



Developing **number**

Optional Skills Assessment Materials

Dinasfawr



Optional Skills Assessment Materials

Developing number

Audience	Teachers at Key Stage 2, in particular those with Year 5 classes; local authorities; tutors in initial teacher training; and others with an interest in education.
Overview	These new materials support learning, teaching and assessment of learners' skills in Year 5. They are designed to assist schools in implementing the revised school curriculum and its frameworks.
Action required	Schools' senior managers and local authority advisers are requested to raise awareness of these new materials within their schools, and to encourage teachers to use the materials to support their focus on developing learners' skills.
Further information	Enquiries about this document should be directed to: Curriculum and Assessment Division Department for Children, Education, Lifelong Learning and Skills Welsh Assembly Government Cathays Park Cardiff CF10 3NQ Tel: 0800 083 6003 e-mail: C&A3-14.C&A3-14@wales.gsi.gov.uk
Additional copies	Can be obtained from: Tel: 0845 603 1108 (English medium) 0870 242 3206 (Welsh medium) Fax: 01767 375920 e-mail: dcells1@prolog.uk.com Or by visiting the Welsh Assembly Government's website www.wales.gov.uk/educationandskills
Related documents	<i>Optional Skills Assessment Materials for Year 5 – An overview;</i> <i>Optional Skills Assessment Materials: Developing communication;</i> <i>Optional Skills Assessment Materials: Developing thinking</i> (Welsh Assembly Government, 2009) These materials are also available in Welsh.

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Overview

Three related activities based around the theme of a fictitious bus company are provided:

- **Activity 1: Plan a route**
- **Activity 2: Timetables**
- **Activity 3: Fares please**

In Activity 1, learners use a map in order to plan and record a bus route around the fictitious city of Dinasfawr. Learners are then asked to plan two further bus routes around other areas of the city, refining the methods they used for their first bus route.

In Activity 2, learners extract information from a given bus timetable in order to complete a timetable for another route. They are then asked to construct a timetable for the bus route they planned during Activity 1. Finally, learners plan a full day's timetable for their bus route, considering the factors that affect bus timetables during a typical day.

In Activity 3, learners extract information from a table of bus fares in order to carry out calculations of different fares. Learners are then asked to construct a table of fares for the bus route they planned during Activity 1, taking into consideration some of the factors that might affect these bus fares.

These activities are not timed assessment tasks, so you should feel free to adapt the materials provided to suit the needs of your learners.

The timings given at the beginning of each activity are suggestions. Some activities may take less time, while others may take considerably more. This will depend on the routes learners take and their interest in the activity itself.



Learner groupings

To promote collaborative learning, most activities are best undertaken by groups or pairs of learners who should be encouraged to share and discuss their ideas. At appropriate times, these groups could come together to present and compare their findings and the methods they use.

At other times, you may wish learners to work individually to provide evidence of their knowledge and skills. Consequently, the worksheets that accompany the activities can be used with groups, pairs or individuals as you consider appropriate.

Links to the skills framework

As learners engage with these materials they will generate evidence that contributes to their individual skills profile.

The 'Developing number across the curriculum' section of the skills framework has three main elements: **Use mathematical information**, **Calculate** and **Interpret and present findings**, with each of these sub-divided into a further two or three strands. These strands are referred to as 'principles' in the skills framework and are shown below.

Use mathematical information

- Using numbers
- Measuring
- Gathering information

Calculate

- Using the number system
- Using a variety of methods

Interpret and present findings

- Talking about and explaining work
- Comparing data
- Recording and interpreting data and presenting findings

Each principle contains six cells that correspond to stages in the development of the related skill. For example, the six cells identified in the **Gathering information** principle are shown below.

Evidence generated by the activities can be linked with cells to provide an indication of an individual learner's progress in the related skill area.

However, when doing this you should bear in mind the following points:

- The evidence generated by the activities will be a small part of the overall evidence that is available to you.
- Much evidence will be generated during other day-to-day learning and teaching; significant elements of this should also contribute to the learner's skills profile.
- The evidence generated by any activity is likely to contribute to a variety of principles and cells.

This final point is of particular importance when you review the **What to look for** section included with each of the activities.

These sections are designed to make evidence gathering more manageable by deliberately focusing on just two or three of the eight principles. However, this means that only some of the evidence that emerges is being considered.

As your familiarity with each of the activities increases, you may find that you are able to incorporate more of the available evidence into a variety of other principles and/or cells.

Count a small number of objects.	Collect data systematically by counting and by measuring. Read, understand and extract data presented in lists, tables, charts, simple graphs and diagrams.	Gather information in a variety of ways, including from questionnaires or databases. Choose data from given information presented in a variety of numerical and graphical ways.	Recognise the difference between, and the implications for, gathering discrete and continuous data. Access and choose data from information presented in a variety of ways and from different sources.	Get relevant information from different sources, including written and graphical material, and first hand by measuring or observing.	Choose how to obtain relevant information from different sources.
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Links to the curriculum

Geography

Skills: Locating places, environments and patterns

1. identify and locate places and environments using globes, atlases and maps
2. follow directions, estimate and calculate distances

English (Oracy)

Skills:

3. communicate clearly and confidently, expressing opinions, adapting talk to audience and purpose, using appropriate gesture, intonation and register in order to engage the listener
4. develop their awareness of the social conventions of conversation and discussion

Mathematics

Skills: 1. Solve mathematical problems

- develop their own mathematical strategies and ideas and consider those of others
- use flexible and effective methods of computation and recording

Mathematics

Skills: 2. Communicate mathematically

- devise and refine their own ways of recording
- explain strategies, methods, choices and conclusions to others in a variety of ways – verbally, graphically, using informal written methods

PSE

Skills: Developing communication

- listen carefully, question and respond to others

PSE

Skills: Working with others

- work cooperatively to solve problems

Activity 1: Plan a route



Links to the skills framework

In order to make evidence gathering more manageable, it is suggested that you concentrate initially on each of the principles shown as a main focus in the table below.

Use mathematical information

- Using numbers
- Measuring
- Gathering information

Calculate

- Using the number system
- Using a variety of methods

Interpret and present findings

- Talking about and explaining work
- Comparing data
- Recording and interpreting data and presenting findings

Key

- Main focus ● Incidental focus
- No intentional focus

Context

This activity is in two parts. Consequently, you may wish to spread it over two or more sessions.

In the first part of the activity, learners use a map in order to demonstrate their number and/or geographical skills. Learners are likely to consider using co-ordinates, directions, symbols and scale.

In the second part of the activity, learners use a map in order to plan and record a bus route around the fictitious city of Dinasfawr. While some learners may record their route using a list of bus stops or directional instructions involving left and right turns, others may use a more sophisticated approach involving compass points, co-ordinates and distances.

If appropriate, some learners can also be challenged to plan other bus routes around Dinasfawr.

Resources

A map and one activity sheet are provided.

For this activity, each group of learners will require a copy of the map.

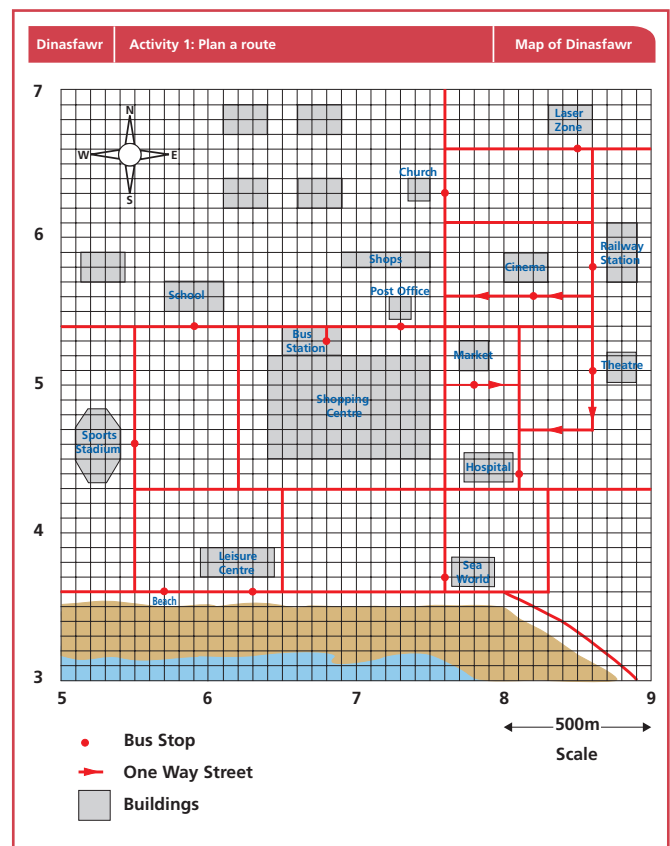
For the second part of the activity, each group of learners will also need a copy of the activity sheet.

The **What to look for** section at the end of this activity provides an indication of some of the evidence that you might expect and the cells with which this evidence might be matched. However, it is important to appreciate that a range of other evidence may also be generated and that this may be more validly associated with other principles and/or cells.

Activity 1 | Plan a route

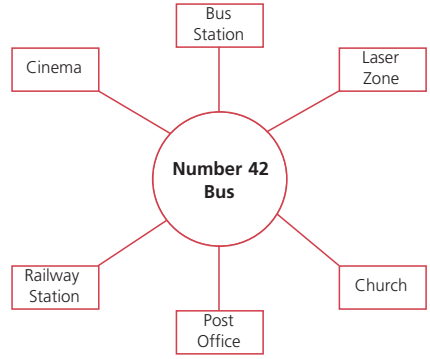
Developing the activity (part 1)

- Display a copy of the map of Dinasfawr on the whiteboard and/or distribute a copy to each group of learners.
- Stimulate whole-class discussion and thinking by asking questions such as:
 - What do you think the sheet shows?
 - How do you know that this is a map?
 - Why are there numbers around the map?
 - What does the diagram (compass) in the top left-hand corner show?
 - How can we identify the bus stops?
 - What is the scale of the map?
- As learners provide answers to questions, it may be appropriate to use the map to demonstrate how these answers were obtained.
- Focus attention on specific skills in order to gather evidence of learners' abilities, e.g:
 - What building is west of Sea World?
 - What are the co-ordinates of the bus stop at the Sports Stadium?
 - What is the distance between the Beach bus stop and the Leisure Centre bus stop?
- As learners provide feedback, encourage other learners to comment and/or ask further questions.
- Less confident learners might be encouraged to write their questions on sticky notes. You or another group member can then read the questions to the rest of the class.



Developing the activity (part 2)

- Distribute a copy of the activity sheet to each group. Explain to learners that they are going to plan a route for the Number 42 Bus around an area of Dinasfawr.
- Stimulate whole-class discussion and thinking by asking questions such as:
 - Have you ever taken a bus ride around a large town?
 - How does the bus driver know where to stop?
 - How does the bus driver know which way to go?
- Encourage learners to record their route using any method they wish.
- Careful observation of learners as they work will provide opportunities for gathering evidence relating to thinking, communication and number skills.
- Allow adequate time for the group to engage with the task, before bringing them together to share and compare their ideas.
- Selecting particular learners and asking appropriate questions, e.g. 'How did you measure the distances between stops?' or 'How did you show a change in direction?', will allow you to gather further evidence.
- Following the reporting back session, you may wish to allow further time for learners to follow up the ideas discussed.

Dinasfawr	Activity 1: Plan a route	Activity sheet
You are in charge of the Dinasfawr Bus Company.  This diagram shows the places the Number 42 Bus visits.  <pre> graph TD Cinema --- Bus((Number 42 Bus)) BusStation[Bus Station] --- Bus LaserZone[Laser Zone] --- Bus Church --- Bus PostOffice[Post Office] --- Bus RailwayStation[Railway Station] --- Bus </pre> • Look at the map of Dinasfawr. • Plan a route for the bus to follow. The route should start and end at the bus station. • Record your route.		

Activity 1 | Plan a route

Developing the activity (a further challenge)

- If appropriate, some learners can be challenged to plan further routes around other areas of Dinasfawr.
- Before they begin, encourage learners to discuss some factors that might influence the planning of their new routes, e.g:
 - Which places would passengers like to visit?
 - Where are the buses likely to pick up most passengers?
 - Should the routes include all bus stops?
 - Are shorter routes better than longer routes?
 - Should all routes start and end at the same place?
- Ask learners to study the map of Dinasfawr carefully and to think about the most appropriate routes.
- Allow adequate time for the groups to plan their routes, before bringing them together to share and compare their ideas.
- Selecting particular learners to report back will provide further opportunities for you to gather specific evidence about individuals.
- After the learners have discussed their routes, it may be appropriate to allow them to refine their first attempts, taking into consideration the improvements suggested by their classmates.

An example of classroom practice

The teacher gave the learners ample time to discuss the map before attempting the activity sheet. Learners were encouraged to ask and answer questions about the map's features, as well as discussing distance, direction, scale and co-ordinates.

Each group then focussed on the task, planning and recording their bus route collaboratively, with little further input from the teacher.

Initially, Group A produced the diagram shown in the illustration opposite.

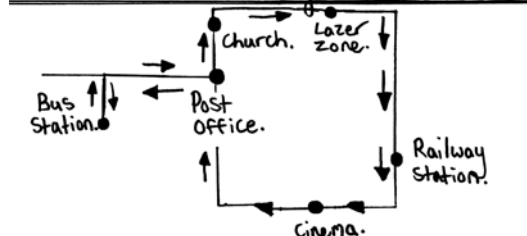
Following further discussion amongst the group, the learners identified some inaccuracies in their diagram and decided to replace it with a list of written directions.

After working for fifteen or twenty minutes, the groups were asked to report back to the rest of the class, describing the approaches they had used and any problems they had experienced.

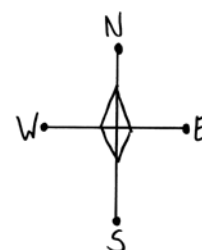
Learners were encouraged to comment on each group's efforts and to offer suggestions for improvements.

Group A

Here is the route I designed.



North, turn East, arrive at the post office. Carry on going East, turn North, arrive at the Church. Carry on going North, turn East and carry on. Arrive at the Lazer Zone. Turn South, arrive at the railway station. Carry on going, turn West, arrive at the cinema. Carry on going, turn South, carry on for a short while, turn West, go past the post office, carry on going, turn South, arrive back at the bus station.



During these discussions, it was pointed out to Group A that, although they had given precise directions for the bus route, they had omitted any reference to distance.

Group A agreed that their work could be improved by adding distances, but said that they found it 'tricky to remember everything' while working.

Group B, on the other hand, used compass directions in conjunction with the distances travelled, to produce a comprehensive set of instructions that described their route accurately.

Group B

Turn east from Bus Station.
Go forward 250m to get to post office and
Go forward 150m and turn North and then ^{stop}
go 450m and stop at church
Carry on North 150m
Turn east and go 450m and stop at laser zone
Go forward 50m
Turn south and drive 400m to railway station
and stop
Carry on South for 100m
Turn West and go 200m to cinema
Carry on forward 300m
Turn South and drive 100m to crossroads,
carry on 550m to other crossroads
Turn West and go 700m then go North 550m
Turn east and go 300m and stop at
Bus Station.

However, this group had chosen to plan a route that took the bus around the Shopping Centre before arriving back at the Bus Station. They explained that they had not realised that they were allowed to travel down the same road twice and accepted that their route was longer than the routes planned by other groups.

The activity had been undertaken enthusiastically by the learners and all groups said that they would like to have the opportunity of 'having another go' so that they could improve on their first attempt at planning a bus route.

Discussion had been lively throughout and the teacher felt that she had been able to gather a great deal of evidence that would contribute to learners' skills profiles.

The different approaches adopted by learners and the different outcomes produced by the groups provided some indication of their grasp of the underlying number skills.

However, as the teacher was not always confident that all group members were secure in their understanding, she used sensitive questioning of individual learners to gain a clearer picture of their contribution to the group outcome.

Activity 1 | Plan a route

What some teachers said about the activity

This activity could be undertaken by mixed or same ability pairs or groups equally successfully, as it generated lots of discussion and is accessible on many different levels.

This would fit very well into an upper junior geography scheme of work.

A discussion with the children following this activity elicited very positive remarks and they enjoyed this activity greatly.

The groups liked the map and quickly recognised it as a coastal town.

The activity encouraged meaningful discussion amongst the learners and gave opportunities to assess language skills.

Lots of mathematical language was used during the pupils' discussions.

What to look for

Gathering information

When considering the map of Dinasfawr and attempting to plan their bus routes, are learners able to:

- demonstrate some understanding of the information given, e.g. by identifying various landmarks and bus stops (Cell 1)
- read, extract and interpret the information given (Cell 2)
- relate the information given on the map to the task presented on the activity sheet in order to produce an appropriate route (Cell 3)
- choose from the information available in order to produce another bus route (Cell 4)?

Recording and interpreting data and presenting findings

When presenting their bus routes, are learners able to:

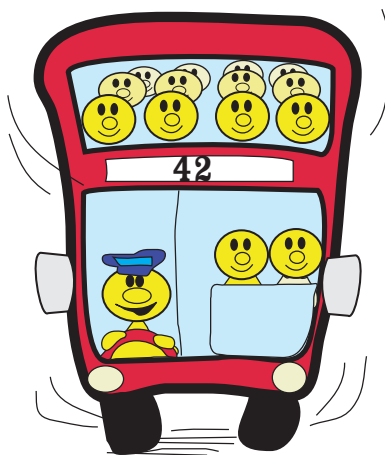
- use simple lists, tables or diagrams (Cell 2)
- use more sophisticated methods, e.g. by using four-figure references, compass directions and/or distances (Cell 3)?

Talking about and explaining work

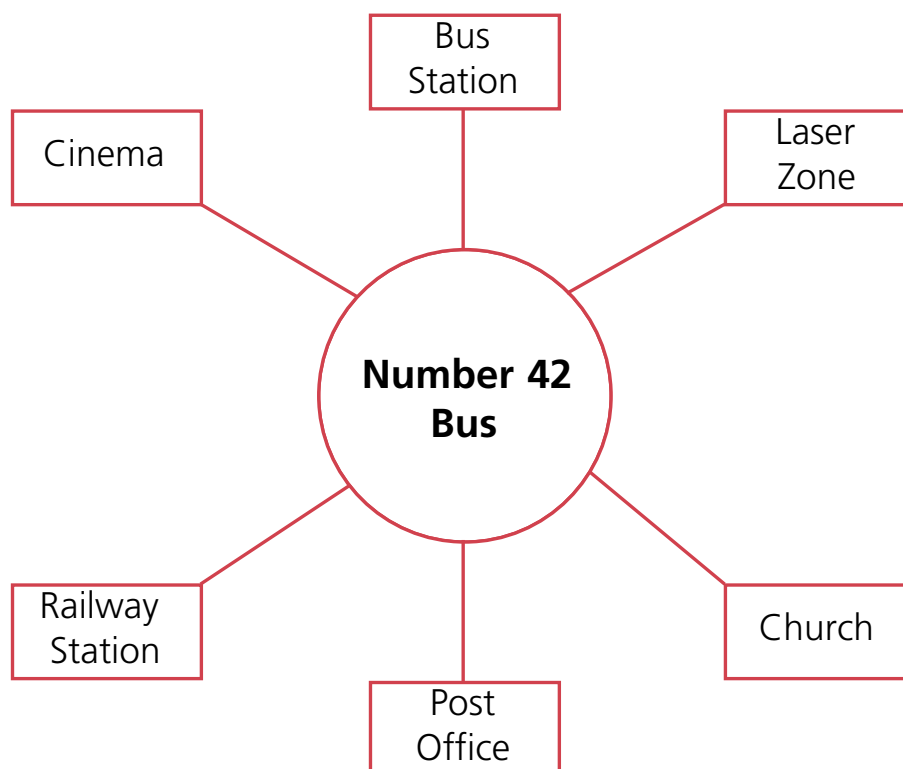
When considering the map of Dinasfawr, discussing their bus routes and/or reporting back, are learners able to:

- talk about what they have done, showing some awareness of the task and the information that is needed for its solution (Cell 1)
- use the language of number, shape and comparatives, e.g. when putting the bus stops in order, discussing directions (left, right, up, down) and/or comparing distances (Cell 2)
- use the language of position (including co-ordinates and compass points), movement and measures when talking about their work (Cell 3)?

You are in charge of the Dinasfawr Bus Company.



This diagram shows the places the Number 42 Bus visits.



- Look at the map of Dinasfawr.
- Plan a route for the bus to follow.
The route should start and end at the bus station.

- Record your route.

Activity 2: Timetables



Links to the skills framework

In order to make evidence gathering more manageable, it is suggested that you concentrate initially on each of the principles shown as a main focus in the table below.

Use mathematical information

- Using numbers
- Measuring
- Gathering information

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Key

- Main focus ● Incidental focus
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The **What to look for** section at the end of this activity provides an indication of some of the evidence that you might expect and the cells with which this evidence might be matched. However, it is important to appreciate that a range of other evidence may also be generated and that this may be more validly associated with other principles and/or cells.

Context

This activity is in two parts. Consequently, you may wish to spread it over two or more sessions.

In the first part of the activity, learners use information from a given timetable to complete a second timetable in which buses travel in the opposite direction around the same route. This provides opportunities for learners to read, understand and extract data and to carry out simple calculations involving time.

In the second part of the activity, learners are encouraged to consider some of the factors that affect bus timetables and to construct their own timetable for the route they planned during Activity 1. If appropriate, some learners can also be challenged to plan a full day's timetable for their bus route.

Resources

One worksheet, one discussion sheet and one activity sheet are provided.

For the first part of the activity, each group of learners will require a copy of the worksheet.

For the second part of the activity, each group of learners will require a copy of the discussion sheet, a copy of the activity sheet and a copy of the map used in Activity 1.

You may wish to provide learners with actual bus timetables as an additional resource. Alternatively, you could use the internet to display examples on the interactive whiteboard.

Activity 2 | Timetables

Developing the activity (part 1)

- Introduce the activity by discussing the notion of a timetable.
- Stimulate whole-class discussion and thinking by asking questions such as:
 - Does the school have a timetable?
 - What is shown on the school timetable?
 - Where else are timetables used?
 - Why are timetables important?
- As learners provide feedback, encourage other learners to comment and/or ask further questions.
- Distribute a copy of the worksheet to each group, pair or individual as you consider appropriate.
- Familiarise learners with the worksheet by asking questions to ascertain their understanding, such as:
 - What time does the Number 100 Bus leave the Leisure Centre?
 - How long does the bus take to travel from the Beach to Sea World?
- Ask learners to complete the timetable for the Number 101 Bus.
- Careful observation of learners as they work will provide opportunities for gathering evidence relating to thinking, communication and number skills.
- Allow adequate time for groups to engage with the task before bringing them back together to explain how they worked out their times.
- Selecting particular learners to report back will provide further opportunities for you to gather specific evidence about individuals.

Dinasfawr	Activity 2: Timetables	Worksheet
Name(s):		
Here is a timetable for the Number 100 Bus.		
Dinasfawr Bus Company	Number 100	
	Bus Station/Beach/Bus Station	
Bus Station		8:30
School		8:33
Sports Stadium		8:36
Beach		8:39
Leisure Centre		8:41
Sea World		8:45
Post Office		8:50
Bus Station		8:52
The Number 101 Bus travels in the opposite direction. Complete the timetable for the Number 101 Bus.		
Dinasfawr Bus Company	Number 101	
	Bus Station/Sea World/Bus Station	
Bus Station		9:00
Post Office		
.....		9:07
.....		
Beach		9:13
Sports Stadium		
.....		
Bus Station		9:22
Explain how you worked out the times.		

An example of classroom practice

Having discussed different timetables with the learners, the teacher distributed the worksheet and asked each group to work out the times for the Number 101 Bus.

After working for five to 10 minutes, the groups were asked to share their results with the rest of the class and to discuss how they had found their answers.

Group A had written answers that were approximately equally spaced between the given times, whilst Group B had reversed the time increments shown on the timetable for the Number 100 Bus. These differences caused some heated discussion, with Group B insisting that their results were correct.

However, a member of Group A pointed out that the bus did not necessarily have to take the same time if it was travelling in the opposite direction. There might be problems with traffic or road works that would cause delays between some stops.

Group B then conceded that this might be possible and were happy to accept that both sets of answers were 'correct'.

Reflecting on the activity, one teacher reported that:

I found this worksheet to be a good teaching tool. Once it had been completed, the learners and I discussed the different factors that might affect the time the bus would take to travel along the route.

Group A

Dinasfawr Bus Company	Number 101 Bus Station/Sea World/Bus Station
Bus Station	9:00
Post Office	<u>9:03</u>
<u>Sea World</u>	9:07
<u>Leisure Centre</u>	<u>9:10</u>
Beach	9:13
Sports Stadium	<u>9:16</u>
<u>School</u>	<u>9:19</u>
Bus Station	9:22

Group B

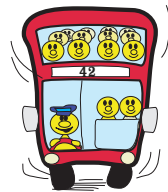
Dinasfawr Bus Company	Number 101 Bus Station/Sea World/Bus Station
Bus Station	9:00
Post Office	<u>9:02</u>
<u>Sea World</u>	9:07
<u>Leisure Centre</u>	<u>9:11</u>
Beach	9:13
Sports Stadium	<u>9:16</u>
<u>School</u>	<u>9:19</u>
Bus Station	9:22

Activity 2 | Timetables

Developing the activity (part 2)

- Display a copy of the discussion sheet on the whiteboard and/or distribute a copy to each group of learners.
- Ask learners to discuss the factors that affect bus timetables and to record some of their ideas on the discussion sheet.
- Careful observation of learners as they work will provide opportunities for gathering evidence relating to thinking, communication and number skills.
- Allow adequate time for groups to engage with the task, before bringing them back together to share and compare their ideas.
- Next, display a copy of the activity sheet on the whiteboard and/or distribute a copy of the activity sheet and the map of Dinasfawr to each group.
- You may wish to remind learners that the Number 42 Bus route was the one they considered in the previous activity.
- Stimulate whole-class discussion and thinking by asking questions such as:
 - How many minutes are there between the times the Number 42 leaves the first two stops?
 - Can you use the map to explain how these times are worked out?
 - Why do we need to allow at least one minute at each of the bus stops?
- Ask learners to work in groups to plan out the remainder of the timetable. Explain that they should consider the information given on the activity sheet and use the route they planned in Activity 1.
- For example, the first two bus stops (the Bus Station and Post Office) are 300 metres apart. As the bus takes 10 seconds to travel 50 metres, it will take one minute to travel 300 metres. Another minute is added to allow passengers to get on or off the bus.

Dinasfawr	Activity 2: Timetables	Discussion sheet
What things affect bus timetables?  Nadia There will be a lot of people getting on and off at the railway station.  Ethan The bus might have to stop at traffic lights.  Alun The bus will have to slow down when it gets to a bus stop. Write some other things that you think will affect bus timetables.		

Dinasfawr	Activity 2: Timetables	Activity sheet								
The first Number 42 Bus leaves the bus station at nine o'clock.  Work out a timetable for this bus to follow. Use the route you planned in Activity 1. <table border="1" style="width: 100%;"> <thead> <tr> <th>Dinasfawr Bus Company</th> <th>Number 42 Bus Station/Railway Station/Bus Station</th> </tr> </thead> <tbody> <tr> <td>Bus Station</td> <td>9:00</td> </tr> <tr> <td>Post Office</td> <td>9:02</td> </tr> <tr> <td>Church</td> <td></td> </tr> </tbody> </table> Some things to think about: • On busy roads the bus takes about 10 seconds to travel 50 metres. • Passengers need at least 1 minute to get on and off the bus. • Times are usually shown in hours and minutes. Explain how you worked out the times.			Dinasfawr Bus Company	Number 42 Bus Station/Railway Station/Bus Station	Bus Station	9:00	Post Office	9:02	Church	
Dinasfawr Bus Company	Number 42 Bus Station/Railway Station/Bus Station									
Bus Station	9:00									
Post Office	9:02									
Church										

- Careful observation of learners as they work will provide opportunities for gathering evidence relating to thinking, communication and number skills.
- Allow adequate time for groups to engage with the task, before bringing them together to share and compare their ideas.
- Selecting particular learners and asking appropriate questions, e.g. 'How did you work out the times between your bus stops?' or 'Did you give your passengers enough time to get on or off the bus?', will allow you to gather further evidence.
- Following the reporting back session you may wish to allow further time for learners to follow-up the ideas discussed.
- Careful observation of learners as they work will provide opportunities for gathering evidence relating to thinking, communication and number skills.
- Allow adequate time for groups to engage with the task, before bringing them back together to share and compare their ideas.
- Selecting particular learners to report back will provide further opportunities for you to gather specific evidence about individuals.
- Following the reporting back session, you may wish to allow further time for learners to follow up the ideas discussed.

Developing the activity (a further challenge)

- If appropriate, some learners can be challenged to plan a full day's timetable for the Number 42 Bus.
- If possible, show learners some actual examples of bus timetables and stimulate whole-class discussion and thinking by asking questions such as:
 - How many times a day do you think the Number 42 should run? Why?
 - What should be the earliest and the latest times?
 - Do you think that the same journey would always take the same time? Why do you think this?
 - What things affect bus timetables?
- When constructing a full day's timetable, learners should be encouraged to take account of the factors they identified as affecting bus timetables in their earlier discussions.

Activity 2 | Timetables

An example of classroom practice

The session began with learners using the discussion sheet to brainstorm ideas on the factors that might affect the running of a bus at different times of the day.



The teacher then distributed the activity sheet and challenged the learners to draw up a timetable for the Number 42 Bus route they had planned earlier. Initially, learners were asked to concentrate on working out the times for the first bus journey of the day.

Each group spent some time re-acquainting themselves with the route they had planned earlier, using the map to discuss the comparative distances between stops and the amount of time it might take the bus to travel along the route.

It soon became apparent, however, that some learners were having problems understanding the scale of the map. They found it difficult to work out the distances and then use the information given on the activity sheet to convert these distances into the time the bus would take to travel between stops.

The teacher decided to reduce the demand of the activity for these learners by telling them that the length of one side of each square on the map represents 10 seconds of travelling time for the bus.

In addition, the teacher drew up a blank timetable, similar to the one shown opposite, on which learners could enter information. Learners were then able to complete this timetable successfully, counting 10-second increments on the map and rounding up their times to the nearest minute.

Dinasfaur Bus Company	Number 42
Bus Station	9:00
Post Office	9:02
Bus Station	

In a later session, the teacher challenged some groups of learners to plan a full day's timetable for the Number 42 Bus. Although learners did not always take account of all the factors that might affect bus journeys at different times of the day, they found the activity interesting and produced some excellent results as indicated opposite.

In this example, the group chose to start their timetable at 9:00a.m. and decided to terminate the bus at 5:56p.m. When asked, they admitted they had not allowed extra time for rush hour traffic or busy locations.

The group quickly recognised that the minutes repeated themselves every hour but decided to allow the driver to have a break between 11:56a.m. and 1:00p.m.

One learner confidently explained that her group had calculated the time between each stop by counting the squares and multiplying this number by 10. She explained that this would give the number of seconds, and to find out the minutes you divide by 60. After this you need to add an extra minute to the time to give the actual departure time of the bus. She said that they rounded any part minutes up to the next whole minute.

The group was also able to evaluate their own timetable and make sensible suggestions as to how they could improve it. They suggested that 20 seconds should be allowed for each 50 metres during the rush hour and that 90 seconds should be allowed for passengers to get on and off the bus at busy locations.

Daily timetable for number 42 bus

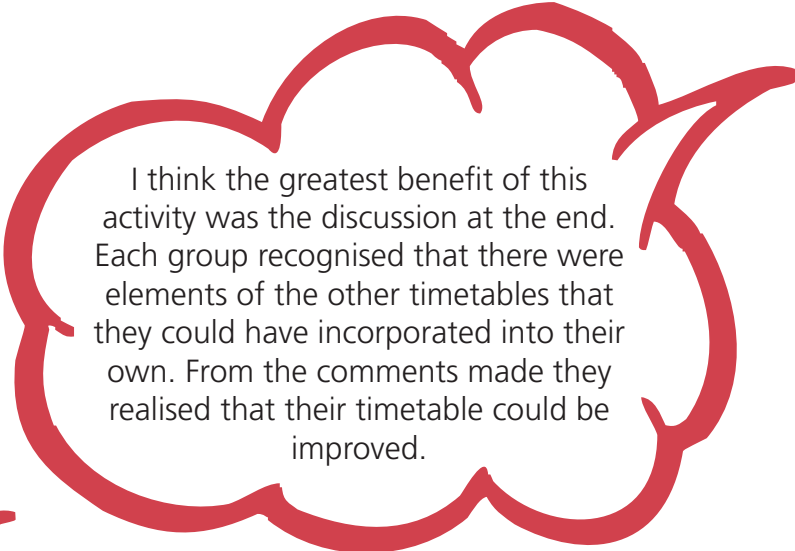
Dinasfawr Bus Company	SERVICE	NUMBER 42	RAILWAY STATION	Bus Station	Bus Station
D	Bus Station	9:00	9:20	9:40	10:00
	Post Office	9:02	9:22	9:42	10:02
	Church	9:05	9:25	9:45	10:05
	Laser Zone	9:08	9:28	9:48	10:08
	railway station	9:11	9:31	9:51	10:11
	Cinema	9:13	9:33	9:53	10:13
A	Bus Station	9:16	9:36	9:56	10:16
D		11:00	11:20	11:40	13:00
		11:02	11:22	11:42	13:02
		11:05	11:25	11:45	13:05
		11:08	11:28	11:48	13:08
		11:11	11:31	11:51	13:11
		11:13	11:33	11:53	13:13
A		11:16	11:36	11:56	13:16
D		14:00	14:20	14:40	15:00
		14:02	14:22	14:42	15:02
		14:05	14:25	14:45	15:05
		14:08	14:28	14:48	15:08
		14:11	14:31	14:51	15:11
		14:13	14:33	14:53	15:13
A		14:16	14:36	14:56	15:16
D		16:00	16:20	16:40	17:00
		16:02	16:22	16:42	17:02
		16:05	16:25	16:45	17:05
		16:08	16:28	16:48	17:08
		16:11	16:31	16:51	17:11
		16:13	16:33	16:53	17:13
A		16:16	16:36	16:56	17:16

Activity 2 | Timetables

What some teachers said about the activity



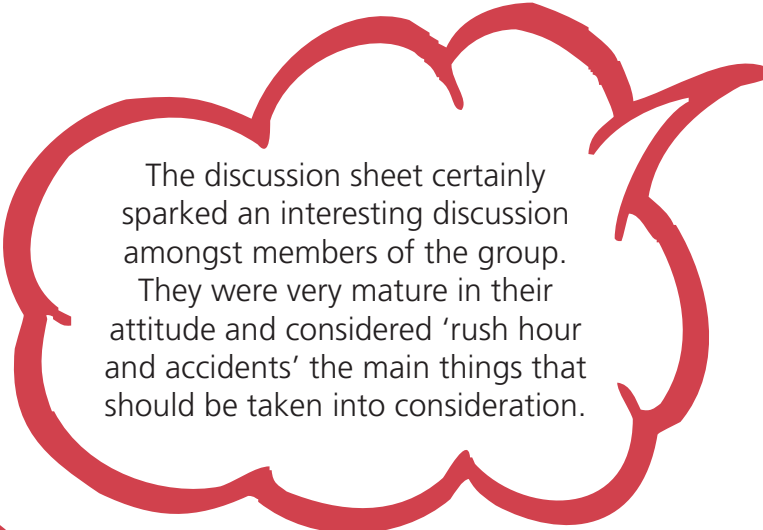
The learners very much enjoyed completing this activity.



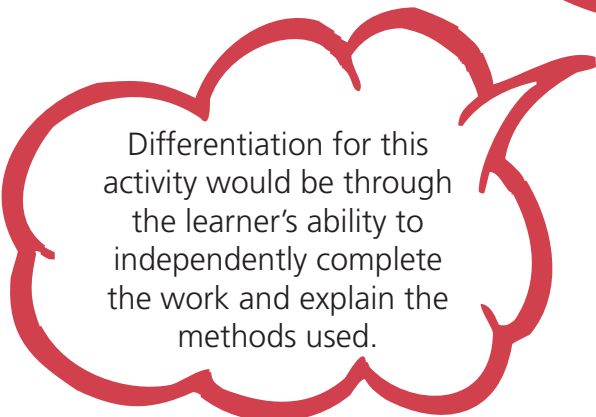
I think the greatest benefit of this activity was the discussion at the end. Each group recognised that there were elements of the other timetables that they could have incorporated into their own. From the comments made they realised that their timetable could be improved.



The activity was accessible to all learners and was greatly enjoyed.



The discussion sheet certainly sparked an interesting discussion amongst members of the group. They were very mature in their attitude and considered 'rush hour and accidents' the main things that should be taken into consideration.



Differentiation for this activity would be through the learner's ability to independently complete the work and explain the methods used.

What to look for

Gathering information

When discussing, reading and/or completing their timetables, are learners able to:

- demonstrate some understanding of the information shown, e.g. by identifying the time the bus leaves a bus stop (Cell 1)
- read, understand and extract the information given, e.g. when considering an actual timetable (Cell 2)
- read and interpret the scale of the map to work out distances between bus stops (Cell 3)
- access and choose data from the information presented on the activity sheet and on the map in order to work out a full-day's bus timetable (Cell 4)?

Using the number system

When discussing the activity and drawing up their timetables, are learners able to:

- choose the appropriate operations for solving addition and subtraction problems, e.g. by completing the timetable on the worksheet (Cell 2)
- recognise the number operations needed to solve problems, e.g. by calculating the times the bus takes to travel between stops and rounding up answers to the next minute (Cell 3)?

Talking about and explaining work

When discussing their timetables and/or the factors that affect bus timetables, are learners able to:

- talk about what they have done, showing an awareness of the need for the times to be listed chronologically on their timetable (Cell 1)
- use the language of number and the symbols for addition, subtraction, multiplication and division, e.g. when calculating distances and estimating times (Cell 2)
- use the language of position, movement and measures when talking about their work (Cell 3)?

Name(s):

Here is a timetable for the Number 100 Bus.

Dinasfawr Bus Company	Number 100 Bus Station/Beach/Bus Station
Bus Station	8:30
School	8:33
Sports Stadium	8:36
Beach	8:39
Leisure Centre	8:41
Sea World	8:45
Post Office	8:50
Bus Station	8:52

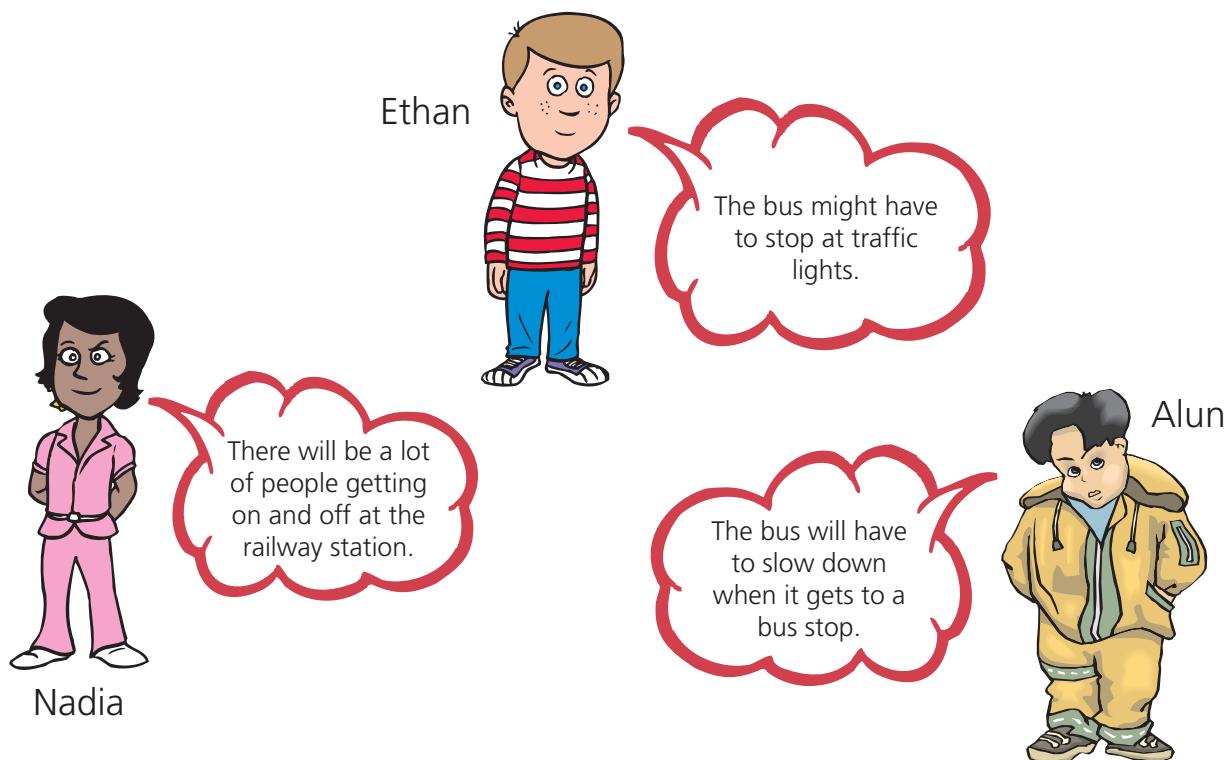
The Number 101 Bus travels in the opposite direction.

Complete the timetable for the Number 101 Bus.

Dinasfawr Bus Company	Number 101 Bus Station/Sea World/Bus Station
Bus Station	9:00
Post Office	
.....	9:07
.....	
Beach	9:13
Sports Stadium	
.....	
Bus Station	9:22

Explain how you worked out the times.

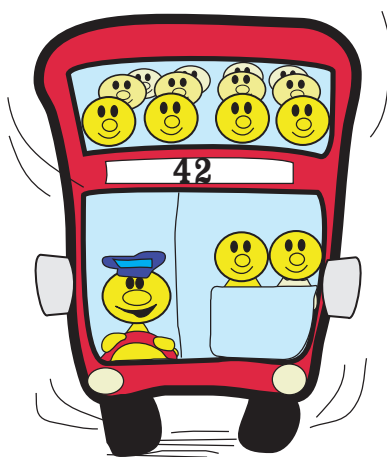
What things affect bus timetables?



Write some other things that you think will affect bus timetables.

Four large, red-outlined cloud shapes arranged in a 2x2 grid, intended for students to write their own ideas about factors affecting bus timetables.

The first Number 42 Bus leaves the bus station at nine o'clock.



Work out a timetable for this bus to follow.

Use the route you planned in Activity 1.

Dinasfawr Bus Company	Number 42 Bus Station/Railway Station/Bus Station
Bus Station	9:00
Post Office	9:02
Church	

Some things to think about:

- On busy roads the bus takes about 10 seconds to travel 50 metres.
- Passengers need at least 1 minute to get on and off the bus.
- Times are usually shown in hours and minutes.

Explain how you worked out the times.

Activity 3: Fares please



Links to the skills framework

In order to make evidence gathering more manageable, it is suggested that you concentrate initially on each of the principles shown as a main focus in the table below.

Use mathematical information

- Using numbers
- Measuring
- Gathering information

Calculate

- Using the number system
- Using a variety of methods

Interpret and present findings

- Talking about and explaining work
- Comparing data
- Recording and interpreting data and presenting findings

Key

- Main focus ● Incidental focus
- No intentional focus

Context

This activity is in two parts. Consequently, you may wish to spread it over two or more sessions.

In the first part of the activity, learners interpret a given fare structure in order to calculate different bus fares. This is developed into a practical activity where learners undertake numerous calculations whilst playing the 'Fares please' game. They are encouraged to discuss the methods they use and to check other learners' calculations for accuracy.

In the second part of the activity, learners are challenged to construct their own fare structure for the route they planned during Activity 1.

Resources

One worksheet, one activity sheet and a set of cut-out cards are provided.

For the first part of the activity, each group of learners will require a copy of the worksheet and a set of the cut-out cards.

For the second part of the activity, each group of learners will require a copy of the activity sheet and a copy of the map used in Activity 1.

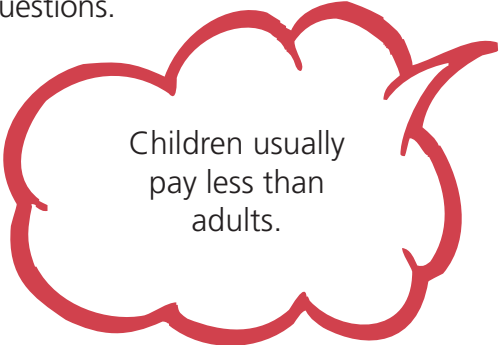
If you consider it appropriate, you may choose to provide calculators.

The **What to look for** section at the end of this activity provides an indication of some of the evidence that you might expect and the cells with which this evidence might be matched. However, it is important to appreciate that a range of other evidence may also be generated and that this may be more validly associated with other principles and/or cells.

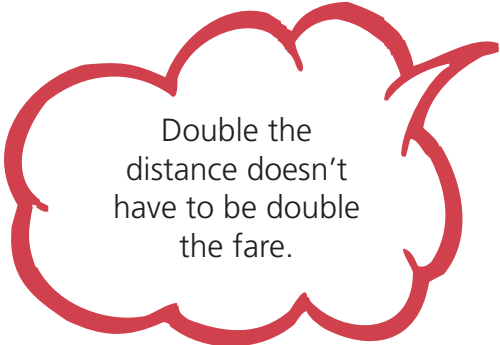
Activity 3 | Fares please

Developing the activity (part 1)

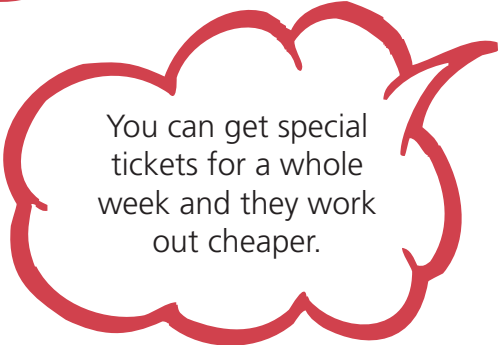
- Introduce the activity by asking learners to relate any experiences they may have had of taking a ride on a public bus service.
- Stimulate whole-class discussion and thinking by asking questions such as:
 - Can you remember the bus fare you were charged for the journey?
 - Were you accompanied on the bus by an adult?
 - Was the adult charged the same fare?
- As learners provide feedback, encourage other learners to comment and/or ask further questions.
- After the general introduction, ask learners to work in groups to discuss the factors that might affect bus fares.
- Allow adequate time for groups to engage with the task, before bringing them together to share and compare their ideas.
- Selecting particular learners to report back will provide further opportunities for you to gather specific evidence about individuals.



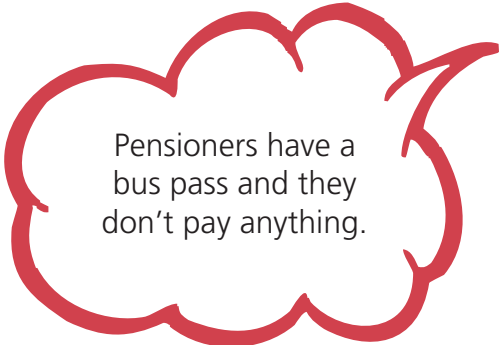
Children usually pay less than adults.



Double the distance doesn't have to be double the fare.



You can get special tickets for a whole week and they work out cheaper.



Pensioners have a bus pass and they don't pay anything.



Children pay about half the fare.



Very small children go free.

- Distribute a copy of the worksheet to each group of learners.
- Stimulate whole-class discussion and thinking by asking questions such as:
 - How many stops are there on the Number 100 Bus route?
 - How many stops are there from the Beach to the Post Office?
 - How much would it cost three children to travel two stops along the route?
 - How much would it cost three adults to travel six stops on the Number 100 Bus?
- As learners provide feedback, encourage other learners to comment and/or ask further questions.
- When you are confident that learners understand what is required, ask them to complete the worksheet.
- Careful observation of learners as they work will provide opportunities for gathering evidence relating to thinking, communication and number skills.
- Allow adequate time for groups to engage with the task, before bringing them together to share and compare their results.
- Once learners have completed the worksheet, they can be given further opportunities to practise calculations by playing the 'Fares please' game.
- To play the game, distribute a set of 'Fares please' cards to each group and explain that the red cards give lists of passengers, while the green cards show the bus journeys these passengers will take.

Dinasfawr	Activity 3: Fares please	Worksheet
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Name(s):

Here is a table of fares and the route for the Number 100 Bus.

Number of stops	Adults	Children under 16	Seniors
one stop	50p	25p	Free
two stops	90p	45p	Free
three stops	£1.20	60p	Free
four or more stops	£1.50	75p	Free

Using this information, work out how much each bus journey will cost.

10-year-old Sarah and her four classmates	Bus Station to School	
Mr and Mrs Jones, 8-year-old Jane and 6-year-old Alan	Beach to Bus Station	
18-year-old Dylan, 15-year-old Carys and 70-year-old grandad	Sports Stadium to Sea World	

Explain how you worked out the times.

- Ask learners to shuffle the two sets of cards and place them face down on the table. Each learner then selects one card of each colour and calculates the cost of that particular journey. Other learners check the calculation and agree or amend the answer, as appropriate.
- Once all the cards have been used, they can be put back into sets, shuffled and reused. Alternatively, learners could make further cards themselves.
- In order to give the game purpose, learners should agree on how many correct calculations are required to produce a winner. Learners could also be asked to design a 'score' sheet on which to record their calculations and answers.

You might like to appoint one member of each group to be in charge of the 'Fares please' game. This learner can be given a calculator to use in the event of any disputes over 'correct' answers.

Activity 3 | Fares please

Some examples of classroom practice

After taking part in the classroom discussion on bus fares, Ffion, Donna and Jo worked together to complete the worksheet.

They spent 10 minutes on their calculations and were then asked to report back to the rest of the class, explaining how they had worked out their answers.

Dinasfawr	Activity 3: Fares please	Worksheet
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Name(s): Ffion Donna Jo

Here is a table of fares and the route for the Number 100 Bus.

School

Bus Station

Sports Stadium

Beach

Leisure Centre

Sea World

Post Office

Number of stops	Adults	Children under 16	Seniors
one stop	50p	25p	Free
two stops	90p	45p	Free
three stops	£1.20	60p	Free
four or more stops	£1.50	75p	Free

Using this information, work out how much each bus journey will cost.

10 year-old Sarah and her four classmates → Bus Station to School

1 stop
 $25p \times 4 = £1$
 + Sarah 25p
 = £1.25

Mr & Mrs Jones, 8 year-old Jane and 6 year-old Alan → Beach to Bus Station

4 stops
 $£1.50$ $75p$ $£3.00$
 $+ £1.50$ $+ 75p$ $£1.50$
 $£3.00$ $150p$ $£4.50$

18 year-old Dylan, 15 year-old Carys and 70 year-old grandad → Sports Stadium to Sea World

3 stops
 $£1.20 + 60p + \text{Free}$
 = £1.80

Explain how you worked out the times.

The first one seemed easy. It was only one stop and there were four children, so 25p times 4 is £1 and that's what we wrote down. Then Jo said that we'd missed out Sarah and she was right. We added another 25p for Sarah and the answer was £1.25 altogether.

There are four people in the second one. Two of them are adults and two of them are under 16. We worked out it was four stops. Four stops is £1.50 for adults and 75p for under 16. That's £3 and £1.50, so it's £4.50 for the four of them.

Sports Stadium to Sea World is three stops. All the people are different prices. Dylan is £1.20, Carys is 60p and grandad goes free. Add them up, it's £1.80 altogether.

A second teacher decided to begin the activity by playing the 'Fares please' game. She displayed the table of fares from the worksheet on the interactive whiteboard and asked the learners questions to stimulate interest and promote understanding.

School		Bus Station		
Number of stops	Adults	Children under 16	Seniors	
one stop	50p	25p	Free	
two stops	90p	45p	Free	
three stops	£1.20	60p	Free	
four or more stops	£1.50	75p	Free	

Diagram showing a circular route: School → Bus Station → Post Office → Sea World → Leisure Centre → Beach → Sports Stadium → School.

Where would you like to visit? How much would it cost you to get there if you started at the Bus Station?

How much would it cost you and a friend to travel from the School to the Leisure Centre?

The learners were then encouraged to play the game and to devise their own rules.

The teacher observed the groups as they played, encouraging learners to use different strategies to check the accuracy of their answers.

One group decided to make the game more challenging by choosing two red cards and one green card for each turn, calculating both sets of fares in order to reach their answer.

The game was much enjoyed by the learners, some of whom went on to produce their own set of cards for a new version of the game.

Bus Station
to
Leisure Centre

14 year-old Sian
and her mum and dad

Mr & Mrs Brown and their
17 year-old twins

4 stops

1 child 75p
2 adults £3

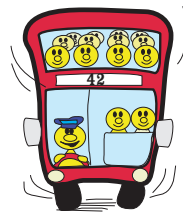
4 adults £6

£6.00
£3.00
£0.75
—
£9.75
—

Activity 3 | Fares please

Developing the activity (part 2)

- Display a copy of the activity sheet on the whiteboard and/or distribute a copy to each group of learners.
- Stimulate whole-class discussion and thinking by asking questions such as:
 - Why does it cost money to run a bus?
 - What sort of things are included in the running costs of £160?
 - What does it mean 'to make a profit'?
 - How can the bus company make money?
 - What sort of things will the bus company need to consider when setting fares?
- As learners provide feedback, encourage other learners to comment and/or ask further questions.
- Ask learners to work in groups to decide on a fare structure for the Number 42 Bus. Distribute a copy of the map for reference and remind them that they planned a route for the Number 42 Bus in Activity 1.
- In order to promote thinking skills, you might suggest:
 - making a decision on the average number of passengers for each bus journey
 - referring back to the fare structure used when playing the 'Fares please' game
 - thinking about the numbers of adults and children that are likely to be on the bus at different times of the day.
- Careful observation of learners as they work will provide opportunities for gathering evidence relating to thinking, communication and number skills.

Dinasfawr	Activity 3: Fares please	Activity sheet
You are in charge of the Dinasfawr Bus Company.  The Number 42 makes 20 journeys each day. In total, it costs £160 a day to run the Number 42. Using the route you planned earlier, decide the fares to charge passengers. Some things to think about: • You want to make a profit. • The bus holds 40 passengers but sometimes it is not very full. • Longer journeys may cost more than shorter ones. Present your results in any way you wish. Explain how you decided upon the fares to charge.		

- Allow adequate time for groups to engage with the task, before bringing them back together to share and compare their ideas.
- Selecting particular learners to report back will provide further opportunities for you to gather specific evidence about individuals.
- Following the reporting back session, you may wish to allow further time for learners to follow up the ideas discussed.

Some examples of classroom practice

Having completed the worksheet and played 'Fares please' in previous sessions, the learners were asked to devise their own fare structure for the Number 42 Bus. The activity sparked some animated discussion as learners considered various possibilities.

We will have to charge by the square, that is, each 50m.

What about 20p for each 50m? That would be £1 for 250m.

That's too much! It would cost £1.20 to go to the Post Office.

Are the children and the adults going to pay the same?

The children should be free.

No, children should pay half the adult fare.

Darren and Kyle decided that they should work out how much each journey would cost the bus company in order to make a profit. They calculated that each journey would cost the company £8 ($£160 \div 20$), so they would need to make more money than this on each trip.

The learners then considered the idea of charging passengers per bus stop, for example, 20p per stop so that a journey of five bus stops would be £1 for an adult and 50p for a child. This led them to consider the approximate number of passengers they could expect on each journey.

20 p per stop
5 stops = £1.00 adult
50p child

They decided that as it was a town route, it would be quite busy and Kyle estimated (arbitrarily) that there would be around 27 passengers per journey, 'Because sometimes there will be more and sometimes there will be less'. Darren suggested that, 'We use 17 adults and 10 children for an average journey'.

As there were five bus stops (excluding the Bus Station) on the Number 42 route, the learners decided to go ahead and work out the daily profit for that route. They multiplied the fares from each journey (£22) by the number of journeys (20) to work out the amount of money made each day (£440). As the bus company's running costs were £160 a day, they subtracted this from the £440 to leave a daily profit of £280.

Darren and Kyle said that the bus would run for six days a week, giving them a weekly profit of £1,680.

They were very excited by the prospect!

estimate 27 people per trip

17 adults	£17
10 children	£5.00
	£22.00
	$\times 20$
	<u>440.00</u>
Profit	$\frac{3440}{-160}$
	<u>280</u>
	$\times 6$
	<u>1680</u>
	<u>+</u>

£17.00
+5.00
22.00

Activity 3 | Fares please

Eva and Beca decided to set up a table of fares based on the number of bus stops travelled. They agreed that if their fares 'didn't work', they could adjust them later in order to ensure that the bus route was profitable. Their proposed fare structure is shown below.

	child	adult	04p
1 stop	20	30	0
2 stop	40	50	0
3 stop	60	80	0
4 stop	75	100	0
5 stop	100	120	0

The learners then listed the times their buses would run, deciding that the first bus would leave at 7 a.m. and the last bus of the day would leave at 8 p.m. They agreed that the bus should run at half-hourly intervals during 'busy times', and at hourly intervals during less busy periods. They also agreed that the maximum number of passengers their buses could carry would be 40.

Alongside each of the bus times, Eva and Beca then recorded the number of passengers (out of 40) that they estimated would travel on each bus. Although these decisions were fairly arbitrary, they were logically based, for example, 'The 8:30 bus will be full, because lots of people will be going to school or work'.

The two learners then calculated the fares that these passengers would generate, writing their results on their chart, which is shown opposite. Note the way in which the learners have headed-up the columns in this chart, using icons to represent the time of the bus (a clock), the number of passengers travelling out of the possible total of 40 ('stick' people) and the amount of money taken (a £ sign).

During the reporting back session, Beca and Eva presented their work to the class and explained how they had obtained their results.

'We estimated that 10 children and 20 adults would be travelling on the 8 o'clock bus going to school and work. We thought they would be on the bus for about four stops. The fares would come to £7.50 for the children and £20 for the adults. That makes £27.50.'

	passengers	£
7:00 AM	15/40	£ 8.25
8:00 AM	30/40	£ 27.50
8:30 AM	40/40	£ 20.00
9:00 AM	25/40	£ 9.00
10:00 AM	7/40	£ 5.00
11:00 AM	20/40	£ 6.00
12:00 PM	25/40	£ 6.75
12:30 PM	36/40	£ 18.00
1:00 PM	40/40	£ 18.75
2:00 PM	30/40	£ 6.00
2:30 PM	20/40	£ 8.25
3:00 PM	20/40	£ 9.00
3:30 PM	40/40	£ 19.00
4:00 PM	40/40	£ 18.00
4:30 PM	40/40	£ 20.00
5:00 PM	20/40	£ 8.00
5:30 PM	20/40	£ 8.00
6:00 PM	20/40	£ 12.00
7:00 PM	30/40	£ 18.00
8:00 PM	20/40	£ 12.00
		247.9
		- 160 =
		£ 87.9

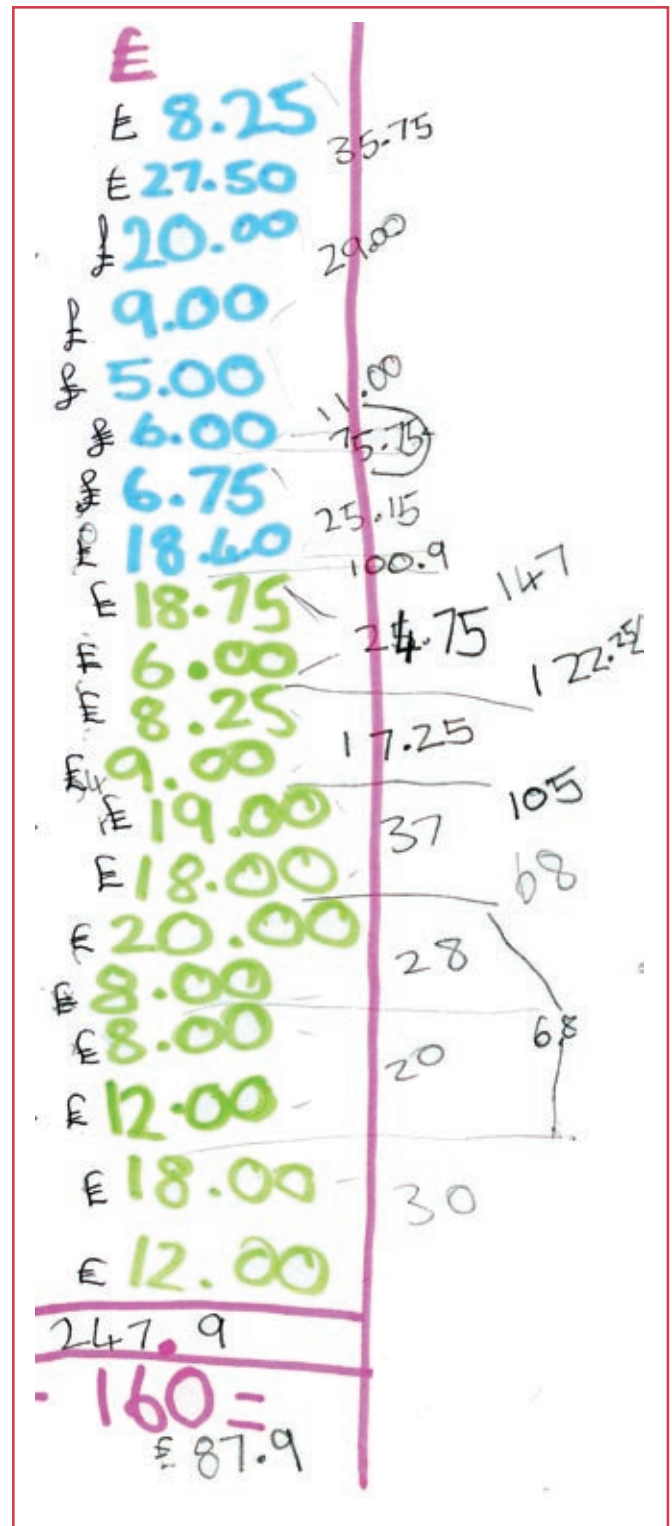
'The 8:30 bus would be full with 20 children and 20 adults. They would go two or three stops.' (The learners explained this was because passengers would be leaving home later as they lived nearer the school or work). 'This makes £9 for children and £11 for adults and would come to £20 altogether.' (The learners explained that they had used 45p for the children as it was the average of 40p and 50p, and 55p for adults as this was the average of 50p and 60p).

'We added the day's bus fares in our heads and they came to £247.90, then take away £160 and we had a profit of £87.90. We then checked our answers with a calculator and found that we were £10 out, so the profit is really £97.50.'

Inspection of the two learners' written work (shown opposite) reveals a wealth of evidence regarding mental computation. For example, starting at the top of the 'fares list' it can be seen that Eva has added £8.25 to £27.50 to get £35.75, £20 to £9 to get £29 and £5 to £6 to get £11 before summing these partial totals (£35.75 + £29.00 + £11.00 = £75.75). She has then added £6.75 to £18.40 to get £25.15, before completing her partial sum (£75.75 + £25.15 = £100.90).

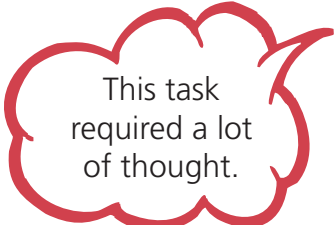
Beca, on the other hand, has started from the bottom of the list and used a similar strategy to arrive at her partial total of £147. Combining Eva's and Beca's sub-totals (£100.90 + £147) gives the figure of £247.90 shown at the bottom of the list of fares, while subtracting £160 (the cost of running the service) gives the profit made. Unfortunately Beca has made a slight slip early on (£30 + £20 + £28 = £78, not £68), and this accounts for the discrepancy of £10 that was noted by the learners when checking their work with a calculator.

Eva and Beca were very happy with the amount of profit they would make and did not feel that they needed to make any adjustments to the table of fares they had agreed at the beginning of the task.

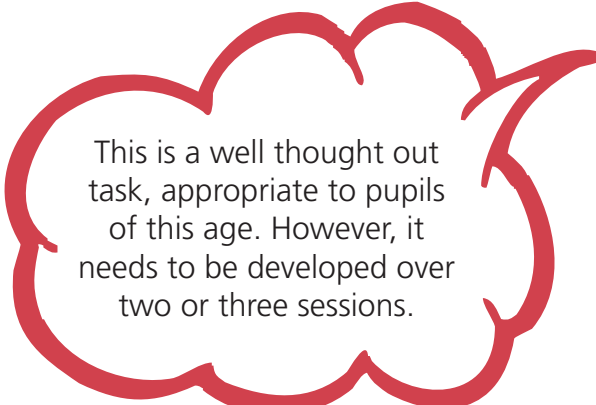


Activity 3 | Fares please

What some teachers said about the activity



This task required a lot of thought.



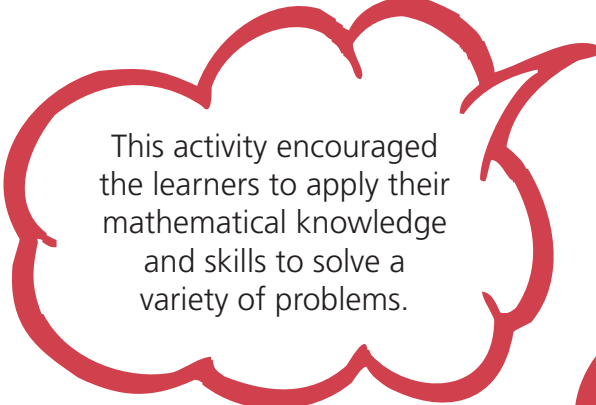
This is a well thought out task, appropriate to pupils of this age. However, it needs to be developed over two or three sessions.



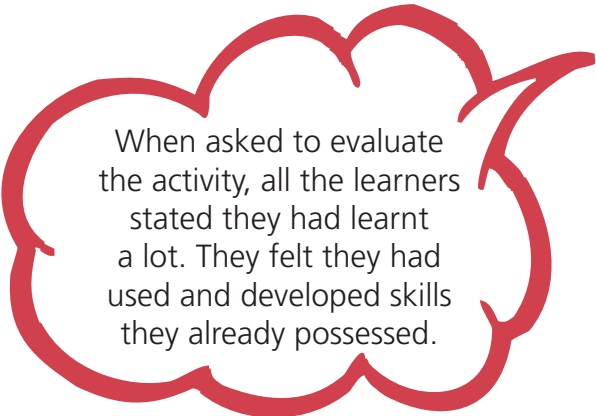
This activity promoted meaningful discussion amongst the groups about how they could improve their work.



The activity was enjoyed by the pupils, who were well motivated throughout.



This activity encouraged the learners to apply their mathematical knowledge and skills to solve a variety of problems.



When asked to evaluate the activity, all the learners stated they had learnt a lot. They felt they had used and developed skills they already possessed.

What to look for

Gathering information

When discussing and using the table of fares and/or the cut-out cards, are learners able to:

- read, understand and extract the information given (Cell 2)
- use the information to respond to questions about the cost of various bus journeys (Cell 2)
- choose appropriate data from the given information in order to calculate the cost of various journeys (Cell 3)?

Using a variety of methods

When constructing a table of fares and carrying out calculations, are learners able to:

- use addition and subtraction strategies appropriately (Cell 2)
- use a variety of mental and written methods, using a calculator when appropriate (Cell 3)
- solve numerical problems in a practical context (Cell 3)
- use mental estimation and approximation to decide whether the results of calculations are sensible (Cell 4)
- use inverse operations to check calculations (Cell 4)?

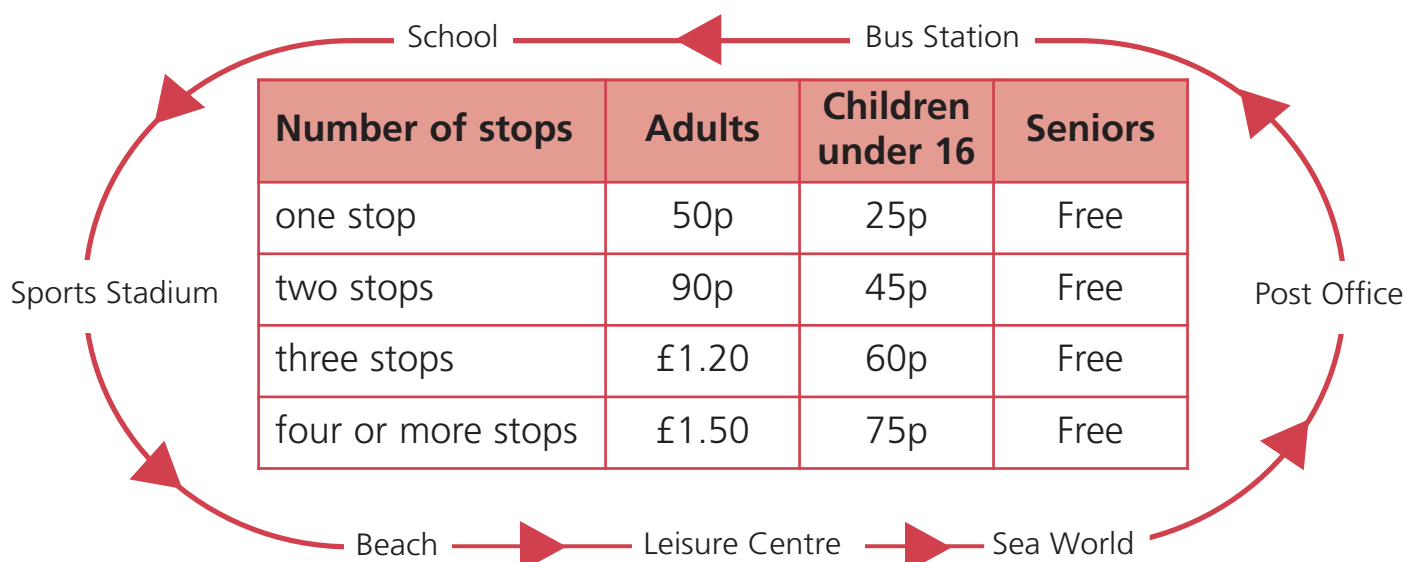
Talking about and explaining work

When discussing the activity and explaining their methods, are learners able to:

- use the language of number and appropriate symbols to explain how they made their calculations (Cell 2)
- use the language of position, movement, data and measures (Cell 3)
- use correct mathematical language, symbols and notation when presenting their work (Cell 4)?

Name(s):

Here is a table of fares and the route for the Number 100 Bus.



Using this information, work out how much each bus journey will cost.

10-year-old Sarah and her four classmates	Bus Station to School	
Mr and Mrs Jones, 8-year-old Jane and 6-year-old Alan	Beach to Bus Station	
18-year-old Dylan, 15-year-old Carys and 70-year-old grandad	Sports Stadium to Sea World	

Explain how you worked out the times.

Passengers

**Mrs James, Mrs Evans and
Mrs Davies, three 80-year-olds**

**Tim, Daniel, Simon and Gareth,
four Year 8 pupils**

**14-year-old Siân
and her parents**

**Mr Thomas and his class of 20
Year 4 pupils**

**15-year-old Debbie and
her 16-year-old friend Paul**

**Mr and Mrs Brown and their
17-year-old twins**

Journeys

**Leisure Centre
to
Sea World**

**Sports Stadium
to
Bus Station**

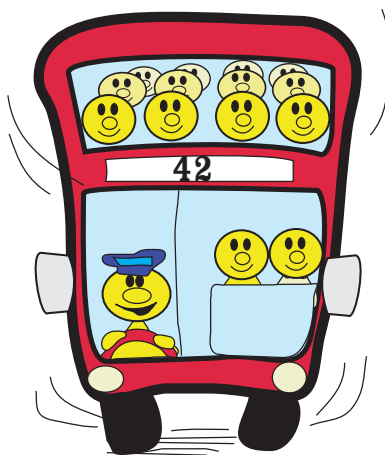
**Beach
to
Post Office**

**Bus Station
to
Leisure Centre**

**School
to
Bus Station**

**Sports Stadium
to
Leisure Centre**

You are in charge of the Dinasfawr Bus Company.



The Number 42 makes 20 journeys each day.

In total, it costs £160 a day to run the Number 42.

Using the route you planned earlier, decide the fares to charge passengers.

Some things to think about:

- You want to make a profit.
- The bus holds 40 passengers but sometimes it is not very full.
- Longer journeys may cost more than shorter ones.

Present your results in any way you wish.

Explain how you decided upon the fares to charge.

