth weight (g)} \times 100}{\text{Adult weight (g)}}$$
DOG (corgi)	284	9	9 x 1000 = 9000	284 / 9000 x 100 = 3.15%
CAT	100	4.5	4,500	2.22%
HORSE	50,000	550	550000	9%
MOUSE	1.	0.040	40	2.5%
KANGAROO (a marsupial)	3	70	70000	0.004
KOALA (a marsupial)	5	13	13,000	0.04 %
FOX	152	8	8000	1.9%
ELEPHANT	100,000	4000	4000000	2.5%
HUMAN	3180	72	7200	4.42%

Task 1.3

Make some observations about the sizes of the animals in the table above. Consider different ways you may compare the sizes of the animals. *Marsupials are smaller. Horse is biggest.*

Comments

Pupil A works confidently and accurately, grouping results effectively. In discussion, she said that she used trial and improvement to find the weights of the fox and elephant.

Probing questions and feedback

- *What accuracy did you decide to use and why? Why does it matter what accuracy you use?*
- *Why is trial and improvement not usually the best way to find a solution? Can you rearrange the equation so that birth weight is the subject?*

Pupil A would benefit from working on activities in which consistent and appropriate rounding leads to effective solutions. Working with other pupils could support her understanding.

Lesson 2: Planning to care for a joey

Pupils work in groups to become 'joey experts' on one species.

Teacher guidance

Observe how well pupils:

- Interpret the data provided
- Make decisions about how to re-present the data
- Understand connections between the sets of data

Feed and Growth Charts
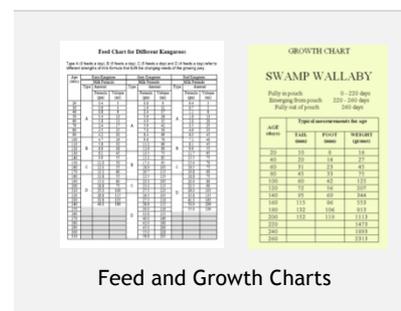
Questions to ask:

- *Can you explain how to use the Feed Chart? What do A, B, C and D refer to?*
- *How does your joey's weight change over time?*
- *Would the graph of weight against age be a straight line? Why not?*
- *How will your graphs help you find the age of your joey?*
- *How will you decide how much to feed it?*

Assessment guidance: Progression in Key Processes

	Analysing	Interpreting and evaluating
P R O G R E S S I O N	Teacher support is needed, eg to use the feed charts and to find suitable scales for graphs Pupil B	Makes simple statements, eg 'As joeys get older, their weight increases' Pupil B
	Uses the feed charts and produces mostly accurate graphs with suitable scales and clearly labelled axes	Interprets the shape of the graphs, eg 'weight doesn't change much but then suddenly it grows a lot'
	Recognises why graphs are a suitable means of showing changes in data over time, and produces accurate and clearly labelled graphs Pupil C	Reflects further, eg by considering how the graphs might continue
	Shows all three sets of data on one graph, ie an accurate double axis graph	Shows understanding of how the sets of data inter-relate Pupil C

Sample response: Pupil B

Comments

Pupil B explained: 'the graph shows its feet get bigger'.
However, his graph showed foot size falling to zero.

Probing questions and feedback

- *What does your graph show the foot length to be when the joey is 240 days? What does it show when the joey is 260 days? Why is that not possible?*

Pupil B would benefit from creating and discussing a range of graphs that represent real-life situations.

Red-Necked Wallaby
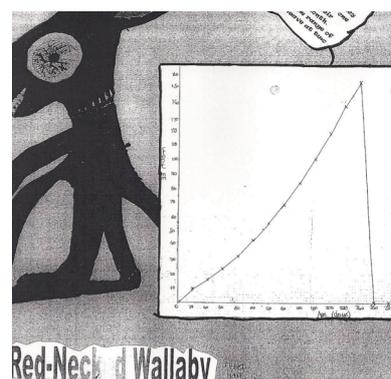
Sample response: Pupil C

Comments

Pupil C drew straight lines to support his understanding of rate of change. He linked information from the feed chart to summarise how the joey grows during each feeding stage.

Probing questions and feedback

- *How would you create a double-axis graph to show all three graphs on one chart? What are the advantages and disadvantages of doing that?*

Pupil C would benefit from opportunities to extend his understanding of different types of graphs.
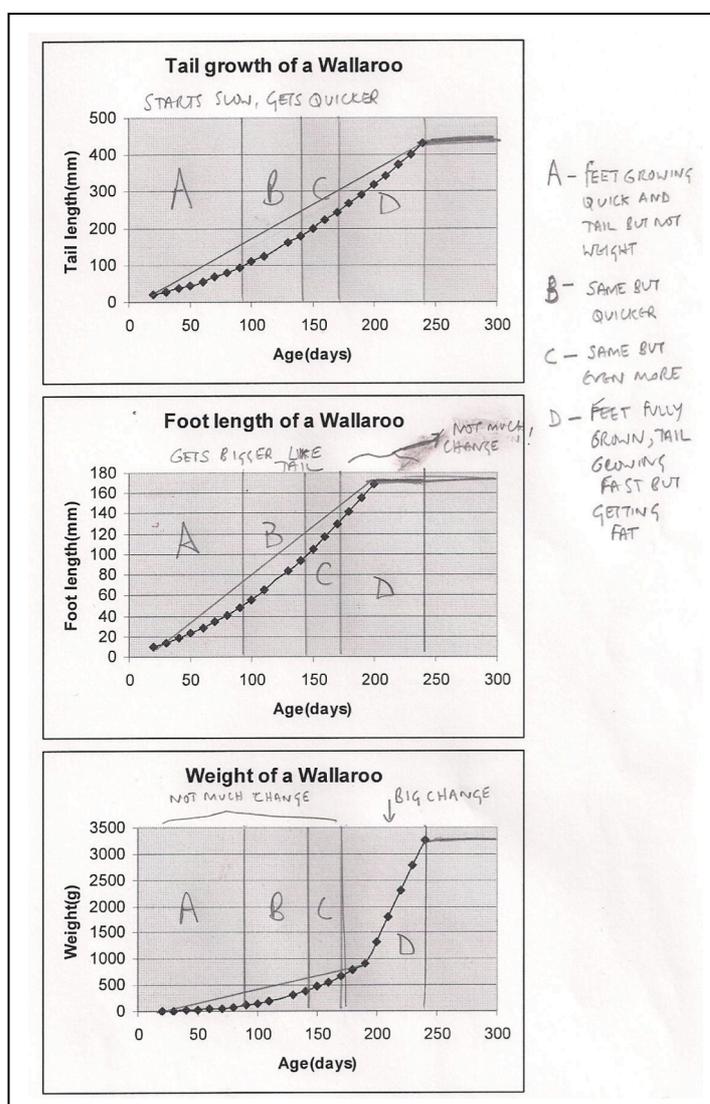
Lessons 3 to 5

During these lessons, pupils produce a poster summarising information about a species of joey. Pupils then use their poster and those produced by class mates to determine the age and species of an unknown joey. Finally, pupils summarise their findings.

Teacher guidance

Observe how well pupils:

- Use a range of information to determine the most likely species and age of the unknown joey

- Communicate the reasons for their choice

- Consider how likely their answer is to be correct

Orphaned joey card

Questions to ask:

- *Which graphs/posters are most helpful? Why? What would you change about your groups' poster and why?*
- *What are the most important factors you will be looking for?*
- *How confident are you that the species is correct? What about its age?*

Assessment guidance: Progression in Key Processes

	Analysing	Communicating and reflecting
P R O G R E S S I O N	Takes accurate and relevant measurements for their joey	Explains what they have done and why
	Identifies the species and age of their joey	Reviews their own or others' work, suggesting simple means of improvement, and explaining their findings Pupil D
	Identifies the species and age of their joey, explaining the conclusions	Reviews their own or others' work, suggesting means of improvement, and explaining their findings clearly
	Identifies the species and age of their joey, explaining the conclusions and recognising that there is an element of uncertainty Pupil D	Uses a range of forms to communicate effectively and concisely; critiques their own and others' performance

Sample response: Pupil D

Orphaned joey card

JOEY ONE

MY JOEY		Red Necked Wallaby Predicted age	Wallaroo Predicted age	Swamp Wallaby Predicted age	Eastern Grey Kangaroo Predicted age	Red Kangaroo Predicted age	
Foot length	25 mm	60	52	64	43days	~~~~48days	
Tail length	47 mm	60	50	83	40days	50days	
Weight	28 g	20	52	20	23days	30days	

My joey   Name : Reggie

Species : Wallaroo

Age (at 20/ 01 /10): 52 days

Comments

Pupil D correctly identified her joey. She played an active part in her group's oral presentation, arguing that although tail length is shown as 50 days rather than 52 'things don't grow exactly, so you can't be certain it will be exactly that, it is just a rough idea'.

Probing questions and feedback

- *Which of mean, median or mode did you use when selecting your value of 52? Why? Can you explain why you didn't use (…)?*

Pupil D would benefit from reviewing others' work. This would allow her to compare approaches and encourage her to reflect on her own performance.

Optional Assessment Activity: Kangaroo feeding

The activity below is a demanding multi-step problem that builds on the case study. It can be used during or after the case study, in class or for homework, in groups or individually, on screen or from paper. Use of ICT allows pupils to make calculations speedily and accurately.

Pupil and teacher spreadsheets are provided with the assessment material
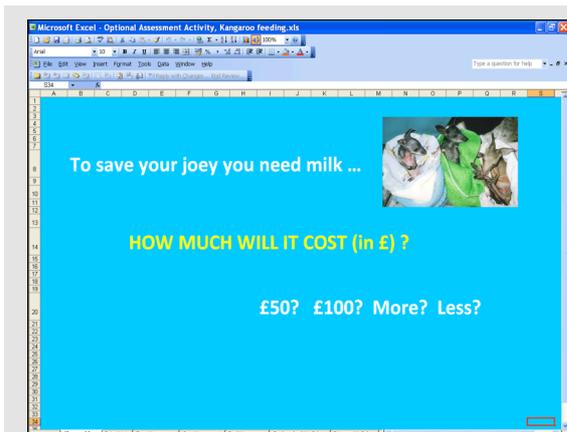
If pupils are going to save a joey they must ensure they have the correct milk and enough of it … but how much will it cost? Ask pupils to make a very rough guess … £50? £100? More? Less?

Allocate different groups of pupils a 20 day old joey of a known species; varying the species as much as possible. Tell them that they are going to work out the total cost of feeding their joey until it is fully out of the pouch.

Pupils use the given information (on the spreadsheet) to solve this multi-step problem, researching for themselves the current conversion rate from Australian dollars to English pounds.

Note that the data used is simplified from that available at http://www.wombaroo.com Pupils may prefer to access the site directly but may need support in interpreting the data. Note that the values are presented as shown, including 'Not valid' for foot length for joeys of age 230 days.)

Assessment guidance: Progression in Key Processes

	Representing	Analysing	Interpreting and evaluating	Communicating and reflecting
P R O G R E S S I O N	Needs teacher support to break down the problem	Makes simple relevant calculations	Attaches meaning to values obtained, eg 'cost per day'	Explains the approach in outline
	Selects appropriate tools, eg chooses to use simple formulae	Finds the total number of grams for one day in each of the intervals	Recognises that complete bags must be bought	Shows partial methods, so that someone else can follow the reasoning
	Recognises that age (days) refers to multiple days and chooses a method to proceed accurately	Multiplies the amount of food needed per day by the number of feeds per day	Notes assumptions, and searches for the cheapest solution Pupil pair E	Gives a clear explanation of methods and findings
	Chooses methods that enables the problem to be solved efficiently and concisely Pupil pair E	Gives a clear, comprehensive and accurate solution Pupil pair E	As above, and recognises that the solution is a 'best fit' given the information provided and assumptions made	Uses a range of forms to communicate findings effectively and concisely Pupil pair E

Sample response: Pupil pair E

Kangaroo Assessment

In our group we are looking at the Euro-Kangaroo

To begin with we decided to find out the exchange rate between AUS $ and GBP £. We found out that £1 =$1.8017. This means £100 would be equivalent to $180.17.

We then began looking at how much we would feed the Kangaroo each day. We did the by using a simple equation. In this equation K is how much we feed the kangaroo each day while A is how much formula A we feed them, B is how much formula B we feed them etc.

$Ka = (A \times 8)$
$Kb = (B \times 6)$
$Kc = (C \times 5)$
$Kd = (D \times 4)$

The total cost would then be all of the individual costs added together.

After this we began to discuss how many days we should work the costs out for. We came to a conclusion that we will work out the cost of the kangaroo until it is 200 days old. We then began creating a spreadsheet showing the total amount of each individual formula and the total cost.

Using this we can begin to draw graphs showing how the daily cost increases over time.

Attached is a spreadsheet showing the total amount of each formula the kangaroo is given.

To work this out we took the total amount of formula each kangaroo is given, which for formula A is 0.42 and the multiplied this by the amount of feeds per day which is 8 for A.

$0.42 \times 8 = 3.36g$

We then had t multiply this by the number of days each amount is given, so since from 20 days old the amount of feed stays the same for 10 days we times 3.36 by 10

$3.36 \times 10 = 336.00$

Days	Formula A (g)	Formula B (g)	Formula C (g)	Formula D (g)
20 days	33.60			
30 days	44.80			
40 days	67.20			
50 days	112.00			
60 days	145.60			
70 days	190.40			
80 days	280.00			
90 days	33.60			
91-93 days	67.20	32.40		
94-96 days	50.40	64.80		
97-99 days	33.60	86.40		
100 days		280.80		
110 days		691.20		
130 days		486.00		
140 days		59.40		
141-143 days		129.60	11.00	
144-146 days		81.00	82.50	
147-149 days		32.4	132.00	
150 days			550.00	
160 days			605.00	
170 days			66.00	
171-173 days			132.00	60.00
174-176 days			99.00	90.00
177-179 days			66.00	120.00
180 days				550.00
190 days				600.00
200 days				75.00
Total	1058.40	2003.40	1743.50	1495.00

We now need to begin to work out the price of each formula over the course of 200 days. To do this we added together the total amount of the formula used over that period of time and divided it by the amount in each pack. For example we divided our total Type A by 140. We then multiplied this by the price. Below is the price list.

	Description	Price
WF-K4001	Type A, 140g	$12.00
WF-K4001	Type B, 180g	$12.00
WF-K6001	Type C, 220g	$12.00
WF-K7001	Type D, 250g	$12.00
WF-K7005	Type D, 1.25kg	$39.00
WF-K7020	Type D, 5kg	$140.00
WF-K7040	Type D, 10kg	$250.00

Comments

The pupils provided a comprehensive report stating assumptions and showing relevant calculations.

Probing questions and feedback

- *How confident are you that the cost will be exactly £214.80?*

The pupils would benefit from working on other multi-step problems, using a wide range of mathematical techniques.

Formula A

$1058.40 \div 140 = 7.56$

Although we would have to round this up to 8 as you cannot buy 0.56 tubs of formula.

$8 \times 12 = \$96$

We then repeated this for the other 3 formulas. For D we used the 250g packet.

Price of Formula A = \$96.00
Price of Formula B = \$144.00
Price of Formula C = \$96.00
Price of Formula D = \$72.00

Finally we added these totals together to find the total price was \$408.00. However if we used a combinations of a 1.25kg tub of D and a 250g tub of D, it would work out cheaper and cost \$51. This means the new total price would be \$387.00.

We then needed to convert this price to GBP £. We already know that the exchange rate is £1=\$1.8017.

$\$387.00 \div 1.8017 = 214.80$

This means the total price would be £214.80