Activity description

Pupils determine how far away they could travel in one hour.

Knowledge of the locality and reference to various maps and timetables, possibly via the internet, is essential in planning a route.


Every second counts

How far away can you get in one hour?

This is a race against time.
Your starting-point is the classroom.
Describe your route from the classroom door.
Give reasons for your choice.
How far would you get?

Nuffield Applying Mathematical Processes (AMP) investigation 'Every second counts'
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Suitability

Pupils working in groups

Time

2 hours upwards

AMP resources

Pupil stimulus

Equipment

A3 paper and coloured pens

Plan of the school

Local transport maps and timetables

Local and national road maps

Railway maps and timetables
and/or
access to the internet and urls for local timetables

Key mathematical language

Route, map, distance, time, speed, graph, compare, optimise, justify

Key processes

Representing
Deciding what information to collect and why.

Analysing
Working with distance and time to find how far they can travel.

Interpreting and evaluating
Drawing together their findings to reach a solution.

Communicating and reflecting
Communicating what they have done and why.

Teacher guidance

This activity works best if pupils are given time at the start for planning and rough work. Knowledge of the locality and reference to various maps and timetables, possibly via the internet, is essential in planning a route.

Encourage pupils to decide as a class on their interpretation of the problem, including whether 'the farthest' means the longest distance travelled or is measured as the crow flies, whether to consider cost, implications of a 'green' mode of travel, realistic transport, legality (they cannot drive), and / or possible waiting time issues on their route.

You may like to show parts of the BBC Top Gear video clip 'race across London' in which four different modes of transport compete to travel from West to East in the shortest time.

www.bbc.co.uk/learningzone/clips/rush-hour-race-across-london-pt-1-2/8329.html

www.bbc.co.uk/learningzone/clips/rush-hour-race-across-london-pt-2-2/8330.html

Organise pupils into groups and set them to discuss the various forms of transport that they could use, and to plan alternative routes, drawing on what they already know. At this stage each group should decide what parameters will inform their journey, and the information and resources they need to carry out the activity.

Collect from each group their list of the resources they need in order to take the activity further. The next stage involves detailed work using maps and timetables. This could be later in the same lesson, or it could be a subsequent lesson.

Even if using the internet, it is helpful to have some paper copies of local train or bus timetables in the classroom. In rural schools you may wish to provide information on the speed of tractors and horses, and to encourage looking for permitted short-cuts across fields and hills.

You may want to specify the starting time from which the hour begins. This could be modified later, possibly as an extension, to decide what would be the most favourable starting time to achieve maximum distance.

During the activity

Encourage pupils within groups to share out tasks among individuals. This will have two advantages: the group will progress faster and each individual will be actively engaged.

Allow groups time to make good headway into their solutions before stopping them for any mid-lesson plenary. Such a plenary can be used to share useful information among the groups, for example distance from classroom to school exit, average walking speed, distance to station or bus stop. Alternatively you could set up the activity so that the board is used by pupils to note key information they think other groups might find useful.

Encourage pupils to regard you or teaching assistants as travel information officers. This puts them in charge of their decisions, interacting with adults when they choose to.

Encourage groups to record reasons for their decisions as they make them.

Circulate in the classroom, listening to pupils' language and observing the quality of the mathematics they use. This is a good opportunity for assessment. Allow pupils the opportunity to learn from their mistakes, choosing what you say to them according to the work they have done so far.

Probing questions and feedback

AMP activities are well suited to formative assessment, enabling pupils to discuss their understanding and decide how to move forward. See http://www.nuffieldfoundation.org/whyAMP for related reading.

- Can you show more clearly the different stages of your journey and how much time each stage will take?
- How can you be sure that you will always be able to complete your journey in one hour?
- Why did you choose that mode of transport?
- What references (map / internet timetable) have you used and why?
- Is this the only route you have looked at, or did you consider any other options?
- So how far does this route take you in total?
- How can you be sure that you have the best solution?

Extensions

- Considering farthest points reached in one hour in several different directions from the school, drawing such points on a map, discussing reasons for, and implications of, the emerging pattern.
- Considering farthest points that can be reached in one direction for different starting times of the day, and looking at the patterns emerging.
- Considering other constraints such as cost or a return trip.
- Drawing a 'time map' where the distances from the school to locations are scaled by the time taken to reach them.
- Link with a school in a different locality, and comparing outcomes with them on this activity.

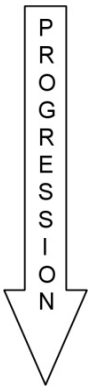
Progression table

The table below can be used for:

- sharing with pupils the aims of their work
- self- and peer-assessment
- helping pupils review their work and improve on it.

The table supports formative assessment but does not provide a procedure for summative assessment. It also does not address the rich overlap between the processes, nor the interplay of processes and activity-specific content. Please edit the table as necessary.

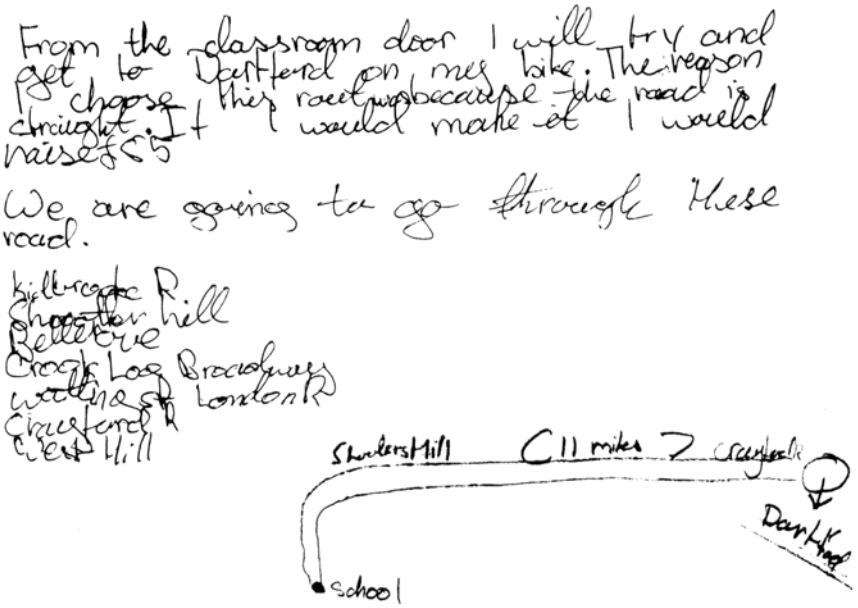
Representing *Selecting a mathematical approach and identifying what mathematical knowledge to use*	**Analysing** *Calculating accurately using effective strategies to work logically towards a solution*	**Interpreting and evaluating** *Interpreting the results of calculations and graphs in developing the final solution*	**Communicating and reflecting** *Throughout the task, communicating and justifying decisions and presenting arguments clearly*
Shows minimal understanding of the problem, e.g. draws or describes a sensible, and possibly familiar, 1-stage route Pupil A	Recognises that time or distance has a role to play in working towards a solution Pupil A	The solution shows that time or distance has been taken into account Pupil A	Sufficient information given for someone else to follow their simple route, e.g. identifies realistic locations along the route and gives a credible destination Pupil A
Shows fuller understanding of the problem, e.g. draws a sketch or describes a multi-stage journey with timings Group B	Makes reference to times and / or distances for different stages along the route Group B, C	The solution shows that time and distance have been taken into account Group B	Presents a simple solution with description that meet the basic principles of the activity, e.g. route and total distance clearly described Group B, C
Considers more than one parameter, e.g. one route using different modes of transport or more than one route using the same transport Group C, Pupil D	Identifies how their solutions meet the criteria, e.g. uses timetables and maps correctly to find time and distance accurately Pupil D	Considers ways of maximising distance before arriving at chosen solution, e.g. compares different routes or justifies distance travelled	Presents all their solutions clearly, with some explanation for their choices Pupil D
Identifies mathematical aspects and methods to produce detailed alternative solutions	Uses appropriate and accurate mathematical graphs and calculations	Considers possible alternatives and problems at key points of the route Group E	Explains and justifies proposed route clearly, e.g. compares distances to arrive at final solution
Shows mathematical insight when representing the task, e.g. uses maps effectively Group E		Uses thorough and reasoned arguments to form an effective solution	Presents cohesive work, with events sequenced and distances justified Group E



Sample responses

Pupil A

This pupil gives a sensible, familiar 1-stage route showing clear place names and a credible destination. The distance covered and a brief justification for the route is given.

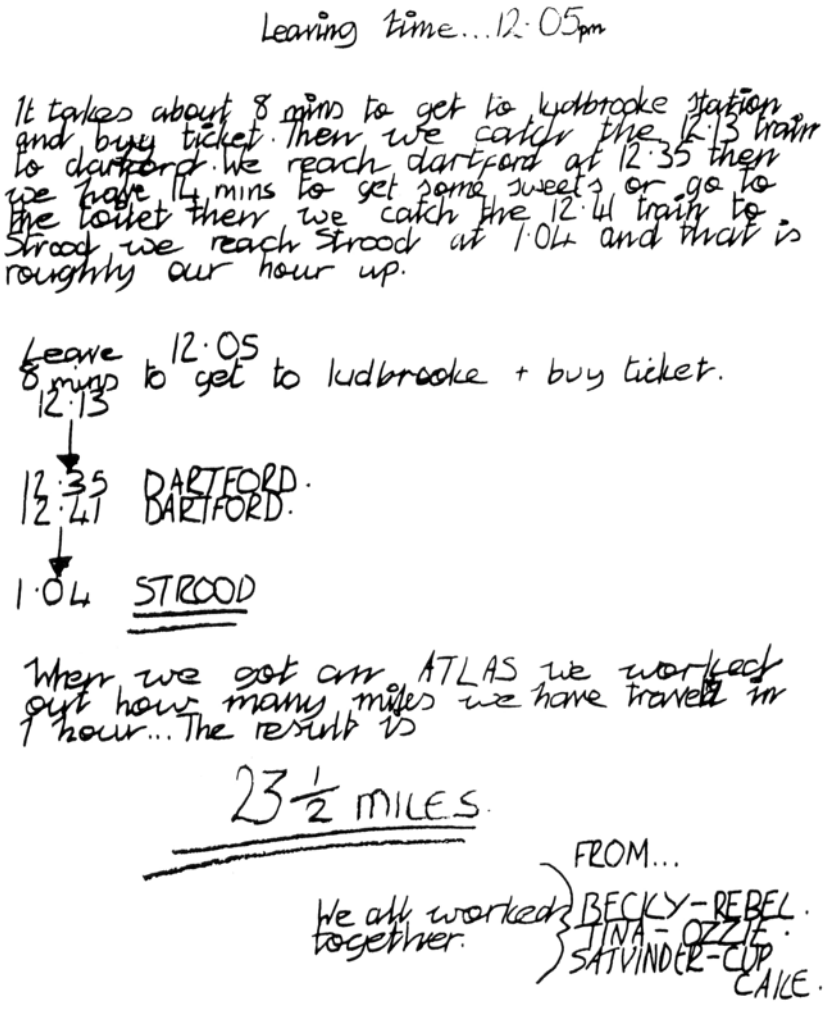


Probing questions

- Can you explain how you arrived at the total distance?
- Do you think that if you look at other means of transport you might get further?

Group B

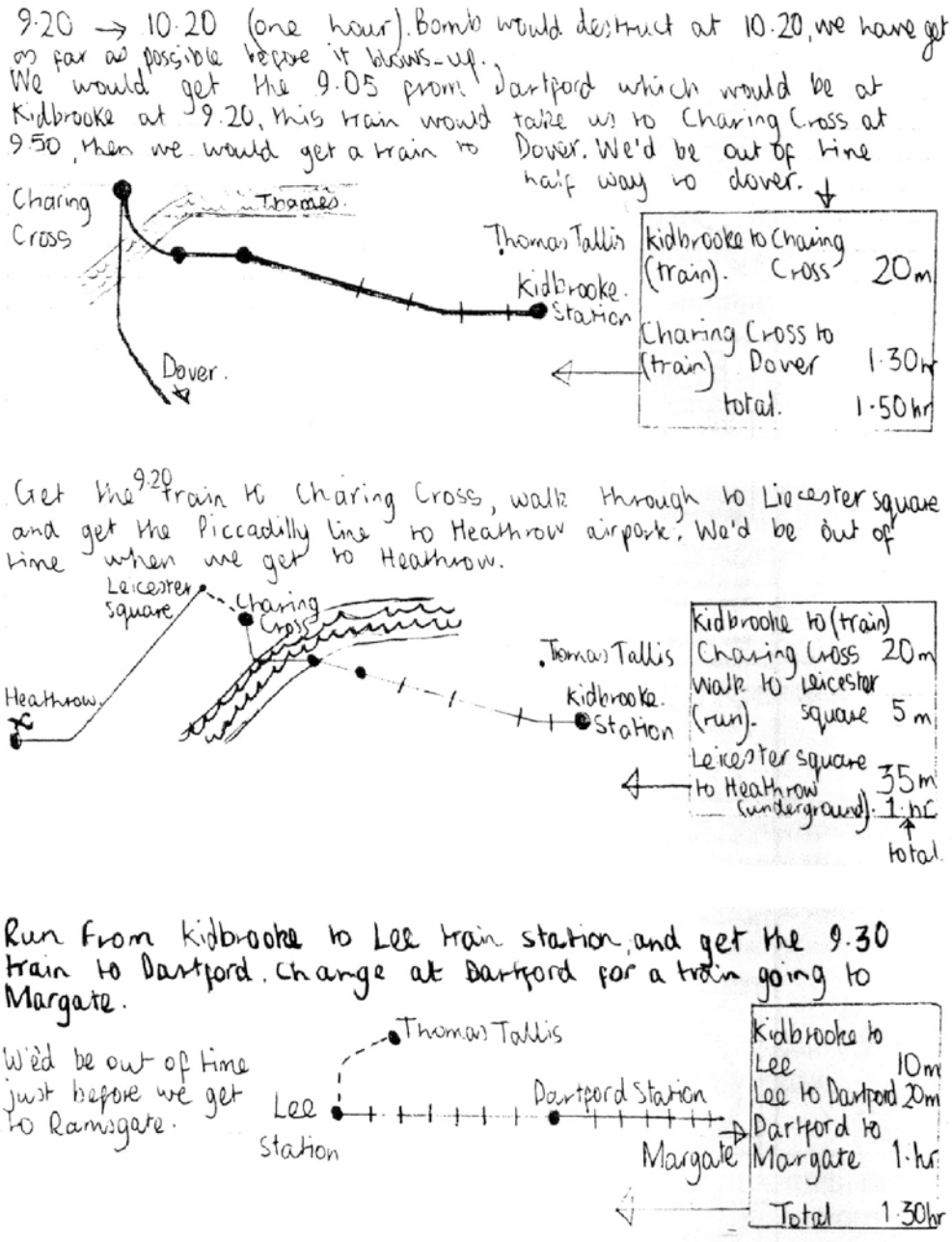
In this example, pupils working as a small group have used a map to find the distance covered by a route clearly planned on public transport. Their initial connection with the train seems very tight, but there follows a 14-minute wait for another train.



Feedback

- To make further progress, the group might be encouraged to plan and evaluate alternative journeys that may use the time more effectively.

Group C

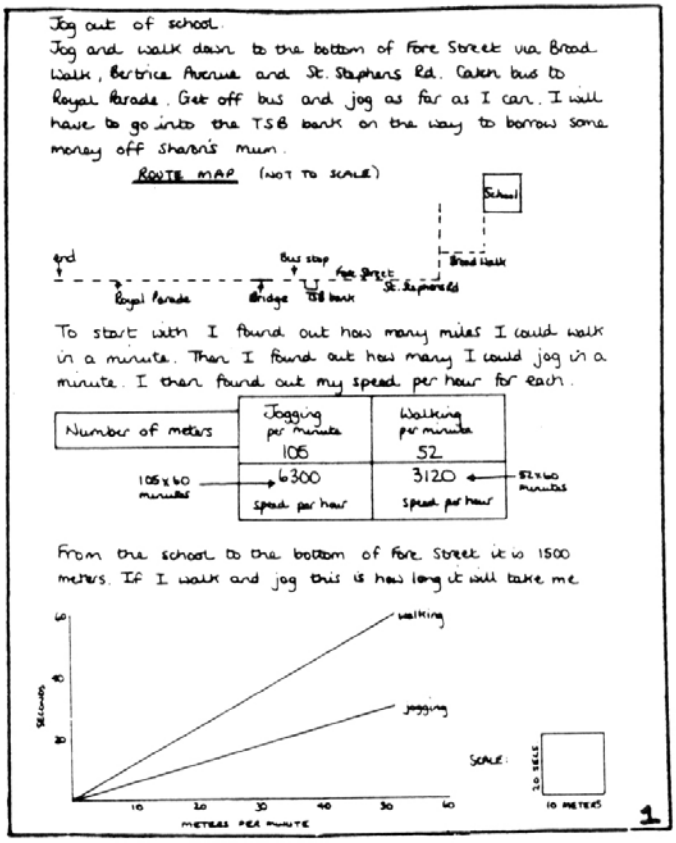


These pupils consider three different routes, presumably chosen because they offer options for leaving Britain. For each, they give a 'map' and summarise their findings using time, recognising that they cannot attain their destinations in the time available. Distances are implied, but are not explicit.

Probing question

- So how far would you get in one hour on each of the journeys you have explored?

Pupil D



Jog out of school.
Jog and walk down to the bottom of Fore Street via Broad Walk, Bertrice Avenue and St. Stephens Rd. Catch bus to Royal Parade. Get off bus and jog as far as I can. I will have to go into the TSB bank on the way to borrow some money off Sharni's mum.

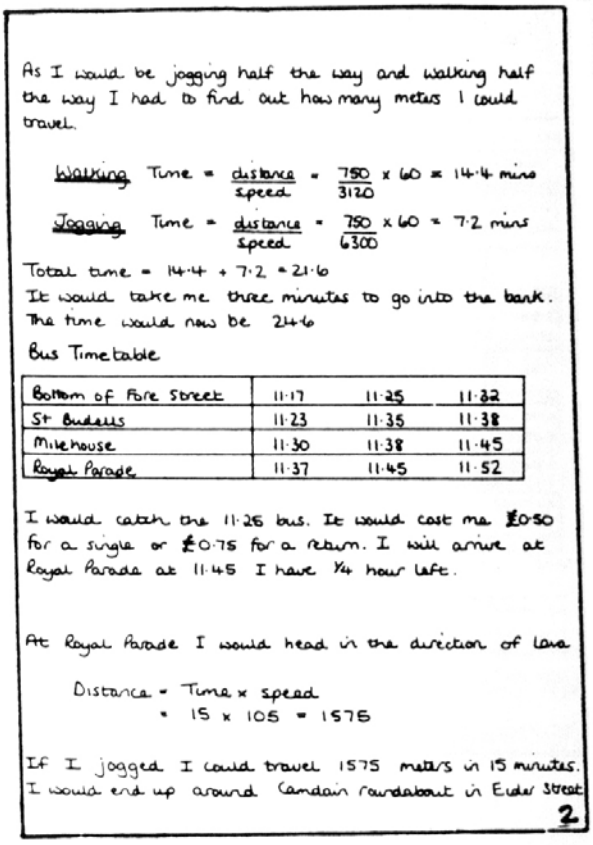
ROUTE MAP (NOT TO SCALE)

To start with I found out how many miles I could walk in a minute. Then I found out how many I could jog in a minute. I then found out my speed per hour for each.

Number of meters	Jogging per minute	Walking per minute
	105	52
105 x 60 minutes →	6300 speed per hour	3120 speed per hour ← 52 x 60 minutes

From the school to the bottom of Fore Street it is 1500 meters. If I walk and jog this is how long it will take me.

1



As I would be jogging half the way and walking half the way I had to find out how many meters I could travel.

Walking Time = distance / speed = 750 / 3120 x 60 = 14.4 mins

Jogging Time = distance / speed = 750 / 6300 x 60 = 7.2 mins

Total time = 14.4 + 7.2 = 21.6
It would take me three minutes to go into the bank.
The time would now be 21.6

Bus Timetable

Bottom of Fore Street	11.17	11.25	11.32
St Budeaux	11.23	11.35	11.38
Milehouse	11.30	11.38	11.45
Royal Parade	11.37	11.45	11.52

I would catch the 11.25 bus. It would cost me £0.50 for a single or £0.75 for a return. I will arrive at Royal Parade at 11.45 I have ¼ hour left.

At Royal Parade I would head in the direction of Lava

Distance = Time x speed
= 15 x 105 = 1575

If I jogged I could travel 1575 meters in 15 minutes. I would end up around Camdain roundabout in Elder Street

2

This pupil has planned a coherent journey using three modes of transport, and illustrates the journey with a clear route map. Calculations using the relationship between time, distance and speed for the first part of the journey are shown, although the graph has errors and limited utility.

While an end destination is given, the total distance travelled is unknown since the distance by bus is not quantified. However, communication is clear with events sequenced and calculations shown.

Probing questions

- How far have you travelled in total?
- Do you feel you have completed the task?
- Is there an alternative route? If so, might it take you further?

Group E's work

We looked at different ways.

Walk	Too slow
Run	We would be tired and it is too slow
Bike	We have only one bike between us!
Bus	Stops too many places
Trains	Newbury has a good station so we will investigate trains
Car	Our parents will take us so we will investigate this too
Plane	We need to get to Heathrow so we will see if this is possible

Trains

The train from Newbury to Paddington leaves at 11:13 so we would waste 13 minutes. We tried going in the other direction but that was at 11: 12.

Newbury to Paddington is 1 hour and 13 minutes so we looked at Slough but that was 12:09 so we would be close to Slough when the hour was up. We used the map and Slough is about 32 miles away so we think we could get about 28 miles away in one hour if we go by train.

Car

Newbury is near the motorway so we can get on that quickly. We asked our parents and they said it would take about 5 minutes to join the motorway so we will have 55 minutes on the M4. We wouldn't go into London because there is too much traffic and we might get in a traffic jam so we are going to Bristol. The speed limit is 70 miles per hour and we don't want to get arrested and lose time so we will go at 70 miles in 60 minutes which is 64 miles in 55 minutes. We estimated on the map that that was farther than Bristol, about Clevedon.

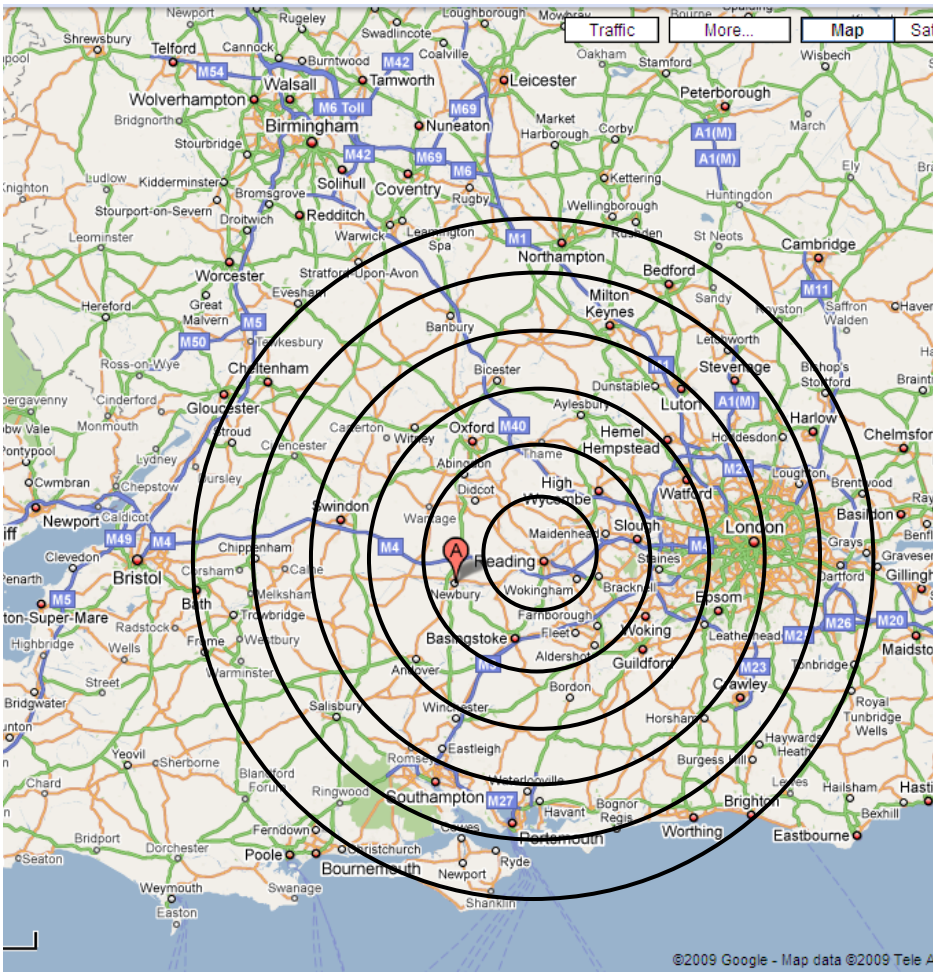
Plane

We can't get to Heathrow in one hour so we looked at Southampton. Newbury to the M3 is about 20 miles. At 60 miles per hour that is 20 minutes. Then it is about another 20 minutes to the airport. If we tell them we are sponsored they might let us fly quickly and leave in 5 minutes. That gives us 15 minutes flying. We tried to find out how fast little planes can go but we couldn't find it so we estimate that they go twice as fast as cars so that is 140 miles per hour which means we can get 35 miles away in the air altogether that is 20 + 25 +35 = about 80 miles .

Conclusion: we can go further by car and air but if we have to pay it would be better to go by car only as there is not much different.

[See Group E's map on the next page]

Group E continued



These pupils consider a wide range of options, from which they select a few to research, justifying their selection.

They use proportional reasoning to find speeds, and use their map to estimate places reached.

They communicate effectively, recognising the approximations involved, and reach a clear conclusion which is tempered by other factors, including cost.

Probing questions and feedback

- How realistic is it to get on a flight in 5 minutes and to consider flying for 15 minutes in a plane? What variants could you consider?
- The pupils have shown their ability to consider various factors and would benefit from working on one of the extensions (see page 3 of these notes).