

Lesson 2: Logging activity

Narrative

After a few days of camping in the forest and carrying out surveillance, the team has gathered some valuable evidence for their report on illegal logging activities to the UN. The information has come from snatched conversations between guards, picking up the frequencies of the Log Inc walkie-talkies, a logging lorry invoice and the loads of a sample of lorries over a period of time. An intercepted walkie-talkie conversation suggests that the logs are destined for pulping to make newsprint and that the area, once cleared, will become a cattle ranch.

Problems

Introductory short problem

The team is putting together evidence for their report for the UN. The loggers have been working 7 days a week. The team has recorded the number of lorries each day and estimated their load and the area of forest cleared. The groups estimate the number of trees being felled by Log Inc per year and the annual area of deforestation.

Supplementary or homework problems (optional)

- 1 To help them assess the scale of the problem, the groups estimate the requirements of a national newspaper, *The Daily Grapevine*, for newsprint and works out approximately how many large rainforest trees are being felled each year just to keep this newspaper supplied.
- 2 Deforestation in rainforests is partly due to clearing space for cattle ranches. Log Inc's annual area of deforestation is destined to become a cattle ranch which supplies a fast food chain, and all the beef will end up as burgers. The groups estimate how many burgers per year the cleared area will provide.

Skills required

In this lesson or the homework pupils will:

- round whole numbers to any given power of 10 and decimals to the nearest whole number or to one or two decimal places
- make estimates and approximations of calculations
- calculate percentages of quantities
- use the order of operations, including brackets, with more complex calculations
- use a calculator efficiently to carry out calculations with more than one step
- enter numbers and interpret the display in different contexts
- check results by considering whether they are of the right order of magnitude and by working problems backwards.

Rainforest resources

- 2.1 Video clip: (2 minutes) The advance party makes another video log entry and demonstrates some of the evidence they have found
- 2.2 (Optional) A4 resource sheet of a short introductory problem (if you are using this, print one per pair)
- 2.3 A4 resource sheet of further problems or homework (print as many copies as needed, depending on your plans)
- 2.4 Mobile phone photos of number plates, close-ups of names and addresses on invoices, including a wood pulping company, and a letter to a developer suggesting that the cleared area will become a cattle ranch
- 2.5 Video clip: (1 minute) A few of the team gains access to Log Inc's CCTV cameras and find out what they are up against. They are nearly discovered by security guards – it's a narrow escape!
- 2.6 Optional homework about the format and contents of the UN report.

Other resources

For pupils: calculators.

Main activity

Introduce the next stage of the mission. Play **Resource 2.1**, a two-minute video clip of the evidence gathered by the advance party.

Give out **Resource 2.2**, a short problem, one per pair. Its main purpose is to find estimates of the number of trees felled by Log Inc each year and the annual area of deforestation to use in subsequent calculations. The problem is intentionally structured so that it does not take too long.

Ask the groups to work on the problem, using calculators as appropriate. You may need to remind them how to calculate a mean and that there are 365 days in a year. They may not be familiar with the hectare ($10\,000\text{ m}^2$). Help them to visualise it by comparing it with the size of a standard football pitch (7140 m^2).

Give out **Resource 2.3**, one per pair, and select problems for the groups to work on collaboratively. You could if you wish allocate different problems to different groups, or the groups could select for themselves the problem that they will tackle. They will need to write at the top of the sheet their estimates of the number of trees felled by Log Inc each year and the annual area of deforestation, carrying forward the information from **Resource 2.2**. If you would prefer the teams to spend longer on these problems, omit **Resource 2.2** and simply give the groups suitable approximations to write on their sheets (e.g. $55\,000$ trees, 2.75 km^2 deforestation).

In the beefburger problem, encourage the groups to think through for themselves how to solve the problem by breaking it down into steps. If it becomes necessary prompt them with hints such as:

- About how many cattle could Log Inc's cleared area support? How much beef would these cattle yield? How many burgers could be made from the beef?
- How much beef does the fast food chain need each day? How many cattle would that be in a year? How much grazing land would these cattle need?

In the newspaper problem, allow the groups to devise how to work out their estimate of the area of deforestation required for the annual sales of the newspaper. If they get really stuck prompt them with a suggestion to work out the mass of new wood pulp required for the weekly circulation of *The Daily Grapevine*. If necessary, as a second hint, ask:

- Approximately how many mature trees need to be felled each year to provide new wood pulp for *The Daily Grapevine*?

Differentiation

Key Stage 3 pupils may not be accustomed to calculating with realistic large numbers. Encourage those who struggle with the calculations to use approximations that will make their calculations easier. If they are not sure which operation to use, ask them to think about the question with easier numbers substituted. More able pupils can be asked to consider how they could make their estimates more accurate and how they could check their working.

The introductory problem could be extended by asking pupils to suggest a likely range for the number of mature trees felled each year.

The newspaper problem could be extended by asking the groups to estimate the area of deforestation each year needed to keep the UK supplied with its national newspapers.

Review

Bring the class together to discuss solutions. Pupils' answers will depend on what approximations they have made. In feedback, compare these answers and whether they are realistic. Discuss the approximations and when they should be made.

Now show **Resource 2.4**, mobile phone photos taken by the team as part of their evidence. Tell the teams that they are now closer to being ready to present their findings to the UN. Ask the class:

- Which data do you think would be more important to present to the UN, and why? In what format would you present it, and why? (e.g. charts, tables, numerically, text, photos) Will you also inform the general public about your findings? If so, how will you do it? (e.g. poster, presentation, TV programme, magazine article)

Finish by playing **Resource 2.5**, a one-minute video clip showing a few of the team gaining access to Log Inc's CCTV cameras. But they are nearly discovered by security guards, so it's a narrow escape!

Optional homework

Ask pupils either to do a remaining problem from **Resource 2.3**, for which they may need a calculator. If they have not already done so, they will need to write at the top of Resource 2.3 their estimates of the area cleared each year, carrying forward the information from Resource 2.2.

Alternatively, they could write up their individual conclusions about the questions for the report to the UN posed at the end of the lesson. To remind them of the questions, use **Resource 2.6**.

Footnote

This lesson offers a particularly good opportunity for pupils to do some persuasive writing in cross-curricular work with the English department. Each group of four could be split into two pairs. One pair could use their data to persuade people not to buy a daily paper in order to save the planet from deforestation. The other pair could take the point of view of the newspaper company and use the same data to persuade people of the benefits of buying a daily paper.

Solutions: Lesson 2

Introductory problem on Resource 2.2

a

	Estimated total number of logs	Estimated number of large trees felled
Sunday	280	140
Monday	400	200
Tuesday	380	190
Wednesday	200	100
Thursday	240	120
Friday	300	150
Saturday	320	160
Total	2120	1060
Mean (per day)	302.9	151.4

- b A rough estimate for the total number of large trees being felled each year is $151.4 \times 365 = 55\,261 \approx 55\,000$, with an estimated range of $73\,000 - 36\,500 = 36\,500$.

Though these rough annual estimates are the best that can be made using the only evidence available to the team, it would be worth discussing their reliability. First, the figures are based on a very small sample of what themselves were estimates. You could ask the teams to think about the degree of error that there could have been when they were estimating the numbers of logs each day, and the effect this would have when the figures are projected across the year. You could also ask them to consider whether it would be likely that logging would continue at the same rate throughout each week of the year. For example, Log Inc, may suspend logging in the two wettest months of the year when the tropical rain is at its heaviest. If this were the case, how would it affect the annual estimates?

Pupils may be familiar with the way that high diving scores are calculated. The highest and lowest marks awarded by the team of judges are discounted and the mean is calculated from the remaining marks. Pupils could think about why this system was introduced. If a similar system were adopted for the logs, how would this affect the mean and the range?

- c The estimated area being cleared by Log Inc each year is $151.4 \times 365 \div 200 \approx 275$ hectares per year ($2\,750\,000 \text{ m}^2$ or 2.75 km^2), with a range of $(73\,000 \div 200) - (36\,500 \div 200) = 365$ hectares per year.
- d About 150 large trees are felled each day.
Each team deals with 10 trees per day, so there are $150 \div 5 = 15$ teams.
Each team has 4 loggers, so $15 \times 4 = 60$ loggers are working for Log Inc.

Further problems on Resource 2.3

Answers will vary depending on pupils' estimates.

2 Beefburgers

- a Assume that Log Inc clears about $2\,750\,000 \text{ m}^2$ of rainforest per year.
This area, if turned into a cattle ranch, would support $2\,750\,000 \div 1000 = 2750$ cattle.

 2750 cattle would yield about $2750 \times 800 = 2\,220\,000 \text{ kg}$ beef.
This beef would make about $2\,220\,000 \div 100 = 22\,200$ burgers.

- b** 75 burgers per second is

$75 \times 60 \times 60 \times 24 = 6\,480\,000$ burgers per day.

If these burgers are each 0.1 kg,
the chain needs 648 000 kg beef each day for their burgers.

The number of cattle needed to supply the beef for one day is about
 $648\,000 \div 800 = 810$ cattle.

The number of cattle needed to supply the beef for one year is about
 $810 \times 365 = 295\,650 \approx 300\,000$ cattle.

These cattle require $300\,000 \times 1000 = 300$ million m^2 of grazing land, or 300 square kilometres,
about twice the size of England and Wales combined.

2 Newspaper production

- a** The newspaper's weekly circulation requires about
 $800\,000 \times 6 \times 0.3 \times 0.6 = 864\,000$ kg new wood pulp.

About $2500 \times 0.9 = 2250$ kg of each tree trunk is used to make new wood pulp.

The weekly circulation requires about $864\,000 \div 2250 = 384$ trees.

The annual circulation requires about $384 \times 52 = 19\,968 \approx 20\,000$ trees.

To produce 20 000 trees, the area of forest that must be cleared is
 $20\,000 \div 200 \approx 100$ hectares ($1\,000\,000 \text{ m}^2$ or 1 km^2)

The problem could be extended by estimating the area of deforestation each year to keep the UK supplied with its national newspapers.

The UK has a population of about 60 million.

The USA has a population of just over 300 million, so (assuming that newspapers are bought at a similar rate per head of population) pupils could estimate the area of deforestation needed to keep the USA supplied annually with national newspapers.

In developed countries, the problem could be tackled, for example, by making national newspapers only available online.

- b** Pupils' suggestions, e.g.

How does the area of newspaper pages used for photographs vary from one type of UK national newspaper to another? (tabloid/broadsheet, weekday/Saturday/Sunday)

If there were no photographs in national newspapers, about how many rainforest trees could be saved each year?

Pupils would need to use measurements, approximations and suitable calculations to answer the questions. They would also need to do Internet research to find out daily circulation figures of national newspapers.

Optional homework on Resource 2.6

Pupils' suggestions and justifications.

The purpose of the homework is to help pupils to see how different reports are suitable for different audiences. Their justifications should address this point.