



National Research and Development Centre
for adult literacy and numeracy

Topic-based teaching

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Maths4Life

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For further details see ncetm.org.uk and maths4life.org. The Maths4Life website will be live and maintained until the end of March 2008 when it will transfer to ncetm.org.uk

Contents

Introduction	4
Why use topic-based teaching?	5
Choosing a topic	5
Planning	6
Your role	8
What's stopping you?	10
Assessing understanding	14
Teaching to a topic – food	16
Teaching to a topic – environment	20
Ways to help your learners	23
Appendix A: Food topic scheme of work	24
Appendix B: Environment topic scheme of work	28

Introduction

This booklet is aimed at tutors working with learners from Entry Level 1 to Level 2. It is not a text book, or a list of recipes for how to teach particular topics. Instead, it suggests an approach to topic based teaching that we have found effective in enabling learners to build their mathematical skills.

Many learners may feel that listening to the tutor and completing their own individual worksheets is the main way of learning. However, we believe that learners learn more if they actually enjoy the activity, have a chance to discuss what they do, explain their work and reach a shared understanding. There is now widespread recognition for the value of collaborative work in developing conceptual understanding (Collaborative Learning in Mathematics: A Challenge to Our Beliefs and Practices, Malcolm Swan, NRDC and NIACE, 2006).

The activities outlined in this booklet work best as shared tasks. This approach may be unfamiliar to many learners, particularly those whose previous mathematics was learned in a traditional, formal class.

Learning is generally most effective when learners are working collaboratively. The task can be pitched a bit higher, just outside an individual learner's comfort zone, so that it needs a second opinion; it may also involve practical equipment that needs a second pair of hands. An explanation of the benefits and ground rules is important for all learners before starting collaborative tasks, so that each group member gets a chance to express an opinion and challenge what others say.

In this context the tutor is not so much an instructor as someone asking the right kind of questions to move discussions on, and does not immediately confirm correct answers. The tutor will want to spend time listening to the discussion in small groups, and may join in, but should try not to replace whole class lectures with small group ones.

As with all learning situations, the tutor will have to make some snap decisions about how to react to situations that develop, particularly those where a group agrees about something which is in fact incorrect. Comparison with the work of other groups where learners have to justify their conclusions can be a more powerful checking strategy than simple validation from the tutor.

Collaborative learning situations tend to have a shared goal of producing an end product, such as a poster, a presentation to the group, or a set of questions for other learners. Discussion of the similarities and differences between posters from different groups can be a very effective way of addressing errors and misconceptions.

Why use topic based teaching?

Our learners may not have done well in traditional mathematics classes at school; they may feel worried, inadequate or just anxious about returning to learning. Topic based teaching gives a different, less threatening, feel to mathematics classes. Learners can get more involved in the sessions especially if they have helped choose the topic. The mathematics may be outside their comfort zone, but they do understand or relate to the chosen topic. They may have something to contribute from their life experience or can find relevant resources.

Working with a topic they have chosen stimulates learners' imagination. They discover that they need to do a particular calculation to find out something that they want to know. Topic based teaching does not disguise the mathematics; it just supplies the relevant mathematics at an appropriate point.

Topic based teaching can also help learners' literacy. Many learners who have problems with numeracy also have problems with their literacy. Indeed, poor literacy can hinder their mathematical capabilities. Planning activities that develop both numeracy and literacy is beneficial. The language of mathematics must not be a barrier to learning.

Choosing a topic

Probably the most worrying thing for tutors about to start topic-based teaching is how to choose a topic. This can be easier than it seems, particularly once you know your learners.

The first time you start with a new group of learners, it is a good idea to have a few topics in mind. These topics must generate a lot of mathematics but will overlap with literacy. For example, you might consider using family health, sport, or something that is happening in your local area. You can bounce ideas around with colleagues to see how you can work with the topics. Team meetings are an ideal place to explore topics as ideas can be generated by and shared with other tutors. If you are not part of a team, networking by phone or email can help.

Later, when you know your learners better, ask them what they would like to investigate. A class brainstorm may come up with as many topics as there are learners in the room. Alternatively, it may come up with very few ideas, especially if learners are not used to group discussions.

Having too many topics is easier to deal with than having too few. You can get more detail from the learners about their particular choice of topic and then you may find that you can group topics together. At this stage, you are not looking for mathematics-specific ideas. The generation of mathematics activities will largely depend on you. If a topic appears too narrow to generate much mathematics, ask for ideas for widening the topic. Eventually you will end up with a list of say three or four topics and learners can vote on which one to do first, or you can give yourself the casting vote since you have to facilitate the mathematics.

If your learners are not comfortable with discussion, they may not generate many topics. In this case, you could use pyramid discussions; start discussions in very small groups and gradually join groups together, making sure that at each stage of the discussion a limited list of topics are agreed by all group members.

If you do not know your learners well, listen to them before the session has started. Do they talk to each other? What do they talk about? Maybe this could highlight a common interest that you could use.

Once you have selected your topic, you are ready to plan the mathematics.

Planning

Generating ideas

Develop a mind map (working with another tutor if possible) of all the ideas relating to mathematics that come out of the chosen topic. For example, see the tutor's mind map on page 20. Roughly match the ideas you have generated to the levels of the curriculum you will need for your learners. Identify any major gaps.

Now look to fill specific gaps; for example, if you need a session on equivalent fractions and your topic is football, you might look at how the game splits up. Consider half of the match in terms of minutes - $45/90$. Now cancel down. At lower levels "a game of two halves" might start to have some meaning for your learners. There are other possibilities for fractions within football – depending on the level of your learners; you can look at ticket prices, attendance at games, home supporters versus away supporters, distance to matches and so on.

It is worthwhile asking the learners to discuss the mathematics work that they could do within the topic, again using a pyramid discussion format. The

learners may come up with ideas that you have not considered or may endorse an idea you want to try. For example, in a topic on shopping for entry 1 and entry 2 learners, we were not going to work on writing cheques (numbers in words) as many people don't have bank accounts. However, our learners specifically asked to be taught how to write cheques, so we changed our plan to include this.

Timing

You need to recognise that some topics are limited in their scope while others can run for many weeks. It depends on how the learners react to the work and how their ideas flow. When you are planning out the topic, if learners are not coming up with ideas, this is a warning that the topic may not work well or may be very limited in its scope.

Try to allow a topic to develop; if you had originally planned it for 6 weeks and it looks like running on, let it. Only stop a topic if the learners or you have lost interest, if there is no useful mathematics coming out of it or if the course is coming to an end.

Scheme of work

Develop your scheme of work from the ideas you and your learners have generated and mapped to the curriculum. Once developed, you don't need to slavishly stick to it. As your learners play with the ideas, they will want to explore some in greater depth. You should adapt your scheme of work as you go along. Don't be afraid to scribble all over it. Do remember to keep a record of the changes you make whether electronically or on a paper copy.

Resources

Many tutors feel that topic-based teaching will be very intensive in terms of needing to create resources for the learners. This need not be so. You can use resources that are readily available, rather than creating worksheets or resources from scratch.

Realia

One way of ensuring that all the resources you use are relevant, up-to-date, topical and have meaning for your learners is to use realia. Ask your learners to find and collect what you need. This helps them to develop as independent learners and also ensures that what you use in the class is what they see in the real world. It also helps them to realise that learning is continuous and to relate their learning in class to the real world.

Games and activities

There is no need to buy expensive mathematics games. You or your learners can create dominoes games using the Maths4Life CD-ROM (available in the *Thinking*

Through Mathematics ringbinder). Many other games or activities require only a few starter materials. Once learners have the idea, they can develop the game or activity at their own level. This builds in differentiation and also enables you to see progress. Learners very rarely make life too easy for themselves – if they do, you can challenge them to make it harder for themselves.

Fieldwork and trips

Try to build in opportunities for local fieldwork or trips in your scheme of work. These enable your learners to do mathematics in the real world. For example, a class working on sport might visit the local sports centre. The learners plan how and when to get there (route, timing, fares) and arrange the trip with the centre. At the centre, they can look at capacity (number of pitches, courts, halls etc), cost of facilities including hire of equipment, season tickets or special deals, catering arrangements especially amounts sold, calendar of events, opening times, and so on. On return they can work with the data they collected and present it in a suitable way.

Using ICT and the Internet

If you have access to ICT and to the Internet in class, you can add another dimension to your topic based teaching. Your learners of all levels can use the Internet to research the topic; you can plan the websites that they should visit.

If your learners collect data on a field trip or as a result of an investigation, they can use various computer packages to manipulate and present their data. We have found MS Word, Powerpoint and Excel particularly useful in this context.

Your role

Facilitator or tutor?

Our aim is to encourage independent learning. This tends to mean that a lot of the time you will be acting as a facilitator rather than as a tutor. However, you need to act as a tutor to ensure that the content of the course meets the needs of the learners and extends their capabilities. You know their current mathematical abilities and you know what they need to learn according to the Adult Numeracy Core Curriculum.

During topic based teaching you will find that you spend a lot of time encouraging discussion. By standing back and listening to the discussions (and only intervening if absolutely necessary) you can identify conceptual errors and misunderstandings, and encourage reluctant learners to join in.

When learners talk about mathematics, they can be developing mathematical

concepts or exploring different approaches to problems. This may result in them taking the topic in a completely new direction. They are then taking control of their own learning.

If this new direction looks as if it would be valuable to their learning, don't feel constrained by your lesson plan or scheme of work. Run with the ideas as far as possible but remember to record the changes in your session evaluation.

Alternatively, if learners find they have a lack of ideas or cannot raise much enthusiasm for discussion of a particular topic, it may be time to find another topic.

You will be helping your learners to drive their ideas forward. Another way you can help them is to get them involved in doing their own research for the topic. They could use the Internet, visit libraries or collect information relevant to the topic from elsewhere.

Making connections

Meaningful connections help to make sense of mathematics and to make it easier to learn. We can use the knowledge and experience that adult learners already have, within their chosen topic.

Topic based teaching allows you to integrate many mathematics topics; for example, the food topic we explore on page 16 incorporates number, decimals, measure, percentages, ratio, shape and data handling.

Although the core curriculum identifies various skills as elements at each level, this should not be seen as a set of hard and fast rules. If learners are encouraged to understand and explore concepts, their investigations may well spread across more than one 'level'. For example, negative numbers do not appear in the entry level curriculum, but learners see negative numbers on frozen food packaging.

Topic based teaching enables you to differentiate within a class; in fact learners themselves may do the differentiation for you, in what they choose to investigate. You can influence this further by engineering the groups in which learners work. Sometimes groups can be level based and other times groups can be formed to give a mix of levels.

This flexibility of topic based teaching also makes it easy to adapt for other classes which may have a different mix of learner levels.

Meeting targets

Topic based teaching need not stand in the way of meeting your targets. If you

feel that you have not covered an element of the curriculum or that your learners would benefit from more work on it, you can manipulate the topic to include it. Alternatively, you can wait until it falls naturally into another topic, or you can just teach it anyway.

In the same way you can add exam preparation when necessary. Your learners will probably have a good understanding of much of the curriculum from their topic based explorations but they will need practice in exam type questions. Here the benefits of building their literacy skills hand in hand with their mathematics skills become really apparent.

What's stopping you?

Many tutors when faced with the idea of teaching mathematics in a topic based way have concerns. We have considered some of the most commonly raised concerns below and offer some strategies for addressing them.

Planning

I don't have a colleague to plan with and I'm not creative – how can I plan?

You may have colleagues who teach at other levels of mathematics, or who teach English to similar learners. You may belong to a team which has team meetings. You may have contacts with tutors at other institutions through email (the National Centre for Excellence in the Teaching of Mathematics (NCETM) has useful discussion boards see ncetm.org.uk). All of these people can be used to bounce ideas around. Failing all of these, family members, particularly young teenagers are full of ideas.

Also, regardless of their skill levels, you can plan with your learners; this way you can be sure of getting their interest.

My boss says I have to have a complete scheme of work for all of the next year of the course. I haven't even chosen topics yet and I don't know what I'll be doing when. How can I cope?

You are likely to choose the first topic for this group of learners so you can get some ideas into your scheme of work for the first few sessions. This will give you an idea of the elements of the curriculum that you have yet to cover and you can create placeholders in your scheme of work for the remaining elements. Later when you choose more topics with your learners, you can adjust your scheme of work to fit.

How can I be sure that we get through the curriculum so that the learners can pass their exams?

Most topics will enable you to cover a wide range of mathematics. After you have developed a scheme of work, matched it to the curriculum and identified any gaps, you can teach a session to fill a gap or pick a new topic to do so. In any case, as you change your scheme of work to follow the learners' developing interests and ideas, you will probably find that the gaps disappear. Of course, teaching the complete curriculum in the traditional way does not guarantee that learners will pass their exams.

**How can I make sure that I can get enough mathematics into the topic?
How can I get the right mix of mathematics into the topic?**

Be careful of how you develop the topic that you and the learners have chosen. Your role as the tutor is to be aware of the learners' mathematics needs and as you gain experience of this way of teaching you will find ways to pull mathematics out of the most unlikely situations. If you find that the topic is a little barren, don't be afraid to find an alternative topic.

Teaching

How can I make sure the session goes where I want it to go?

You can't. The session will go where it goes, guided by the learners' needs. As long as valuable learning is taking place and learners' needs are being met, don't worry. Make sure that you bring the learning out in a well structured plenary so that learners are reminded of what they have achieved. Also make sure that you evaluate the session afterwards so that you can annotate your scheme of work and add the unachieved objectives to a future session.

I'm not teaching, I'm just standing there

Remember that your role is to facilitate the learning. You won't be just standing there. You will be observing and listening to learners. You can assess their learning by careful use of questioning. You can also assess them by listening to their discussions with other learners. This will give you a clear indication of their level of understanding.

It all takes too long and we don't seem to get anything done in the sessions

This is a different style of teaching and learning. Although it appears that learning is slower, the learners develop a greater depth of understanding because they are driving their own learning forwards. You may also find that the learning lasts longer.

The learners aren't getting any practice

Although the learners are not formally completing worksheets or exercises, they are getting practice. They are examining and exploring concepts and applying them to situations that they are likely to encounter in real life. They are practising but maybe not always in class.

How do I work with so many different levels in my class?

Use the abilities of the learners to help you. Mixed ability groups work well in discussions. More able learners have an opportunity to reinforce their own understanding by helping and coaching less able learners.

Vary the groups and the tasks within the overall topic – some elements may need to be taught in ability groups. For example, you could have one group adding and subtracting to check change while another group calculates % discount.

Learners can develop additional resources and problems to stretch themselves and each other. Just be careful that they don't push each other too hard.

What if I've never taught English before? How can I teach a topic-based class?

This style of teaching gives you an opportunity to develop learners' understanding of the language of mathematics. Otherwise, it's more about helping learners to interpret the way that written problems are set; this is important to their mathematics. If you are lucky enough to have an English teaching colleague to team-teach with you, there are other opportunities that can be exploited.

What if the learners prefer to do worksheets?

Learners often feel more comfortable doing worksheets because it is what they expect to do in a mathematics class. However, you are trying to create independent learners and so you need to encourage them to try new ways of working.

Time

How do I find time to plan?

In the short term, the planning load is greater. In particular, planning the questions you want to ask takes time. However, as you get more experienced with this way of teaching you will find that you want to plan more with the learners themselves. Also, as you don't have to spend as much time preparing and marking worksheets, you will have more time available for planning.

How will I find time to create resources?

You will find that you create fewer worksheets and scaffolding forms for your learners. Learners can make their own resources with guidance from you. Rather than preparing a game, learners can develop their own. You can use realia such as food packets. You don't have to collect these – ask learners to bring in what you need. This has the benefit of using realia that learners actually use rather than what we, the tutors, think they use.

Assessing understanding

On entry to a class all learners should complete diagnostic assessments so they and their tutors know their strengths and weaknesses and areas for development. Tutors can then plan appropriate activities and extensions to meet the needs of all class members.

This is particularly important where you may be working with learners whose mathematics skills are better than their English skills. If necessary, a Reader should be available for the diagnostic assessment so that the assessment of mathematics skills is not distorted by poor reading skills.

Modes of assessment

Traditionally, mathematics has been assessed summatively by the end of term test, or by the successful completion of examples or worksheets. Although we still need to use summative assessment to allow learners the chance to gain national accreditation, assessing them formatively by the use of appropriate questioning and observation may be more useful in assessing learners' skills and achievements throughout the year.

We need to use questioning and observation (our formative assessment tools) to enable us to:

- **build on learners' existing knowledge**
- **identify misconceptions**
- **identify rote learning without understanding.**

Class questions, which everyone has a chance to think about and answer, can provide a useful starting point for discussion. This is very effective with topic based teaching especially where a topic has been agreed with the learners. For example, tutors could ask "When you go shopping for food, what do you have to think about?" In this example, most learners will have experience of shopping or opinions on the question and so the discussion is likely to be lively.

This means that we need to provide a way for all learners to take part without the quieter members of the class being overwhelmed by the more confident. One way of doing this is to consider these questions in carefully constructed groups before taking a class consensus of all groups' discussions. The tutor's assessing role in this case is to listen and to observe, and only occasionally to intervene by offering encouragement or directing questions to quieter group members.

Silence as a tool of assessment is surprisingly effective. It gives learners the time

they need to think their answers through before expressing them. Also, listening to their explanations and to learners' discussions between themselves can be a more powerful assessment tool than any number of written diagnostic tests.

We need not abandon summative tests; we can make them work for us. Learners can use existing questions as models to write their own questions for each other. They must be able to calculate the answers before they can pose the questions. This can lead them to writing their own questions without a model, using their own interests and life experience to make them real. This process also builds up learners' confidence for when they are faced with the national summative tests towards the end of their course.

Tutors can use questions to find out whether a learner knows the answer to a specific closed question such as how much an item costs with a 30% discount. However, we can use questions much more imaginatively for formative assessment and to encourage mathematical thinking.

When a new area of mathematics emerges from the chosen topic, questions can help us to identify what learners already know, and some of the misconceptions already deeply embedded in their learning.

For example, asking "How do you know if you have enough cash to buy your food shopping?" might tell you if learners know how to estimate or round, or if they can count their coins. If they have a rounding strategy, their explanation of it can give you insight into whether they understand the principle of mathematical rounding or whether their understanding is purely practical or based on guesswork.

Alternatively, asking "How much water do you think is in that lock?" (or swimming pool if more convenient) might tell you if learners have any ideas about volume at all. How they discuss the problem, the questions they ask each other and you, and the way they set about tackling the practical task of taking measurements is all very informative.

We need to plan our questions. Asking questions without having considered possible responses is a dangerous business. Even so, learners inevitably spring surprises.

Having asked questions, tutors need to consider how to react to the responses. You may need to ask supplementary questions to try to explore what has led to an incorrect response. Equally, it is often worthwhile to question a correct response. Sometimes learners have the right answer with totally the wrong reasoning. We need to be flexible when deciding how far to follow a line of enquiry which was not planned for in the lesson.

Questioning learners about why they are doing something is a good way of uncovering their thinking processes. Devil's advocate questions (for example, "Two for the price of one is the same as 50% off isn't it?") or What if...? questions (for example, "What if the level of the river rises by 20 cms? How much water would there be in the lock then?") can help to see if learners have developed a good understanding of a concept.

Learner questions are also important. Some learners may be comfortable asking questions of the tutor and of each other, but many are not. We should set up situations where they need to question each other. In all situations, make sure everyone has time to think before they respond.

Teaching to a topic – food

Choosing a topic

Although we would usually discuss possible topics with our learners and choose from a list generated by the learners, we did not do this with this topic. We chose this topic because everyone in class was talking about a TV programme about school dinners, and also because there were many news items on the effects of the food you eat. We felt that since everyone has to buy and cook food, everyone would have some experience of the topic. There was also scope for a lot of mathematics in the topic.

Planning

Working in a teaching team, we produced a mind map of ideas relating to food. (The teaching team included both numeracy and literacy teachers.) See tutors' mind map on page 20.

In the first session with the learners, we asked them to give us ideas related to food and produced another mind map. See learners' mind map on page 19.

Our scheme of work developed from these two mind maps. We tried to bear in mind what our learners needed to be able to do (in terms of the numeracy core curriculum). So for E1 and E2 learners, we needed to practise adding, subtracting, multiplying, rounding and so on. Many of these could easily be included in the topic, for example, working with money comes from the shopping aspects of food. Other elements of the curriculum needed more thought. See Scheme of Work on page 24.

Sample sessions – food topic

We have included three sample sessions to show how to use the topic as a framework for generating the mathematics that you want to cover.

Session 1 - Calorie counting

- 1 Ask learners to list what they ate yesterday including all meals, snacks and drinks. You can limit the scope of this exercise as required e.g. Entry Level 1 learners might only be asked "What did you have for breakfast?"
- 2 Give learners a calorie counting chart.
- 3 Add the calories consumed in a day. Although Entry 1 and Entry 2 level learners are not expected to handle larger numbers, the task has to reflect real life. Learners can use a calculator to check their workings.
- 4 Compare results in groups. Discuss. We found this generated many "what if?" questions as learners manipulated their lists of foods and calories – for example, "What if I used 2 spoons of sugar instead of 3 in each cup of tea?" "What if I hadn't had that doughnut? It would be 400 less calories in a day." The learners themselves generated the mathematics. We encouraged correct use of mathematical vocabulary (more, less, twice as much).
- 5 Extension activity: learners can create bar charts of calories for their group.
- 6 Extension activity: calculate daily intake as a percentage of recommended calories.
- 7 Extension activity: compare daily intake with "a healthy diet" (internet search). www.scottishsport.co.uk is a useful site.
- 8 Extension activity: compare cost of learners' actual diet from different supermarkets. They could use supermarkets' online shopping tools to find out prices.

Session 2 - The restaurant

- 1 Split learners into groups. Allocate each group a different type of restaurant, for example, fast-food, coffee shop or snack bar, pub or restaurant.
- 2 Each group creates a menu for their restaurant (using ICT if available), describing the food appropriately. Cost the food and price it for the menu (consider profit margins with L1 and L2 learners).
- 3 Groups present their menus and justify their pricings to the other groups.
- 4 Use each other's menus to select a meal. Add costs, check change (E1 and E2 select coins, E2 and above, write cheques). Extension – use prepared waiter's order lists to calculate cost of other meals e.g. 2 x chicken, 1 steak, 1 veg.
- 5 Design restaurant interior – create mind map of what would be needed. Estimate and measure length, width and height of room, calculate area of walls, floor, depending on level of learner.
- 6 Calculate amount of paint required, amount of carpet/ flooring. Cost these.
- 7 Decide what furniture is required and how many of each would fit. Draw floor plan. Cost this.
- 8 Measure windows for curtains or blinds and cost appropriate materials.
- 9 Opening hours. Work with times (am, pm, number of hours open). Staff costs – how many staff do you need, what type of staff (cleaners, waiters, chefs, managers) how much are they paid per hour, how many hours do they work, are they paid overtime or bonuses?

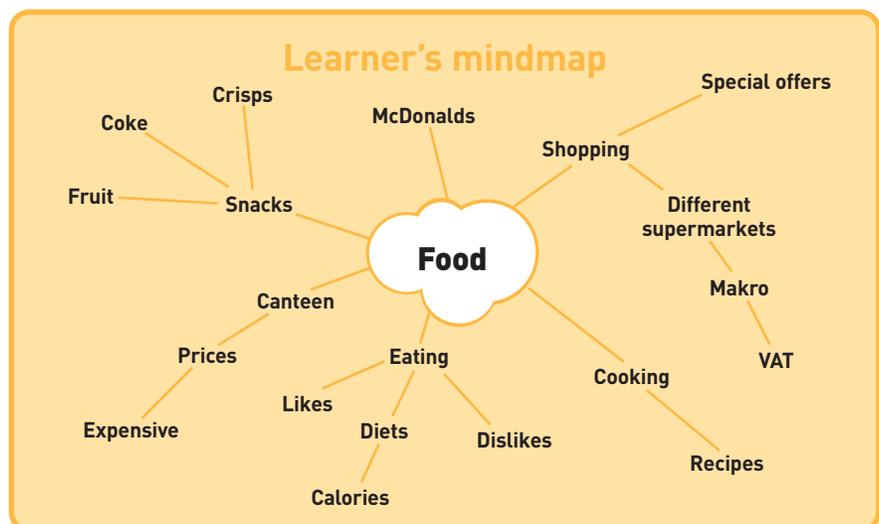
Session 3 - Special offers

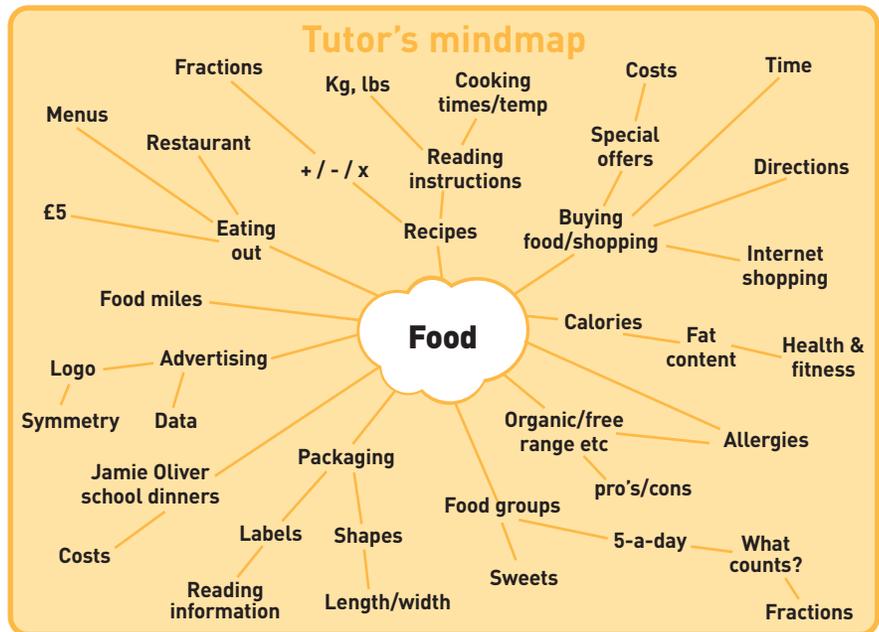
- 1 Ask learners what types of special offers they have come across. For example, 2 for the price of 1, BOGOF (buy one, get one free), 50% off, half price, discount sales. Ask them to discuss what these offers mean and to explain to each other.
- 2 Give out supermarket offer sheets. Ask learners to calculate savings on food bills if they take advantage of the offers.
- 3 Examine the benefits of bulk buying.
- 4 Calculate the saving on sales goods with percentage discounts or the extra cost on items surcharged because they were bought with a credit card.

Assessing

The role-playing involved in the restaurant sessions gives rise to many opportunities for observing and formatively assessing learners' progress in dealing with money and doing calculations of various sorts.

The small group presentations in many of the sessions give similar opportunities and additionally enable learners to show their skills in presenting data. The types of questions other learners ask give you an opportunity to assess their level of understanding. The responses to those questions also give you insight. This work also aims to build a deep understanding of the concepts and skills which will be assessed summatively at the end of the course.





Teaching to a topic – the environment

Choosing and planning the topic

The environment topic came about due to learners' comments when the local council announced the introduction of household recycling collections. This led to a discussion about a number of local and wider environment issues.

As with the food topic, we planned by mind mapping with other tutors and with the learners. We ended up with a series of short topics related by the common theme of the environment. This shows how easily you can adapt topic based teaching to the time you have available.

Our environment scheme of work (see Appendix B) is for E1 and E2 learners, with an emphasis on practising adding, subtracting, multiplying, handling data and so on. In what follows we examine how it could be developed for learners working at other levels.

For higher level learners, we need to introduce extra elements of the curriculum including more complex decimals, fractions, percentages, ratio, statistical measures, perimeter, area and volume.

Sample sessions – environment topic

We have included two sample sessions to show how to use the topic as a framework for generating the mathematics that you want to cover.

Session 1 - Recycling

The original scheme of work (see Appendix B) calls for the following activities:

Combine individual tally charts to produce a group chart

Produce a bar chart

Present and interpret the information from the bar chart

To modify this session for learners at Level 1 and Level 2, you might use some of the following activities:

Groups of learners collect information on local and national recycling rates. Ensure that this information includes a breakdown by type of recycled materials and year on year changes. The information will probably be given in metric tonnes but if not, there is an opportunity for conversion work.

Produce graphs or charts to present the information clearly. This may involve rounding, interpreting large numbers including decimals.

Interpret and analyse the data shown on the graphs and charts. In particular, use statistical measures to compare recycling rates amongst local authorities, find year on year percentage increase or decrease.

Present and justify findings to the rest of the class.

Session 2 - Local environment - parks/gardens

The original scheme of work calls for the following activities:

How many parks, gardens, open spaces – count from map of Reading

Research and write about types of park

Planting out Forbury Gardens - shapes of flowerbeds, +/- number of plants

To modify this session for learners at Level 1 and Level 2, you might give learners the project of investigating the mathematics associated with a local park or garden.

This might include some of the activities below. Ideally, any data collection activities would form part of a session but if you don't have access or you don't have time, ask learners to do these activities in their own time.

Groups of learners plan their investigation.

Groups of learners estimate, pace and measure accurately and record the dimensions of the park, individual flowerbeds and any other features of note.

Calculate perimeter and area of whole park and lawns, paths and flowerbeds.

Calculate what fraction, percentage or ratio of the park is made up of flowerbeds, lawns and paths.

Produce a scale drawing of the park.

**Extension activity: calculate the amount of compost required to mulch flowerbeds to a depth of 10cm. How much would this cost to buy?
Compare prices from different suppliers.**

Learners could present their work at the next session, showing how they planned their investigation, the data they collected and what they did with it.

Assessing

The group work enables learners to discuss and compare ideas and gives you opportunities to observe and assess their progress.

The small group presentations of the investigation will show you how learners structure their work. These presentations will also illustrate learners' thinking processes and their methods of calculation. The level of work achieved before your learners ask for advice will give you a sound understanding of their independence, confidence and mathematical ability.

Again, these activities aim to build skills and understanding ready for summative assessment at the end of the course.

Ways to help your learners

Do

Do

Remember that these are adult learners, so find out what they are interested in.

Use their experiences to guide your choice of both topic and activities.

Use group work and make sure that activities are enjoyable and stimulating.

Encourage discussion in small groups, and also (only when learners become are confident), in larger groups.

If an activity doesn't work, be ready to abandon it or to take suggestions from your learners as to how it might be developed.

Think about how groups are composed. This can encourage quiet learners to blossom and accomplished leaders to take a back seat.

Use silence; give lots of thinking time when you ask questions.

Support learners in checking their own and each other's work.

Make sure calculators are always available for learners to use to check their work, but encourage learners to estimate first and then check.

Encourage learners to make up questions for each other.

Use the Internet as a resource – learners are happy to research information in this way, but do support them especially if they have poor reading skills.

Don't

Give endless drills and practice tests.

Allow "death by worksheet".

Give out proformas or writing frames for lower level learners; they learn by making up their own format for recording data *and* become more independent.

Tell learners all the answers.

Let learners become too comfortable in their groups.

Don't

Appendix A Scheme of work – Food topic

Wk no.	Topic Area/ Content	Delivery Method/ Student activity	Resources	Assessments	Core curriculum references
Week 1	Brainstorm topics relating to food. What is a healthy diet? What do you eat in a typical day? Using calorie chart work out how many calories you eat in a typical day. Is this more or less than ideal?	<ul style="list-style-type: none"> Class discussion Write list of food Individual counting of calories 	White board 'What do I eat?' information Dictionaries Calorie chart Calculators for checking	Q & A & observe: <ul style="list-style-type: none"> contributions to discussion use of information from table use of calculator Spelling correct Results of adding	N1/E1.2-4, E1.6-7, N1/E2.2-4, E2.7-8 HD1/E1.1, HD1/E2.1 Literacy – speaking & listening
Week 2	Count calories in healthy option meal. Compare to own meals Discuss food groups Identify which food groups some foods belong to.	<ul style="list-style-type: none"> Small groups to work out calories in healthy meal. Add up total. Class discussion Scan text 	Healthy meal option Calorie chart White board Text listing food groups and some foods	Q & A & observe: <ul style="list-style-type: none"> contributions to discussion scanning of text Results of addition and comparison	N1/E1.2-4, E1.6-7, N1/E2.2-4, E2.7-8 HD1/E1.1, HD1/E2.1 Literacy – speaking & listening, reading
Week 3	Discuss 5 portions of fruit or veg per day scheme. Complete cloze exercise 'Eat your greens!' Identify own intake, compare to others Do these people eat 5 a day? Dice darts	<ul style="list-style-type: none"> Class discussion Individual completion of cloze passage Small groups discuss fractions $\frac{1}{2}$ and $\frac{1}{4}$. + and - numbers Small group adding and subtracting to win 	'Eat your greens' cloze Table of 5 a day quotas Sample fruit/veg intake Dice White board	Q & A & observe: <ul style="list-style-type: none"> contributions to discussion use of fractions team work + and - in game 	N1/E1.2-6, N1/E2.1-2, E2.7 N2/E2.1-2 HD1/E1.1, HD1/E2.1 Literacy – speaking & listening, reading, writing words

Week 4

Reading labels on back of food packets.
Sort packets into order for quantity of salt, carbohydrates, proteins. Comment.
Try using crisp packets, pizza packaging, ready made meals, drinks etc.
Compare prices, quantities

- Using tables to extract information
- Discuss and sort numbers into order
- + and x quantities
- + - prices, quantities

Food packets and boxes

- Q & A & observe:
- contributions to discussion
 - sorting numbers into order
 - interpreting data
 - following instructions
- Results of calculations

N1/E1.1-6, N1/E2.1-5, E2.7
MSS1/E1.5, MSS1/E2.6
HD1/E1.1-2, HD1/E2.1, E2.3
Literacy – speaking & listening, reading

Week 5

Round prices to nearest 10p.
School/ work dinners – compare cost of healthy/unhealthy school/work lunch boxes

- Describe method of rounding learners use mini-whiteboards to practise
- Identify healthy lunchbox
- Identify unhealthy lunchbox
- Cost lunchboxes
- Compare costs

Mini whiteboards
Marker pens
Price lists
Internet shopping prices

- Q & A & observe:
- contributions to discussion
 - rounding prices
 - identifying healthy & unhealthy food
- Results of totalled lunchbox & price comparison

N1/E2.6
MSS1/E2.2
HD1/E1.1-2, HD1/E2.1
Literacy – speaking & listening, reading

Week 6

Find 'healthy' recipe.
Adjust ingredients for 5 people, 10 people, 20 people. (How can you x 20?)
Cost ingredients (rounded to nearest 10p)

- Discussion – what makes a healthy lunchbox?
- Small group find recipe
- X5, x10, x20.
- Add costs

Jamie's school dinners website for recipe
Multiplication squares if needed

- Q & A & observe:
- strategies for multiplying
 - contributions to discussion
- Results of multiplication
Results of rounding

N1/E2.5-7
MSS1/E2.2
HD1/E1.1, HD1/E2.1
Literacy – speaking & listening, reading

Week 7

Identify what is meant by supermarket offers.
Are they a good deal?
Identify types of offers.
Compare prices of different size packages e.g. cereals, washing powder, chocolate bars

- Small group discussion to identify and list supermarket offers
- Work out prices per gram or per 100g
- Work out best deals
- Use calculators

Paper /pens
Calculators
Food packages, price lists

- Q & A & observe:
- contributions to discussion
 - use of calculator
 - identification of best deals
- Results of calculations

N1/E1.7, N1/E2.8
MSS1/E1.5, MSS1/E2.2, E2.6
HD1/E1.1, HD1/E2.1
Literacy – speaking & listening, reading

Wk no.	Topic Area/ Content	Delivery Method/ Student activity	Resources	Assessments	Core curriculum references
Week 8	<p>Food packaging. Why are food packages the shape they are? What are the shapes called? Matching similar shapes How many packages fit on shelf?</p>	<ul style="list-style-type: none"> • Discussion about food packaging. • Identify as many shapes as possible. Sort into similar types. Properties • Practical measuring to work out how many of different shapes can fit on one shelf. 	<p>Examples of food packaging of a variety of shapes and sizes (learners to bring some in) Rulers</p>	<p>Q & A & observe:</p> <ul style="list-style-type: none"> • contributions to discussion • naming shapes • identifying properties <p>Results of calculations to work out how many fit onto shelf</p>	<p>MSS1/E1.4, MSS1/E2.5 MSS2/E1.1, MSS2/E2.1-2 HD1/E1.1, HD1/E2.1 Literacy – speaking & listening, reading</p>
Week 9	<p>Eating places 1. Fast food, 2. Snack bar, 3. Restaurant Plan menu for chosen venue. Describe food and price accurately.</p>	<ul style="list-style-type: none"> • Use of adjectives • Use internet to check prices • Use MS-Word to design menus • Present menus to rest of class 	<p>Internet Sample menus</p>	<p>Q & A & observe:</p> <ul style="list-style-type: none"> • contributions to discussion • using adjectives • presentations • learner Q&A • price comparisons 	<p>MSS1/E2.2 HD1/E1.1, HD1/E2.1 Literacy – speaking & listening, reading, writing</p>
Week 10	<p>Swap menus and 'buy' meals from others Add total Check change Write cheque for total Round price to nearest £</p>	<ul style="list-style-type: none"> • Adding prices and checking change • Describe how to write a cheque • Describe method of rounding learners use mini-whiteboards to practise 	<p>Calculators for checking Coins Numbers as words sheet Mini-whiteboards Marker pens</p>	<p>Q & A & observe:</p> <ul style="list-style-type: none"> • contributions to discussion • rounding • + & - <p>Spelling of numbers correct</p>	<p>N1/E1.2, N1/E2.2 MSS1/E1.1, MSS1/E2.1-2 Literacy – speaking & listening, reading, writing...</p>
Week 11	<p>Measuring – design restaurant interior Estimate and measure room length, width, height How much carpet? Measure for curtains/blinds, price</p>	<ul style="list-style-type: none"> • Using metric measures • Using appropriate measuring instruments • Working out prices 	<p>Rulers, tape measures, Helium balloon Catalogues Material Price tags</p>	<p>Q & A & observe:</p> <ul style="list-style-type: none"> • contributions to discussion • estimating • measuring <p>Results of calculations</p>	<p>MSS1/E1.4, MSS1/E2.2, E2.5, E2.9 HD1/E1.1, HD1/E2.1 Literacy – speaking & listening, reading</p>

Week 12

Time – opening hours
Work out staff costs

- Work out opening times and number of hours
 - Number/type of staff
 - Pay per hour
 - Calculate staff costs
- Clocks

Calculators for checking

- Q & A & observe:
- contributions to discussion
 - use of calculators for checking
- Results of calculations of time, staff costs

N1/E1.7, N1/E2.8
MSS1/E1.2,
MSS1/E2.2-4
Literacy – speaking & listening

Week 13

Food miles.
Work out where food is from. Work out how far it has travelled to get here.
Food box – how far have the ingredients travelled altogether. Compare to UK grown box.
Extension: Work out costs

- Discuss what food miles are
- Identify where food is from on map.
- Use mileage scale or calculate the distance by using scale on map.
- Round miles to nearest 100 miles
- Total number of miles

Atlas, maps
Food labels
Information about box schemes
Ruler
Calculator (if needed)

- Q & A & observe:
- contributions to discussion
 - use of maps, atlases and scale
 - use of calculator
- Results of calculations

N1/E1.7, N1/E2.8
MSS1/E1.4, MSS1/E2.5
HD1/E1.1, HD1/E2.1
Literacy – speaking & listening

Week 14

Visit to canteen
Identify the origin of produce on sale
Present the data to other groups

- Produce tally chart to show frequency of produce from the different countries
- Discuss ways of showing the data clearly
- Produce bar charts to show this data
- Present the charts to the other groups

Flip paper
Rulers
Paper for tally charts
Marker pens

- Q & A & observe:
- contributions to discussion
 - collection of data
 - presentations
- Correct bar charts, tally charts

HD1/E1.1-3,
HD1/E2.1-5
Literacy – speaking & listening

Appendix B Scheme of work – Environment topic

Wk no.	Topic Area/ Content	Delivery Method/ Student activity	Resources	Assessments	Core curriculum references
Week 1	<p>Recycling Video about recycling What do you think happens to rubbish? Powerpoint presentation – where would you like it to go? Compare individual recycling rates +/- Introduce tally charts</p>	<ul style="list-style-type: none"> • Watch and comment on video • Write a short paragraph. • Discuss feelings • Add & subtract numbers • <i>Learners to collect recycling data</i> 	<p>Video about recycling PowerPoint presentation Dictionaries</p>	<p>Q & A & observe:</p> <ul style="list-style-type: none"> • contributions to discussion <p>Words spelled correctly Results of + and -</p>	<p>N1/E1.1-6, N1/E2.1-4, E2.7 HD1/E1.2, HD1/E2.3- Literacy – speaking and listening, writing text...</p>
Week 2	<p>Recycling Research – how to get rid of rubbish. Time – opening times of tip, dustbin collection times Multiplication – if x cars each throw y things away how much altogether</p>	<ul style="list-style-type: none"> • Research then write paragraph • Read and understand times in analogue and digital form • Multiplying whole numbers 	<p>Internet / leaflets Dice (for x and y) calculators</p>	<p>Q& A and observe:</p> <ul style="list-style-type: none"> • use of calculator to x • team work • learners' interpretations of times & dates and of information extracted 	<p>N1/E1.7, N1/E2.8 MSS1/E1.2, MSS1/E2.3-4 HD1/E1.1, HD1/E2.1 Literacy – speaking and listening, reading, writing text.</p>
Week 3	<p>Recycling Combine individual tally charts to produce a group chart Produce a bar chart Present and interpret the information from the bar chart</p>	<ul style="list-style-type: none"> • Small groups - combine tally chart results & produce bar chart • Present in groups to class • Compare results 	<p>Individual tally charts Plain paper Marker pens Rulers</p>	<p>Q& A and observe:</p> <ul style="list-style-type: none"> • team work • presentations <p>Complete tally chart Complete bar chart</p>	<p>HD1/E1.1-3, HD1/E2.1-5 Literacy – speaking and listening</p>

Week 4

Local environment – the canal

River/canal lock visit
Carry out survey of swans and ducks
Photos about canal life - order

- Estimate (by pacing) dimensions of lock and boats
- Count and keep tally of number of swans and ducks
- Compare paces with measured lengths (back at college)
- Discuss photos and sort into order

Clip boards
Photos
Tape measures
Tally chart

- Q & A & observe learners work:
- sensible estimation
 - careful & accurate measuring
 - counting & recording
 - learner choices
- Complete tally chart (from own data)

N1/E1.1, N1/E2.1
MSS1/E1.3-4,
MSS1/E2.5
HD1/E1.2-3,
HD1/E2.3-5

Literacy – speaking
and listening

Week 5

Local environment – the canal

Why do we have locks?
Write about the lock
Statistics relating to lock – how many boats fit into the lock? How much does the depth of water change?
Statistics relating to swan and duck survey.

<http://www.startling101.bitinternet.co.uk/canals/lckworks.htm#>
Statistics about lock/boats
Swan & duck survey results
Dictionaries

- Q & A & observe learners:
- presentations of data collected
 - contribution to discussion
 - interpretation of charts
- Complete bar chart & tally chart
Words spelled correctly & positional vocabulary used

N1/E1.1-6, N1/E2.1-4,
2.7
MSS2/E1.2, MSS2/E2.3
HD1/E1.1-3,
HD1/E2.1-5

Literacy – speaking
and listening, writing
text...

Week 6

Local environment – the canal

Blake's Lock museum – opening times
What is in it? costs, restaurant

Leaflet about Blake's
Lock
museum/restaurant
Calculators

- Q & A & observe learners:
- interpretation of information from leaflets
 - use of calculator to check answers
- Results of calculations (cost of meal and change)

N1/E1.7, N1/E2.8
MSS1/E1.1,
MSS1/E2.1-2
HD1/E1.1, HD1/E2.1

Literacy – speaking
and listening,
reading...

Wk no.	Topic Area/ Content	Delivery Method/ Student activity	Resources	Assessments	Core curriculum references
Week 7	<p>Local environment - parks/gardens How many parks, gardens, open spaces – count from map of Reading Research and write about types of park Planting out Forbury Gardens - shapes of flowerbeds, +/- number of plants</p>	<ul style="list-style-type: none"> Group work to identify different types of park then write about one of them Identify shapes of flowerbeds Add & subtract numbers 	<p>Map of Reading Plan of Forbury garden Information on numbers of plants Dictionaries</p>	<p>Q & A & observe learners :</p> <ul style="list-style-type: none"> counting & identification from map identification of 2D shapes <p>Results of calculations Words spelled correctly</p>	<p>N1/E1.1-6, N1/E2.1-4, E2.7 MSS2/E1.1, MSS2/E2.1-2</p> <p>Literacy – speaking and listening, writing...</p>
Week 8	<p>Local environment - parks/gardens Planting seeds – reading and understanding instructions on seed packet. Repeated adding distances to work out space needed for seeds Make a multiplication square</p>	<ul style="list-style-type: none"> Reading and interpreting instructions Repeated adding whole numbers Produce a times table square to be laminated for future use. 	<p>Seed packets Blank times table square</p>	<p>Q & A & observe learners :</p> <ul style="list-style-type: none"> interpretation of information on seed packets identification of months and seasons of the year making connections between repeated adding & multiplying <p>Results of calculations Tables square correct & complete</p>	<p>N1/E1.4, E1.6, N1/E2.3-5, E2.7 MSS1/E1.2, E1.4 MSS1/E2.3, 2.5</p> <p>Literacy – speaking and listening, reading...</p>
Week 9	<p>Local environment - parks/gardens Give directions to park or garden Identify how much fencing needed to surround garden Identify plants that will not grow higher than the fence.</p>	<ul style="list-style-type: none"> Giving and understanding directions Calculating perimeter by adding length of sides Comparing heights 	<p>Map of Reading Plan of gardens with measurements Plant details</p>	<p>Q & A & observe learners :</p> <ul style="list-style-type: none"> Use of positional vocabulary in describing route <p>Results of calculations Results of height comparison</p>	<p>N1/E1.4, E1.6, N1/E2.3-5, E2.7 MSS1/E1.4, MSS1/E2.5 MSS2/E1.2, MSS2/E2.3</p> <p>Literacy – speaking and listening</p>

Week 10

Weather

Weather forecast – use internet to identify weather and range of temperatures in local area
Read and produce pictograms
Set up rain gauge experiment at college

- Use internet to identify local weather forecast
- Compare temperatures
- Draw & interpret pictograms
- Discuss recording of rain gauge experiment in ml

Internet access
Pictogram data
Blank paper
Container for rain
Measuring jug

Q & A & observe learners :

- interpretation of weather chart
- temperature comparisons

Complete pictogram

MSS1/E2.8
HD1/E1.1-3, HD1/E2.1,
E2.4-5

Literacy – speaking
and listening, reading

Week 11

Weather

Weather data – rainfall - What causes flooding?
Identify results of rain experiment
How do they measure rain? Standard and non-standard capacity measures
Capacity using litres and millilitres

- Discuss/research floods/drought
- Work out capacity of bottles & different shaped 1 litre containers

Bottles of water etc.
Containers
Measuring jugs
Rain experiment
Flip paper

Q & A & observe learners :

- estimating & measuring capacity
- contribution to discussion
- Making connections between standard and non- standard measurements

MSS1/E1.6,
MSS1/E2.7, E2.9

Literacy – speaking
and listening

Week 12

Power

Identify current types of fuel – coal, gas, electricity, oil
Costs – reading meters, looking at bills

- Identify current types of fuel and disadvantages
- How to read a meter
- Calculate costs
- How to read a bill

Gas/electricity bills
and examples from internet

Q & A & observe learners :

- reading dials
- reading bills

Results of cost calculations

N1/E1.2, N1/E2.2
MSS1/E1.1,
MSS1/E2.1-2, E2.9
HD1/E1.1, HD1/E2.1

Literacy – speaking
and listening

Wk no.	Topic Area/ Content	Delivery Method/ Student activity	Resources	Assessments	Core curriculum references
Week 13	<p>Power Different forms of power – wind, wave, solar, hydro-electric power, water mills How much power does a house need? How much power do appliances use?</p>	<ul style="list-style-type: none"> Identify alternative types of power and amounts created Work out how to calculate how much would be needed by a house Play appliance game (including ? and ? KW appliances) 	<p>Pie charts of types of power Appliance game Dice Calculators</p>	<p>Q & A & observe learners:</p> <ul style="list-style-type: none"> contribution to discussion interpreting pie charts interpreting and using ? and ? calculations in game use of calculator 	<p>N1/E1.7, N1/E2.5, E2.7-8 N2/E2.1-2 HD1/E2.1 Literacy – speaking and listening, reading</p>
Week 14	<p>Power National environment - clone towns, urban facilities Post Offices disappearing, does this affect you? Postage and weighing activity</p>	<ul style="list-style-type: none"> Discussion about clone towns. Write about how you would feel if there was no Post Office nearby Pricing postage and weighing & measuring packages 	<p>Postage prices Packages Scales Dictionaries</p>	<p>Q & A & observe learners:</p> <ul style="list-style-type: none"> contribution to discussion weighing measuring interpreting postage chart <p>Spelling correct Results of postage calculations</p>	<p>MSS1/E1.3-5, MSS1/E2.2, E2.5-6, E2.9 HD1/E1.1-2, HD1/E2.1, E2.3 Literacy – speaking and listening, reading</p>
Week 15	<p>National environment - beaches and coast Where are they? What is the distance to nearest beaches? How can we get there?</p>	<ul style="list-style-type: none"> Work out distance Calculate & compare costs by bus or train Plan journey using timetable 	<p>Maps & distance charts Internet Timetables Calculators Bus and train prices</p>	<p>Q & A & observe learners:</p> <ul style="list-style-type: none"> contribution to discussion reading of distance charts reading of timetables <p>Results of cost calculations and comparisons</p>	<p>MSS1/E1.1-2, E1.4, MSS1/E2.1-5 HD1/E1.1, HD1/E2.1 Literacy – speaking and listening, reading</p>

Notes

Notes

About the authors

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Christine leads the numeracy team in the Learning Skills department at Thames Valley University (formerly Reading College). She teaches Skills for Life numeracy classes, maths study skills sessions and numeracy teacher training courses. She has been a teacher researcher on two Maths4Life pathfinder projects - "Formative assessment in adult numeracy" and "Funds of knowledge".

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This booklet is produced by Maths4Life to provide teachers of adult numeracy and mathematics with ideas on using a topic-based approach. It considers pedagogical and practical issues, and provides a series of topics which have already been used successfully in the adult classroom with learners up to about Level 2.