

Problem solving

Objectives

- To consider approaches to problem solving for children with severe or profound and multiple learning difficulties
- To identify opportunities to work on problem solving in the daily mathematics lesson and throughout the school day
- To consider the respective benefits of whole-class teaching and individual or group work
- To consider strategies for teaching classes with a wide range of abilities about problem solving
- To consider the role of additional adults in supporting children's mathematical learning (optional)

Resources

- OHTs 3.1–3.8
- Video sequence 3: *Problem solving and data handling*
- Handouts 3.1–3.4
- Reference copy for the presenter of *Towards the National Curriculum for Mathematics: examples of what pupils with special educational needs should be able to do at each P level* (DfES 0637/2001)
- Reference copy for the presenter of *Planning, teaching and assessing the curriculum for pupils with learning difficulties: mathematics* (QCA/DfES 2001)

Outline of the session		
Introduction Problem solving in an SLD/PMLD context	Talk Discussion	10 minutes
Progression in problem solving Planning for progression in learning	Talk Discussion Activity	15 minutes
Seizing opportunities Ideas for problem solving throughout the school day	Discussion Activity	15 minutes
The daily mathematics lesson Using the three-part lesson structure	Video Discussion	30 minutes
The role of additional adults in the classroom (optional) Considering ways in which additional adults can enhance children's learning	Discussion	15 minutes
Conclusion Key points from the session	Talk	5 minutes

Introduction

10 minutes

OHT 3.1

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Show **OHT 3.1** and talk through the objectives for the session.

Say that the term 'problem solving' in mathematics can sometimes present a stumbling block for staff in settings for children with severe or profound and multiple learning difficulties, because it is not always clear what problem solving means for these children.

Ask whether this is the case for participants, and how confident they feel in planning their teaching of problem solving.

Say that confidence can be increased if we think of problem solving as any activity where a solution is required to a real-life situation. At an early stage of learning, this might be how to operate a switch to gain access to a preferred stimulus, or how to fit an object into a box; at a later stage it might be finding out whether there are enough cups for everyone in the class to have a drink, or estimating how many large bottles of squash will be needed for the school fete.

OHT 3.2

The key skills of problem solving

Perception

- recognising opportunities
- recognising and identifying problems

Thinking

- breaking down a problem into elements
- thinking through the relevant features of a problem
- planning ways to solve a problem

Action

- remembering how to solve a problem

Evaluation

- evaluating how a plan worked
- recognising when existing plans and strategies need changes

Show **OHT 3.2**. Remind participants about what the QCA guidance *Planning, teaching and assessing the curriculum for pupils with learning difficulties: developing skills (QCA/DfES 2001)* has to say about the key elements of problem solving, as follows.

Perception

- Recognising opportunities, *e.g. taking part in group attempts to solve problems – such as 'How many bottles of coke, lemonade and squash will we need to buy for our party?'*
- Recognising and identifying problems, *e.g. a favourite toy out of reach, a missing bus pass before a journey, being in an uncomfortable position, needing to find out which type of soft drink will be most popular at the party.*

Thinking

- Breaking down a problem into elements, *e.g. organising a meal which involves buying food, then cooking and serving the food and clearing away, or (for the party) deciding to find out first the most popular drink, then how many glasses people are likely to drink, then how many glasses in a bottle ...*

- Thinking through the relevant features of a problem, *e.g. what to do when faced with an overflowing sink, or (for the party) what information needs to be collected.*
- Planning ways to solve a problem, *e.g. talking to other children about previous solutions to similar difficulties, or planning a simple survey of preferences for different soft drinks.*

Action

- Remembering how to solve a problem, *e.g. using strategies such as rehearsal, visualisation or a symbol script.*

Evaluation

- Evaluating how a plan worked, *e.g. honestly assessing the value of a contribution after a problem-solving attempt, checking whether the right information was collected.*
- Recognising when existing plans and strategies need changes, *e.g. stopping to think and talk to other children before starting to act, deciding to carry out a survey in a different way next time.*

Problem solving can be approached in three different ways: go through the approaches in **OHT 3.3**. Ask participants for further examples of each approach from their own classes.

OHT 3.3**Approaches to problem solving****Practical investigation**

- Children to investigate 'How many?' or 'What if?' (How many items will fit into a box, or cups of juice can be poured from a jug, etc.)

Enquiry

- What kind of animal should we have as a school pet?
- What flavour ice-cream do most people like?

Trial and improvement

- Which toys or items will fit into the different-sized boxes? How can we find out?

Problem solving also lends itself to a number of different ways of organising lessons. Show

OHT 3.4, comparing the two different organisational arrangements which they describe.

OHT **3.4**

Organising the lesson

Approach A

- Start with and discuss a task during the introduction to the lesson, involving the whole class
- Children then continue with the same task or activity in small groups with targeted adult support

Approach B

- Complete the activity as a whole class
- Follow on from this with children working on related tasks, appropriately differentiated

Give an example of **Approach A**, as follows.

Activity: Choosing a greeting card and posting it to a friend or family member.

Problems to be solved: What kind of card? What envelope will fit? How do we get it to the recipient?

In groups or individual work:

- 1 Sort two cards and envelopes with obvious differences, discussing why the large one won't fit into the small envelope.
- 2 Sort more cards with less obvious differences, discussing how to decide what to do if one card fits two envelopes.
- 3 Sort cards for different occasions, e.g. birthday, Christmas, wedding, etc., discussing why we have cards for different occasions and asking questions such as 'What card would you send John for his birthday?'

Now give this example of **Approach B**.

Activity: Getting ready for a trip out of school, discussing what you might need to go to the beach or park. As a class make a list of items and collect them.

Problems to be solved: What do we need to take on our trip to the beach or park? How many of each do we need? What containers will be suitable to take them in?

Related tasks:

- Children check the items listed, ensuring there are enough for everyone in the class.
- Children decide on an appropriate bag or box to hold everything.
- Children sort through additional items such as hats and choose the ones they think will be suitable from a box containing sun hats, woolly hats, baby hats, adults' hats, helmets, etc.

Progression in problem solving

15 minutes



Activity

Refer to the booklet *Towards the National Curriculum in Mathematics: examples of what pupils with special educational needs should be able to do at each P level*. Draw attention to the specific reference to problem solving (pages 12–15).

P levels 1 to 3 refer to communication with adults, particularly with reference to patterns and sequences, and anticipating results.

P levels 4 to 8 are more structured and can be broken down into two distinct areas:

- reasoning about numbers or shapes;
- problems involving 'real life', money or measures.

Give out **handout 3.1**, explaining that it suggests a progression in problem-solving activities, linked to the exemplification of P level descriptors in the booklet.

Ask participants in pairs to read and discuss each of the P levels and where the work they are doing in school fits into the progression chart.

Take brief feedback.

Suggest that progression charts such as this one can be written for the children in an individual school.

Suggest that this could be a supplementary activity to do as a whole-school staff.

Seizing opportunities

15 minutes



Activity

Ask participants to work in pairs again. Give out **handout 3.2** and ask each pair to work on one of the times of day on the handout. Make sure that between them the group cover all the times of day. Ask them to identify problem-solving opportunities which might present themselves at that time.

Give out **handout 3.3** and ask participants to compare their ideas with those listed on the handout. Take feedback on additional ideas to add to the handout: record these so that you can later provide participants with a collated list.

The daily mathematics lesson

30 minutes

Explain that the next part of the session uses a video sequence.

Before showing the video, put up the questions on **OHT 3.5**.

OHT 3.5

Discussion questions

- What problems were the children solving in the lesson?
- Which of the three approaches to problem solving (practical investigation, enquiry, trial and improvement) were used?
- Which of the key skills of problem solving (perception, thinking, action, evaluation) did the children demonstrate?

Explain that the video sequence shows the application of problem-solving skills to a whole-class data handling lesson. Share the teacher's lesson notes with participants (**handout 3.4**), reminding them that these notes were written to accompany and provide a context for the video sequence and are therefore more detailed than the teacher's normal planning.

After showing the video sequence, take feedback and discuss the questions posed. Emphasise the following points.

- There were two problems for the children to solve: first, categorising the group into children who were in school and children who were at home, and second, deciding how many of each flavour of crisps the teacher would need to buy for the group.
- The approach used was one of enquiry rather than practical problem solving or trial and improvement.
- The teacher helped children to recognise and identify the problem (**perception**) when she explained that she needed to know how many of each flavour of crisps would be needed; some of the children spontaneously recognised another problem to be solved when they noticed that the flavours on the table did not match the chart.
- The teacher modelled the **thinking** needed to solve the problem: for example, breaking the problem down into elements.
- All the children took part in the **action** and were supported in **remembering** how they had solved the problem.
- There was a good deal of **evaluation**, particularly when the group noticed the error that had been made and were asked to comment on what should be done to correct it.

Then ask participants in threes to discuss the questions on **OHT 3.6**.

OHT 3.6

Questions to consider

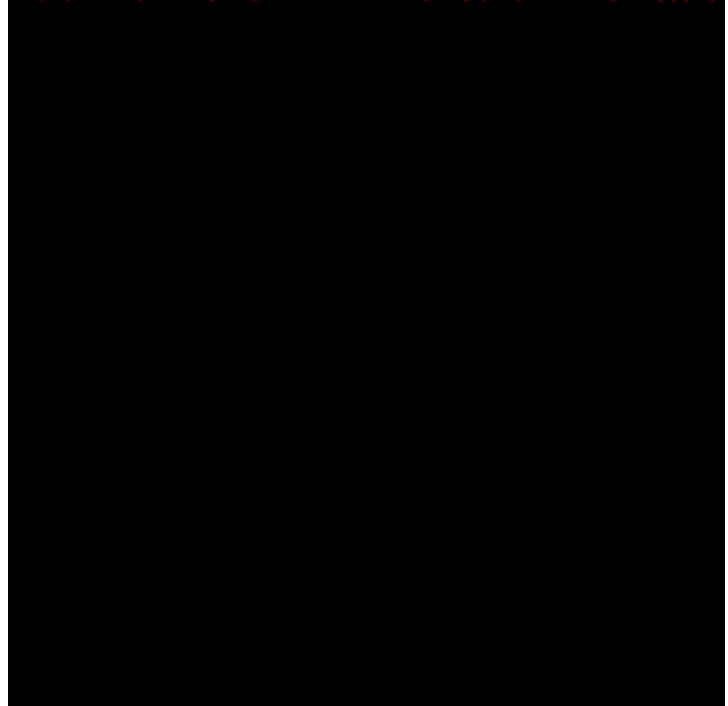
- Which areas of mathematics lend themselves to whole-class teaching in schools or settings for children with severe or profound and multiple learning difficulties?
- What are the benefits of whole-class teaching over group or individual work?
- When would you use a mixture of the two approaches to teaching?

Take feedback, reinforcing that whole-class teaching:

- can give a clear focus on the learning objectives for the lesson, which may be missing when everyone is working in small groups or on individual tasks;
- enables children to learn from one another;
- can help to develop language skills, as children who are verbal explain their thinking to others;
- promotes the skills of social interaction.

Say that some tasks – like the problem-solving tasks on the video – lend themselves to whole-class teaching throughout the lesson. In general, however, a mixture of whole-class and individual or small-group work should be used, particularly where the range of ability in the class is wide.

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The role of additional adults in the classroom (optional)

15 minutes

OHT 3.7

The role of additional adults

Additional adults can enhance children's learning by encouraging them to:

- apply skills
- consolidate learning

They can be deployed to:

- direct children's learning
- encourage and enable participation
- evaluate reactions and responses
- model approaches and vocabulary
- illustrate ideas
- use questioning
- explain tasks
- deal with some disruptions

Show **OHT 3.7**.

Ask participants which of these roles they noticed in the video sequence. Ask for examples of how the roles were fulfilled.

Emphasise the key role played by additional adults in encouraging and enabling participation, modelling approaches to the task and developing vocabulary.

Ask participants, each teacher working with the teaching assistants in their team, to review a recent mathematics lesson in their classroom, considering which of the roles of additional adults were planned for and which might be further developed.

Conclusion

5 minutes

OHT 3.8

Key points

- Start from the children's interest level and relate problem solving to real-life situations
- Provide a selection of tasks or activities that include:
 - practical investigation
 - enquiry
 - trial and improvement
- Link the activities to progression within the P levels
- Use opportunities throughout the school day to support work in the daily mathematics lesson; encourage children to use and apply their skills in other contexts

Finish by showing **OHT 3.8**. Remind participants that the video sequence showed a structured 'enquiry' approach, and that there are other equally valid approaches to problem solving which are readily applicable to the practical, hands-on and multi-sensory learning which takes place in settings for children with severe or profound and multiple learning difficulties.



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OHT 3.2

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Approaches to problem solving

Practical investigation

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Enquiry

- What kind of animal should we have as a school pet?
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Discussion questions

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OHT 3.6

Questions to consider

- Which areas of mathematics lend themselves to whole-class teaching in schools or settings for children with severe or profound and multiple learning difficulties?
- What are the benefits of whole-class teaching over group or individual work?
- When would you use a mixture of the two approaches to teaching?



The role of additional adults

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- consolidate learning

They can be deployed to:

- direct children's learning
- encourage and enable participation
- evaluate reactions and responses
- model approaches and vocabulary
- illustrate ideas
- use questioning
- explain tasks
- deal with some disruptions



OHT 3.8

Key points

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 - practical investigation
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- Link the activities to progression within the P levels
- Use opportunities throughout the school day to support work in the daily mathematics lesson; encourage children to use and apply their skills in other contexts

Handout 3.1

page 1 of 2

Progression in problem solving

P level	Level descriptors	Examples of learning contexts/activities	Page reference*	Questions/stimulus/response
P1 (i)	Encounter activities and experiences. May be passive or resistant. May show simple reflex responses	Smell or taste foods in a context where the group are making a choice Experience repeatedly the contrasting features of objects or sounds	12	Children react through: <ul style="list-style-type: none"> – eye contact – eye pointing – head turning – known cry/sound – physical movement – facial movement
P1 (ii)	May have periods when they appear alert and ready to focus their attention on certain people, events, objects or parts of objects	Use eye movement or reflexive reactions to show awareness of light, sounds, or movement to music that stops and is started again Play 'Pass the parcel' with a bell wrapped inside and tactile paper. Use a bow of textured ribbon to undo	12	
P2 (i)	React to new activities and experiences Accept and engage in coactive exploration	Move (with support) items from one place to another Switch attention between contrasting objects	12	
P2 (ii)	Perform actions, often by trial and improvement Cooperate with shared exploration and supported participation	Use a switch to gain a response required from toy or computer software, by trial and error Use a 'big mac' to make a response	12	
P3 (i)	Explore materials in increasingly complex ways Observe the results of their own actions with interest	Reach into a bag to feel objects in party game Explore/ play' with toys/items selected	12	
P3 (ii)	Apply potential solutions systematically to problems	Apply remembered solutions to make things happen Consistently use a particular response to ask for a turn in a game	12	
P4	Anticipate, follow and join in mathematical activities when given a contextual clue	When prompted, match cakes to plates in order that there is one each Set the table for a party, collect responses of who wants to eat what	15	'Has everybody got a cake on their plate?' 'What does [name] want to eat?'
P5	Solve simple problems practically	Group objects that have similar key features such as shape (or colour), or functions, e.g. all cups Make small sets the same Help set the table with sandwiches, biscuits and crisps Select appropriate containers for items of different sizes; put items away in boxes, or wrap presents using boxes	13 15	In setting the table, ask children 'Are there any more cups/plates/forks, etc.?' 'What shall we do with all the cakes?' 'What else can we put on this plate with the cheese sandwiches?' 'How can we wrap these gifts? Will this item fit into the box?'

*Page references are to Towards the National Curriculum in Mathematics: examples of what pupils with special educational needs should be able to do at each P level (DfES 0637/2001)

Handout 3.1 page 2 of 2

Progression in problem solving

P level	Level descriptors	Examples of learning contexts/activities	Page reference*	Questions/stimulus/response
P6	Sort objects and materials according to criteria Begin to identify when an object is different and does not belong to given categories	With assistance, order up to three socks or items of clothes by length along a washing line, using obvious size differences – baby sock, own sock, Christmas stocking Put all the food into the basket for the picnic; put all the play equipment into the box Indicate which items should not go in the food basket where examples differ, e.g. football in with the apples, etc.	12 15	'Is this [hold up item] longer than this [hold up another item]?' Try items on a mannequin, ask which fit 'Is this something we could eat?' 'Would you play with this?' 'Does this [show item] go into the basket?' 'Would you eat this?'
P7	Identify when an object is different or does not belong to a familiar category Complete a range of classification activities using given criteria	Remove items and give reasons – eye point to labels Sort all the toothbrushes and pencils, put them into sets (using a pencil case and toothbrush holder)	15 15	'Can you put all the clothes together in the suitcase?' 'Does this belong in the pencil case or the toothbrush holder?'
P8	Recognise, describe and recreate simple repeating patterns and sequences Begin to use their developing mathematical understanding of counting to solve simple problems encountered in play, games or other work	Ensure all children in the group have a coat, sun hat or gloves to play out Find out that there are not enough aprons for the art lesson and fetch one more Count out enough cups for everyone to have a drink	13 15	'Where are [name]'s gloves?' 'Has [name] got a hat?' 'Has everyone got a cup to have a drink?' 'Do we need more/fewer cups?' 'How many do we need?' 'How many more do we need?'

*Page references are to Towards the National Curriculum in Mathematics: examples of what pupils with special educational needs should be able to do at each P level (DFES 0637/2001)

Handout 3.2

Opportunities for problem solving throughout the day

Time of day	Opportunities
Register	<ul style="list-style-type: none"> ➤ ➤ ➤
Assembly	<ul style="list-style-type: none"> ➤ ➤ ➤
Break time	<ul style="list-style-type: none"> ➤ ➤ ➤
Drinks/snack time	<ul style="list-style-type: none"> ➤ ➤ ➤
Dinner time	<ul style="list-style-type: none"> ➤ ➤ ➤
Physiotherapy sessions	<ul style="list-style-type: none"> ➤ ➤ ➤
Home time	<ul style="list-style-type: none"> ➤ ➤ ➤
Daily mathematics lesson	<ul style="list-style-type: none"> ➤ ➤ ➤
At home	<ul style="list-style-type: none"> ➤ ➤ ➤

Handout 3.3

Opportunities for problem solving throughout the day

Time of day	Opportunities
Register	<ul style="list-style-type: none"> ➤ Sets – children in, children not in ➤ Carroll diagram girl/boy in/out ➤ Choice of meals, hot dinner, packed lunch
Assembly	<ul style="list-style-type: none"> ➤ Girls or boys to go into line first ➤ Pattern – girl – boy – girl – boy, etc. ➤ All wheelchairs to the back, set chairs for others (how many?)
Break time	<ul style="list-style-type: none"> ➤ 1 coat/2 gloves per person ➤ Toy/car for each child – who wants what? (take vouchers, one child to give them out)
Drinks/snack time	<ul style="list-style-type: none"> ➤ 1 cup per person, how many altogether? ➤ Choice – who wants what? orange/milk/water ➤ 1 biscuit per plate ➤ How many biscuits are left in the tin?
Dinner time	<ul style="list-style-type: none"> ➤ Setting the table – knives/forks ➤ Food choice – likes/dislikes ➤ Napkins for children ➤ Rota for clearing the table
Physiotherapy sessions	<ul style="list-style-type: none"> ➤ Choose a ball to hold or bounce from the basket (with other items including the ball) ➤ How can you move over to the ...? What is in the way?
Home time	<ul style="list-style-type: none"> ➤ Coats per child ➤ Giving out homework ➤ Queuing for the bus – which bus stop do you need?
Daily mathematics lesson	<ul style="list-style-type: none"> ➤ Hand puppets with faces of the children attached ➤ Finding the 'mathematics box' ➤ How many people are here for mathematics today? ➤ Data handling – human graphs – children stand in sets, choices, how many? ➤ Number – Have we got enough _____? ➤ Shape, space and measures – putting items in boxes, how many will fit? Check by counting
At home	<ul style="list-style-type: none"> ➤ Select which toys to play with, which TV programmes to watch ➤ Order the events leading up to going to bed, e.g. having a bath, choosing pyjamas, cleaning teeth, etc.

Handout 3.4

The daily mathematics lesson

Lesson notes

The mental or oral starter

Objectives: Anticipate, follow and join in mathematical activities when given a contextual clue

Activities: From the class set of photographs, each child is to indicate his/her photograph (in some cases using mirrors to compare). Put the pictures on to school picture to say who is present. Ask questions 'Is here today?' Photographs of any absent children will remain on the picture of their house.

Pose the questions 'How many children are in our class today? How can we find out?' Count the photographs, encourage pupils to point to each photograph in turn. Adults to count the number of pupils.

Vocabulary

How many?

Resources

Photographs of each child, school picture, picture of children's houses or one picture to indicate home

The main teaching activity

Objectives: Solve simple problems practically

Use data to help solve a simple problem

The teacher will ... pose the problem: 'We are going to have crisps with our drinks today. How many of each flavour will we need? Which flavour do most children in our class like the best?'

She will demonstrate the various flavour options and ask the children how we can show which flavour we like the best.

The pupils will ... be given the opportunity to choose a flavour of crisps by testing all the options available from the packets. Once they have made a decision they will take or be given a card to represent their choice. All children will select a card.

Using the crisp packets as a stimulus, the teacher will make a simple pictogram to show the choices and ask each child to add their card. This will show the most popular choice within the class.

Vocabulary

Problem, choice, how many?

Resources

Various flavours of crisps (salt and vinegar, ready salted, cheese and onion) crisp cards, coloured plates (red, blue, green)

The plenary

Which flavour do we need the most of? How many packets of crisps will I need?

Children to select the packet they chose from all the choices using the colour of the packet.

Handling data

Objectives

- To consider the range of opportunities for teaching data handling in settings for children with severe or profound and multiple learning difficulties
- To outline the data-handling cycle
- To explore the links between data handling and P level exemplification
- To consider strategies for teaching classes with a wide range of abilities about data handling
- To consider the role of questioning in supporting children's learning (optional)

Resources

- OHTs 4.1–4.7
- Video sequence 3: *Problem solving and data handling*
- Handouts 3.2, 3.4 and 4.1–4.3 for each participant
- Sets of cards made by cutting up handout 4.3: one set for every four participants
- *Towards the National Curriculum for Mathematics: examples of what pupils with special educational needs should be able to do at each P level* (DfES 0637/2001): enough copies for one between two
- *Accessing the National Curriculum for Mathematics: examples of what pupils with special educational needs should be able to do at each P level* (DfES 0292/2002): enough copies for one between two, or photocopies of pages 26–29

- Reference copy for presenter of *Planning, teaching and assessing the curriculum for pupils with learning difficulties: mathematics* (QCA/DfES 2001)
- Reference copy for presenter of the *Framework for teaching mathematics: Reception to Year 6* (DfES NNFT 1999)

Outline of the session

Introduction Introducing the session objectives and considering the place of data handling in the curriculum	Talk	5 minutes
Data-handling opportunities Looking at the data-handling cycle and opportunities for data handling throughout the day	Talk Discussion Activity	15 minutes
Collecting and representing data Considering ways of representing data, and linking data handling to the P levels	Talk Activity	20 minutes
Observing teaching strategies Observing a data handling lesson	Video Discussion	15 minutes
The use of questioning (optional) The use of questions at each stage of the data-handling cycle	Activity	15 minutes
Conclusion Key points from the session	Talk	5 minutes

Introduction

5 minutes

OHT 4.1

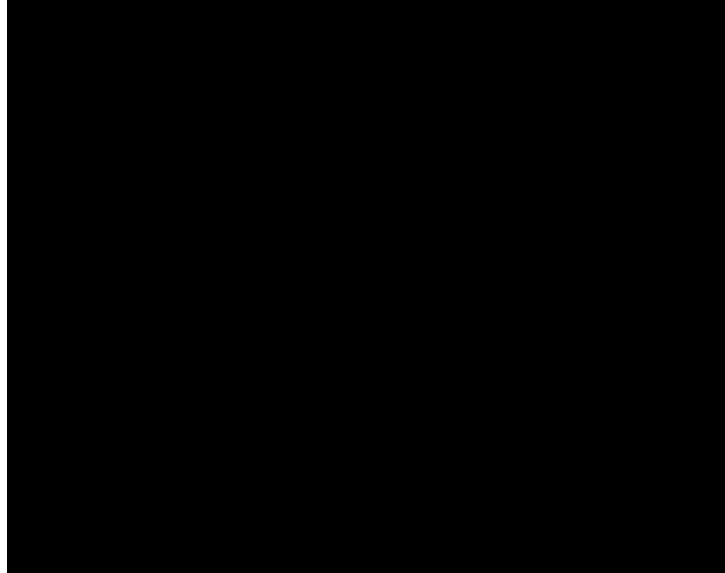
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- to consider the role of questioning in supporting children's learning (optional)

Show **OHT 4.1**, which gives the session objectives. Say that in this session there will be time to consider the place that data handling has in the mathematics curriculum for children with severe or profound and multiple learning difficulties. This session will also identify the steps in the data-handling cycle and give time to discuss teaching strategies.

While the handling data strand of mathematics is not explicitly labelled as such in the National Curriculum until Key Stage 2, in Key Stage 1 it is embedded within number, and is explicit as a strand in all key stages in the National Numeracy Strategy *Framework for teaching mathematics: Reception to Year 6*. Even at the P levels, there are crucial early activities which lay the foundations for data handling. In order to maintain high expectations for all children, it is also necessary to be aware of the progression within the P levels. While a child may be working at a particular P level most of the time, there will be times when the objective and activity planned can enable him or her to operate at higher levels.

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OHT 4.2

QCA guidance

Teaching data handling across the key stages can help pupils to:

- associate an object, and later a symbol, with a real event, person or item
- use symbols to represent events, people and items
- represent information or data in a variety of forms and describe them to others
- select information that is of particular relevance or interest to be represented and, once collected, draw conclusions from the outcome

Explain that the QCA mathematics document *Planning, teaching and assessing the curriculum for pupils with learning difficulties* gives guidance on the benefits of teaching data handling across all key stages. Talk through **OHT 4.2**.

The skill of collecting, recording, interpreting and presenting data also helps children to apply mathematics in practical situations, thereby reinforcing work in 'using and applying mathematics'.

Data-handling opportunities**15 minutes**

OHT 4.3

Five aspects of the data-handling cycle

- specify the problem
- plan
- collect data
- process and represent
- interpret and discuss

Show **OHT 4.3**, which illustrates the data-handling cycle. Expand on each bullet point, as follows.

Specify the problem: formulate questions in terms of the data needed and the type of inference to be made from them. For example, if the problem is specified as 'Which type of sandwich should we take on our school picnic?', the data needed can be framed as 'What are the most popular flavours in sandwich fillings?'

Plan: decide what data should be collected, including sample size and data format, and what statistical analysis needs to be carried out. In the sandwich example, this might be: data from all children and staff, data on everyone's choice out of five flavours, data represented as a tally chart, block graph or pictogram.

Collect data: obtain data from a variety of appropriate sources, including experiments and surveys, and primary and secondary sources. In the sandwich example, the data would be collected from a primary source (actually asking people) rather than from a secondary source (data reported by others – such as a report from a well-known store on the popularity of various types of sandwich).

Process and represent: reduce the raw data into summary information, including lists, tables and charts – such as a tally chart showing the numbers of people choosing each of the five types of sandwiches.

Interpret and discuss: to provide insight into the problem, relate summarised data to the initial questions – for example, ask children to use the tally chart to decide what type of sandwich to make for the picnic.

It is important to emphasise the direct link to problem-solving skills, in particular those of enquiry and data handling, since data is collected, represented and interpreted in response to a real question or problem.



Activity

Ask participants to look at **handout 4.1**. Explain that the headings have been taken from the 'Opportunities and activities at Key Stage 2' section of the QCA mathematics document *Planning, teaching and assessing the curriculum for pupils with learning difficulties*. The document emphasises that the key aspect of data handling for children with learning difficulties is to 'represent information and communicate to others'.

Give out copies of **handout 3.2**, *Opportunities for problem solving throughout the school day*, from the problem-solving session.

Work in pairs, using handout 3.2 as a prompt and noting down on handout 4.1 opportunities for handling data throughout the day and in the daily mathematics lesson. After about **8 minutes**, take feedback and emphasise how much data-handling work is already being done but may not be recognised. Make the following points.

- Links can be made between data handling in mathematics and other subjects.
- There are opportunities throughout the day for children to handle data: for example, making choices through a communications board or keeping a tally of who is present in the classroom.
- School events such as picnics, parties and sports days lend themselves to handling data: for example, what type of sandwich should we have for a picnic?
- All adults engaging with children, including therapists and care assistants, should be aware of the opportunities that exist so that they can also reinforce the learning.

Explain that the next part of the session will look at different ways to collect and represent information and identify data handling within the P level descriptions.

Collecting and representing data

20 minutes

OHT 4.4

Representing data

table (Y1)	frequency table (Y3)
pictogram (Y2)	tally chart (Y4)
block graph (Y2)	bar line chart (Y5)
Venn diagram (Y3)	line graph (Y5)
Carroll diagram (Y3)	pie chart (Y6)
bar chart (Y3)	

Put up **OHT 4.4**. Explain that it lists the most common ways of representing data, with the year group in which they first appear in the National Numeracy Strategy *Framework for teaching mathematics: Reception to Year 6*.

Say that graphs and charts provide ways of displaying a set of information that has been collected together for a purpose. Graphs and charts represent complex information at a glance and use space economically – as in, for example, a price chart or a bus timetable. The way that the data is represented should reflect the purpose of the data collection.



Activity

Give out **handout 4.2**. Ask participants, working with a partner, to label each of the charts or graphs with one of the descriptions on OHT 4.4.

OHT 4.5

Representing data

- 1 frequency table
- 2 pictogram
- 3 table
- 4 line graph
- 5 tally chart
- 6 pie chart
- 7 Carroll diagram
- 8 block graph
- 9 bar line chart
- 10 Venn diagram
- 11 bar chart

Show **OHT 4.5**, the correct answers, and ask participants which graphs or charts they found it most difficult to put a name to.

Explain that:

- **charts**, such as pictograms and pie charts, often display unrelated items having no natural order, e.g. ways of coming to school;
- **graphs**, such as line graphs, usually display data that represent the relationship between two variables, and have natural order, e.g. the growth of plants over time.

Say that while some children with severe learning difficulties may be able to use representations like those in handout 4.2, others will use alternative ways of representing information.

OHT 4.6

Representing data

- positioning children in lines to show choices
- finger tallies
- placing name labels in set rings
- placing objects on plastic block graph mats
- photographing children or objects to show sets
- sorting objects into boxes
- tallies, ticks
- photographs on communication boards
- lining objects up, e.g. choice of crisps, biscuits, drink
- using block charts made of towers of blocks or bricks

Show **OHT 4.6**, which suggests some of these options. The first bullet point is an example of 'human graphs'. Venn diagrams can be created using hoops or skipping ropes, and Carroll diagrams and block graphs can be made using masking tape and labels.



Activity

Ask participants to work in pairs and look at *Towards the National Curriculum for Mathematics: examples of what pupils with special educational needs should be able to do at each P level*.

Each pair should focus on a different strand of mathematics (numbers and the number system, calculations, solving problems, and measures, shape and space), tracking across the P levels.

Ask them to focus on the following questions.

- Which examples could be considered as data handling?
- How might the data be collected?
- How might the data be represented?

After about **10 minutes** take feedback and emphasise the need to make activities relevant to children's lives. Remind participants that magazines, shopping catalogues and junk mail also provide stimulating materials for representing information.

While teachers working with children at primary level are not required to be familiar with the Key Stage 3 curriculum, it would be useful to be aware of the relevant supplement of examples for data handling as none exist in the primary document *Towards the National Curriculum for Mathematics: examples of what pupils should be able to do at each P level*. Remind teachers that some of the activities may not be age-appropriate for primary children. Allow **about 5 minutes** to look at the examples on pages 26–29 of *Accessing the National Curriculum for Mathematics: examples of what pupils with special educational needs should be able to do at each P level*.

Take feedback and ask participants to suggest additions to the list of representations on OHT 4.6.

Observing teaching strategies

15 minutes

If you have previously worked through session 3 on problem solving, explain that you are now going to watch the video sequence from that session again. This time it will be viewed with a different question in mind.

If you have not previously worked through the session on problem solving, give out **handout 3.4** from that session, explaining that it shows the teacher's lesson notes. Remind participants that these notes were written by the teacher to accompany the video and as a result are more detailed than the teacher's normal planning. Allow a few minutes to read the handout.

OHT **4.2**

QCA guidance

Teaching data handling across the key stages can help pupils to:

- associate an object, and later a symbol, with a real event, person or item
- use symbols to represent events, people and items
- represent information or data in a variety of forms and describe them to others
- select information that is of particular relevance or interest to be represented and, once collected, draw conclusions from the outcome

Put up **OHT 4.2** again. Ask participants, as they watch the video sequence, to look for examples of these four elements of data handling.

After showing the video, take feedback, drawing out:

- the association between symbols – photographs of the children and their homes, crisp packets, and cards with small photographs of crisp packets – and people or objects;

- the forms in which data were represented: sorting into sets (present/absent, with the symbolic representation reinforced with a headcount), a block graph (using symbolic representation of crisp choices);
- the conclusions drawn about whether there were 'enough' of each type of crisp for the class.

The use of questioning (optional activity) 15 minutes

OHT 4.3

Five aspects of the data-handling cycle

- specify the problem
- plan
- collect data
- process and represent
- interpret and discuss

Put up **OHT 4.3** again. Ask participants to work in fours. Give each group of four a set of cards made by cutting up a copy of **handout 4.3**, which lists the questions used in the video sequence. Ask each group to sort their cards into piles, representing the five stages in the data-handling cycle shown on the OHT: specify the problem; plan; collect data; process and represent the data; interpret and discuss.

Discuss the outcome of this sorting exercise. You should find that most of the questions relate to the 'interpret and discuss' stage of the cycle – appropriately, since it is at this stage that the teacher needed to relate the data to the practical problem to be solved, and help children reflect on what they had found out. There was also – again appropriately – a scattering of questions at the stages of specifying the problem, collecting the data, and processing and representing the data. There are none at the planning stage. Might it have been useful to ask questions to help plan the data to be collected, or decide how to represent the data? Or would this have been too difficult for the group? Discuss these issues, asking for any suggestions on how to frame questions at the planning stage.

Finally, ask participants to look through all the questions again and nominate, in their groups, particular questions which they feel moved the children's thinking on. Take feedback, asking for the reasons for their choice. Open up the discussion into issues such as the purpose and place of open and closed questions, giving children plenty of time to respond, and questioning to reinforce learning.

Conclusion

5 minutes

Finish by showing **OHT 4.7** and talking through the key points from the session.

OHT 4.7

Key points

- Data handling is relevant to all children, whatever the stage in their learning
- Data handling should always be in response to a specific question or problem
- Data-handling opportunities exist throughout the day and not just in the daily mathematics lesson
- Children should be involved in interpreting a variety of representations of data
- It is helpful to understand the stages in the data-handling cycle, and plan teaching accordingly

OHT 4.1

Objectives

- to consider the range of opportunities for teaching data handling in settings for children with severe or profound and multiple learning difficulties
- to outline the data-handling cycle
- to explore the links between data handling and P level exemplification
- to consider strategies for teaching classes with a wide range of abilities about data handling
- to consider the role of questioning in supporting children's learning (optional)



QCA guidance

Teaching data handling across the key stages can help pupils to:

- associate an object, and later a symbol, with a real event, person or item
- use symbols to represent events, people and items
- represent information or data in a variety of forms and describe them to others
- select information that is of particular relevance or interest to be represented and, once collected, draw conclusions from the outcome





Five aspects of the data-handling cycle

- specify the problem
- plan
- collect data
- process and represent
- interpret and discuss



Representing data

table (Y1)

frequency table (Y3)

pictogram (Y2)

tally chart (Y4)

block graph (Y2)

bar line chart (Y5)

Venn diagram (Y3)

line graph (Y5)

Carroll diagram (Y3)

pie chart (Y6)

bar chart (Y3)





OHT 4.5

Representing data

- 1 frequency table
- 2 pictogram
- 3 table
- 4 line graph
- 5 tally chart
- 6 pie chart
- 7 Carroll diagram
- 8 block graph
- 9 bar line chart
- 10 Venn diagram
- 11 bar chart



Representing data

- positioning children in lines to show choices
- finger tallies
- placing name labels in set rings
- placing objects on plastic block graph mats
- photographing children or objects to show sets
- sorting objects into boxes
- tallies, ticks
- photographs on communication boards
- lining objects up, e.g. choice of crisps, biscuits, drink
- using block charts made of towers of blocks or bricks

OHT 4.7

Key points

- Data handling is relevant to all children, whatever the stage in their learning
- Data handling should always be in response to a specific question or problem
- Data-handling opportunities exist throughout the day and not just in the daily mathematics lesson
- Children should be involved in interpreting a variety of representations of data
- It is helpful to understand the stages in the data-handling cycle, and plan teaching accordingly

Handout 4.1

Opportunities for teaching data handling

Representing and communicating information	
Recognise symbols	
Throughout the day	The daily mathematics lesson
Represent information	
Throughout the day	The daily mathematics lesson
Interpret data	
Throughout the day	The daily mathematics lesson

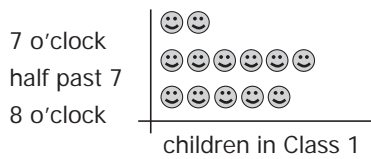
Handout 4.2

Ways of representing data

1. Our favourite colours

Favourite colours	Votes
blue	6
green	4
pink	8
red	7

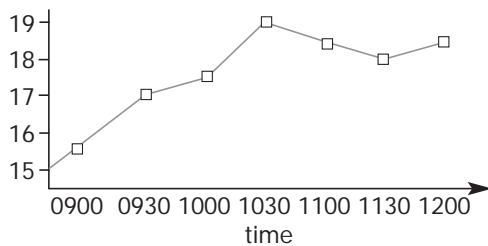
2. Our bed times



3. Our names

3 letters	4 letters	5 letters	6 letters
Ann	Kate	Halim	Pritam
Sam	Ajit	David	Sophie
Ali	Tara	Jyoti	
	Mark		

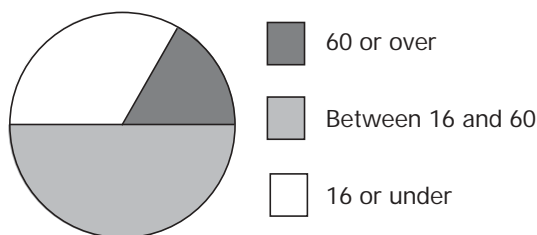
4. Room temperature on 19 May



5. Our illnesses

German measles	### ///
Mumps	///
Chicken pox	### ##
Flu	### ## ///
Measles	/

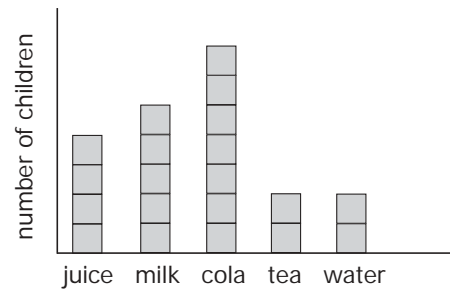
6. Ages of the population of Ham village



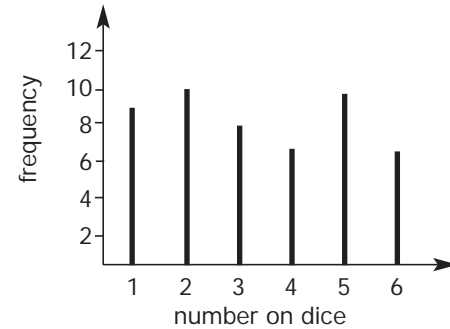
7. Our favourite crisps

	boys in our school	girls in our school
prefer plain crisps	15	11
prefer flavoured crisps	20	14

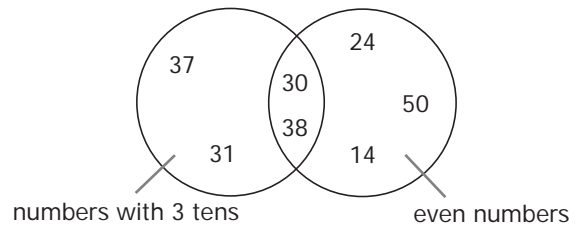
8. What we like to drink



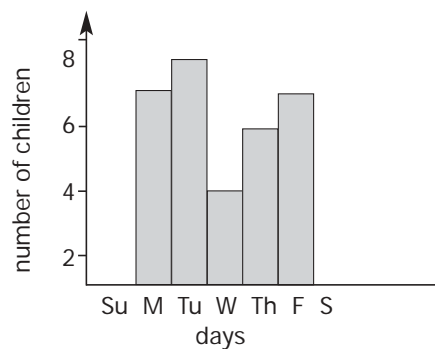
9. Rolling a dice



10. Sorting numbers



11. Children absent from school



Handout 4.3

Questioning

<p>(While the children are tasting the crisps)</p> <p>1. Which one did you like best? Which crisps did you like best?</p>	<p>(After the crisps from the shopping basket have been given out)</p> <p>9. How many packets of green should be on the table now?</p>
<p>(When the teacher brings out the chart)</p> <p>2. We've got to work out how many crisps I need to buy – what have I got at the bottom here?</p>	<p>(After the crisps from the shopping basket have been given out)</p> <p>10. How many cheese and onion should we have on the table?</p>
<p>(When the children are sticking their cards on the chart)</p> <p>3. Chastity, where do you think your little card will go?</p>	<p>(After the crisps from the shopping basket have been given out, and the group find that there are too many of one colour on the table and not enough of another)</p> <p>11. So what should we do?</p>
<p>(When the children are sticking their cards on the chart)</p> <p>4. How many like green now? How many's this? (pointing to chart)</p>	<p>(After the crisps from the shopping basket have been given out, and the group find that there are too many of one colour on the table and not enough of another)</p> <p>12. You think Liam picked the wrong one? Liam, did you pick the wrong one?</p>
<p>(When the teacher has got out her shopping basket)</p> <p>5. How many packets of blue crisps do I need – can you count?</p>	<p>(Plenary)</p> <p>13. I wonder which flavour of crisps do our class seem to like best? Which ones are there more of?</p>
<p>(When the teacher has got out her shopping basket)</p> <p>6. I wonder if I've got enough?</p>	<p>(Plenary)</p> <p>14. How do we know it's the green one? (i.e. that the class like best)</p>
<p>(When the teacher has got out her shopping basket)</p> <p>7. How many (red ones) do I need?</p>	<p>(Plenary)</p> <p>15. How did we find out it's the green one that people liked the most? What did we do?</p>
<p>(When the teacher finds there are not enough of one colour in her shopping basket)</p> <p>8. What shall I do?</p>	<p>(Plenary)</p> <p>16. So which flavour did we find out that most people in our class like? Which one was it?</p>

Shape and space

Objectives

- To review the breadth of curriculum content in the school's work on shape and space
- To consider progression in shape and space for children with severe or profound and multiple learning difficulties
- To consider strategies for teaching classes with a wide range of abilities about shape and space

Resources

- OHTs 5.1–5.5
- Video sequence 4: *Shape and space* containing clips of five different teaching activities
- Handouts 5.1–5.5 for each participant
- Photographs 1–7, at the end of the notes for this session
- A bag of solid shapes containing, for example, hexagonal prisms, pyramids and cylinders
- Flipchart and pens
- OHT pen
- *Towards the National Curriculum for Mathematics: examples of what pupils with special educational needs should be able to do at each P level* (DfES 0637/2001): enough copies (or photocopies of pages 18–21) for one between two
- *Accessing the National Curriculum for Mathematics: examples of what pupils with special educational needs should be able to do at each P level* (DfES 0292/2002): enough copies (or photocopies of pages 18–21) for one between two
- At least one copy of the National Numeracy Strategy *Framework for teaching mathematics: Reception to Year 6* (DfES NNFT 1999) for every three participants

Outline of the session		
Introduction Issues in teaching shape and space to children with severe or profound and multiple learning difficulties	Talk Discussion Activity	10 minutes
Breadth within the shape and space curriculum Discussion of curriculum content	Talk Discussion	10 minutes
Progression within the shape and space curriculum Activities to support vertical and lateral progression	Video Activities	25 minutes
Planning for progression Developing a progression document for your school	Activity Discussion	25 minutes
Conclusion Key points	Talk	5 minutes

Introduction

10 minutes

OHT 5.1

Objectives

- to review the breadth of curriculum content in the school's work on shape and space
- to consider progression in shape and space for children with severe or profound and multiple learning difficulties
- to consider strategies for teaching classes with a wide range of abilities about shape and space

Show **OHT 5.1**. Emphasise that shape and space is an area of the curriculum that is rich in ideas for activities to present to children with severe or profound and multiple learning difficulties. It can be taught in the context of everyday life, in using and applying mathematics. We want to develop in our children an understanding of the properties of the shapes they see and handle in real-life situations. As an example, when they are holding a box, we want them to explore what it can be used for, what will fit inside it and how several boxes can fit together.

Say that even though it is rich in ideas for activities, teaching shape and space can nevertheless present some difficulties in the context of severe or profound and multiple learning difficulties. Where children may spend several years learning about the names and properties of basic shapes, it is important to find ways of varying the work they are given to do.

This session aims to provide practical help with this task.

The video sequences will show a variety of short activities undertaken with a class of Foundation Stage and Key Stage 1 children. The video and the accompanying activities will provide an opportunity for staff to spend some time considering:

- the activities that they already do;
- the opportunities for new activities;
- a framework to help with the task of developing progression across the school for those children for whom vertical or linear progression may be limited.



Activity

Ask participants, working in pairs, to sit back to back. Give one member of each pair an object from your bag of solid shapes. Ask the person holding the shape to describe it to their partner, who must try to identify what the shape is.

After **2 or 3 minutes**, ask participants to give examples of the vocabulary that they used to describe the shapes. Draw out key vocabulary such as 'edge', 'face' and 'corner'. Say that although as adults we are able to use quite sophisticated language, children will initially use only words that are meaningful to them, for example words like 'wheel', 'ball' or 'apple' for a sphere. This language should be accepted; the teacher can then gradually introduce the correct vocabulary.

Ask participants whether they used words for two-dimensional shapes when trying to describe three-dimensional shapes to their partners. Draw out the relevant vocabulary – 'circle', 'triangle', etc.

Now say that one of the first issues to address with shape and space is whether to begin with work on two-dimensional or three-dimensional shapes. Note that all children have access to three-dimensional shapes from an early age through the items that they are given to explore and manipulate. For children with severe learning difficulties, it will be especially important that they are able to feel and manipulate the shapes we are asking them to label and describe. It seems logical, therefore, to introduce three-dimensional shapes first. Mathematical analysis of three-dimensional shapes, as we have seen from the activity on describing shapes to a partner, will include a need to name the faces; starting with three-dimensional shapes and their properties will thus lead naturally into work on two-dimensional shapes.

Ask participants to discuss their views on two-dimensional and three-dimensional shapes and to try to reach an agreement on the appropriate starting point for the school. Quickly take feedback.

Breadth within the shape and space curriculum

10 minutes



Activity

Ask each class group of staff to list some of the activities which they have undertaken when teaching the topic of shape and space. Allow approximately **3 or 4 minutes**.

Take feedback from each group and list their suggestions on a flipchart or chalkboard. (Keep this information on display to refer to in the next part of the session.)

OHT 5.2

Names and properties of 2-D and 3-D shapes	Patterns, symmetry and transformations	Position, direction and movement

Show **OHT 5.2**, saying that you are now going to look together at three different aspects of the shape and space curriculum – properties of shapes, patterns and symmetry, and position, movement and direction. In reality these areas are not distinct, and overlaps and links will occur naturally.

Refer back to the flipchart or chalkboard where you listed activities within shape and space, and add them to OHT 5.2 in the appropriate column. Discuss whether they cover the breadth within the shape and space curriculum: two-dimensional and three-dimensional shape, pattern, symmetry and transformations, position, direction and movement. Draw out any areas within the shape and space curriculum which offer new possibilities.

You may find that:

- while many activities relate to **naming** shapes, there may be relatively little work on the **properties** of shapes;
- there may be scope to do more work on **relating** naming shapes and learning about their properties to everyday objects, packets, containers, etc.;

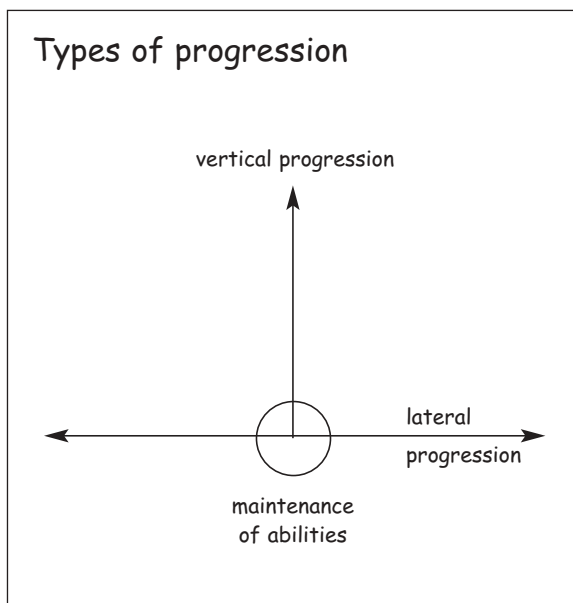
- there may be scope for work on **solving problems** such as what will or will not fit into a box, whether round biscuits fit in a square box, how shapes fit together, how shapes tessellate, which shapes would be good for tiles and which would leave large gaps;
- while work on **pattern** may be well represented, work on **reflection** and **reflective symmetry** may need to be developed to ensure progression from basic learning about symmetry; the area of transformations may open new horizons for staff;
- work on **position, direction and movement** may be under-represented, and is the focus for discussion later in the session.

Finally, ask participants, working in threes, to look at pages 24–27 of the National Numeracy Strategy *Framework for teaching mathematics: Reception to Year 6 Supplement of Examples* (Reception), and identify learning experiences relevant to the children they teach.

Progression within the space and shape curriculum

25 minutes

OHT 5.3



Show **OHT 5.3** and remind participants of the types of progression which the QCA describes in its guidance on *Planning, teaching and assessing the curriculum for pupils with learning difficulties*.

Vertical progression describes those occasions when children develop increasingly complex knowledge, skills and understanding, in a linear fashion.

Lateral progression describes the occasions when children widen and consolidate their understanding, applying a skill, for example, in a new situation.

Maintenance of abilities describes those occasions when children who may have complex temporary difficulties or regressive conditions are able to retain knowledge, skills and understanding despite these adverse circumstances.

The organisation of the P levels and National Curriculum levels illustrates vertical progression. It is essential, however, to recognise the achievement involved in the maintenance of abilities for some children. It is also essential to remember and plan also for lateral progression, offering children opportunities to extend their experiences and understanding in a range of contexts. They may thus progress **within** a level, by gaining greater breadth in learning and applying it to diverse circumstances before progressing to higher levels, as well as progressing to higher levels.

For children for whom progress is slow, we have the continuing challenge of finding more and varied ways to present activities which can address early levels of development, and which are age-appropriate. We need to encourage curiosity by providing new experiences, and giving time for exploration and manipulation of objects; this will allow for opportunities for sensori-motor learning to take place.

Explain that you are now going to show some video sequences and photographs to stimulate discussion about ensuring variety and planning for vertical and lateral progression.

Most of the activities shown can be carried out in a variety of ways according to the level at which a child is working.

Explain that the suggested ideas for progression are only intended as a starting point. In some cases it will be appropriate to move your children on more quickly, and to be able to work more closely with ideas as they are listed in the *Framework for teaching mathematics: Reception to Year 6 Supplement of Examples*. In other instances, you will need to add activities to each section at early developmental levels. In doing this, you will be broadening the context in which the children experience shape and space, revisiting ideas and objectives through varied activities, and providing opportunities to transfer their experiences into other lessons and real-life situations.



Activities

The three bears

Give out **handout 5.1**. Ask participants, while watching 'the three bears' video sequence, to work in pairs, noting the opportunities they see for children operating at each of the P levels to take part in the lesson. Suggest that pairs might concentrate on looking for opportunities for a couple of P levels rather than all of them. Ensure that the full range is covered.

Show the first clip on the video sequence. Allow a couple of minutes at the end of the video for people to make notes. Ask each pair to identify an appropriate next learning step in a **vertical progression** for a child operating within one of the P levels on which they have focused.

Take feedback.

Before moving on, draw attention to the opportunity on the video sequence for free play and how the children 'hugged' the teddies, sat them on the chairs, and so on. Adults were present to guide and offer suggestions and to encourage involvement, but the activity was not adult-directed all of the time.

Concentric circles and bubbles

Now watch the second clip on the video sequence, which shows the group exploring pattern, shape and space. Related vocabulary ('circle', 'round') is being used as the children see a pattern

of concentric circles being produced. They then go on to blow bubbles, and work in pairs to produce bubble prints.

After watching the video, ask participants to suggest activities which might follow on from the concentric circles activity to ensure **lateral progression**.

After gathering examples, say that some of the children in the video went on to produce pictures of concentric circles, first placing a large circle on the page, and then building it up by adding circles of decreasing sizes. For older pupils this type of activity could involve placing plates or dishes of different sizes inside each other.

Interactive display

Explain that the next video sequence shows how interactive displays can be used. A display of shapes can be produced which can be shared by the whole school and can create the links from mathematical shapes to everyday objects. An interactive display allows the children an opportunity to explore the shapes, to handle them and to learn more about their properties. The two tables on the video are set out to include circles and spheres, and squares, cubes and cuboids.

Show the third and fourth clips on the video sequence: 'interactive display' and 'on the mat'. Note how the children choose shapes from the display to manipulate and explore on the mat. These young children are then given the opportunity to experience movement, position and direction by being rolled over the large cylinders and balls.

Ask the group to consider how the work 'on the mat' could be developed for **lateral progression** in mathematics. How can children who work at early developmental levels be given opportunities to experience movement, position and direction through gross motor movement at the different key stages?

After taking feedback, you may want to add some of the following suggestions:

- Place children on sheets and slowly pull the sheets around the floor (for younger children).
- Use playground equipment, swings, slides, wheelchair swings and roundabouts.
- Use tricycles, bicycles, wheelchairs.
- Make or draw routes to follow, maps and mazes.
- Involve pupils in wheelchair dancing.
- Involve pupils in circle dances and square dances.

Show **photographs 1 and 2** of pieces of equipment that can be used to show movement and direction.

Pizza faces

The fifth video sequence shows another sensory activity with a group of children making pizza faces, continuing to focus on circles and identifying them in a real-life context. After watching the video, ask participants to think of learning experiences targeted at **vertical progression** for the children involved. Say that, for example, the teacher might repeat the pizza-making with a choice of sizes in the fruit and vegetable shapes – large and small circular shapes from which some of the children would be able to make judgements about which would be appropriate for the pizza face. The **vertical progression** here would be into learning about relative size.

Planning for progression

25 minutes



Activity

If staff have not previously had time to study the P level exemplification documents *Towards the National Curriculum for Mathematics* and *Accessing the National Curriculum for Mathematics*, give these out and allow time to look at them. The first document refers to Key Stages 1 and 2, and the second to Key Stage 3.

Give out **handouts 5.2 and 5.3**. These are intended to give ideas and form a starting point for discussion. They list group activities that can be accessed by children working at any P level. They show how activities can be varied in age-appropriate ways to ensure **lateral progression** for children who may potentially be working on the same learning objectives over several years. Teachers could draw on them to plan lessons on shape and space, once they have identified their lesson objectives (remind participants here that planning needs to start from objectives, rather than from activities – the activities are the means but not the end).

Allow **2 or 3 minutes** for participants to look at the handouts, noting how some themes are taken from the Foundation Stage and developed through the other key stages, as was the gross motor activity which was discussed above.

Ask participants to work in threes or class teams and take one of the activities on **handout 5.2** which is relevant to the key stage in which they work – for example, stacking beakers, or playmats with roadways, or mapmaking. They should:

- identify a relevant learning objective in movement, position and direction for a child or group in their class, drawing on the National Numeracy Strategy P level exemplification and where appropriate the *Framework for teaching mathematics: Reception to Year 6*;
- make brief notes on how they would work with the child or group on that learning objective in the context of the activity they have selected from the handout.

Ask one group to give feedback on the work they would plan.

Refer participants to **handout 5.3** and show **photographs 3 and 4**: children printing with squares on square paper, triangles on triangular paper, etc., and pictures made from shapes.

Show **photographs 5, 6 and 7**: toys made from triangular shapes.

Say that the resources shown in the photographs are of the kind readily available from educational catalogues, craft shops and novelty stores.

These could again be developed across the key stages, with younger children making the two-dimensional print pictures, then the shape books, moving on to making the cow, fairy, crocodile, etc.

Now give out **handout 5.4** and ask participants to begin drafting on to it their ideas for activities within the pattern and symmetry aspect of shape and space. Take time to refer to the National Numeracy Strategy *Framework for teaching mathematics: Reception to Year 6 Supplement of Examples* for shape and space, noting where symmetry is introduced and how it develops, where rotation comes in, translation, etc. Even though these come in further through the Framework, they

can be accessed at earlier levels: for example, the spinning top shown on the video is an introduction to rotation at an early level. For lateral progression for Key Stage 3, use overhead transparency acetates to produce discs for the projector to be used in a light room.

Where staff are from a small school, suggest that they work as a whole-school group. If the school is larger, it may be better for staff to work in mixed groups with representatives from each key stage. Allow approximately **15 minutes** for this activity.

Rhymes and songs

Give out **handout 5.5** and make the suggestion that rhymes and songs about shape and space could also be allocated to different key stages, to avoid Key Stage 3 pupils singing the same ones as Key Stage 1. 'The square rhyme' could perhaps be for Key Stage 2, as it begins to look at the properties of shapes, corners and edges. The first song, 'In my bag', may be appropriate for Foundation Stage; the second, 'I can see the shapes', for Key Stage 1; and the third, 'Draw a curve', which includes angles, for Key Stage 3. The majority of children with severe and complex needs can access all of the rhymes.

Ask for other ideas on rhymes and songs which people use, and examples of books that contain further selections.

Conclusion

5 minutes

OHT 5.4

Key points

- Ensure that the breadth of the shape and space curriculum is covered
- Look at the content of the yearly teaching programmes of study for all year groups
- Draw on work you have done as a staff group to list activities appropriate to each key stage
- Always plan from clear objectives and review the activity to ensure that there is opportunity for all children to participate

Show **OHT 5.4**, emphasising the following key points.

- We need to ensure in our planning that the breadth of the shape and space curriculum is covered, including work on the properties of shapes as well as their names, work on position, direction and movement (especially for children who are not independently mobile), and work on reflective symmetry and transformations.
- We need to look at the content of the yearly teaching programmes of study for all year groups. It is important not to plan just from Key Stage 1 content. Introducing rotation, reflection, symmetry, position and direction provides opportunities for lateral progression.
- It is useful for school staff to work together, as they have begun to in this session, on listing

age-appropriate activities for each key stage. Such lists will complement medium-term plans, enable teachers to avoid too much repetition, and help them with their short-term planning.

- We need to make sure that we plan from clear objectives and review the activity to ensure that there is opportunity for all children to participate in as meaningful a way as possible. Children's level of participation should be in line with their identified P level, e.g. P1(i). Children will be given the opportunity to experience and encounter activities related to shape and space. For some children their involvement may be passive, fully supported, may involve showing resistance, or simply be touching an item.

Finish by putting up some questions as **OHT 5.5** and agreeing any further action needed.

OHT 5.5

Final questions

- Do we, as a school, teach the breadth of the shape and space curriculum?
- Do all of us know what other teachers cover in shape and space?
- Does our planning and monitoring system allow us to avoid repetition?
- What more do we need to do to complete the work we have done today on planning for progression?

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7



Objectives

- to review the breadth of curriculum content in the school's work on shape and space
- to consider progression in shape and space for children with severe or profound and multiple learning difficulties
- to consider strategies for teaching classes with a wide range of abilities about shape and space





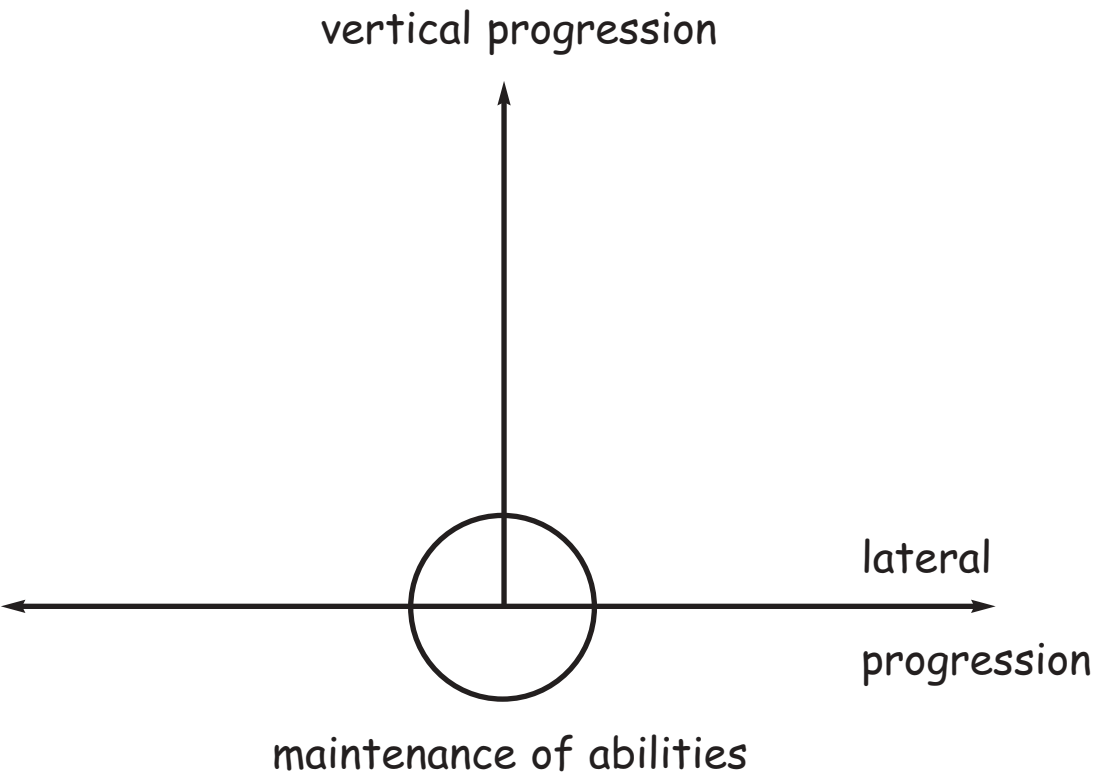
Breadth in the shape and space curriculum

Names and properties of 2-D and 3-D shapes	Patterns, symmetry and transformations	Position, direction and movement





Types of progression





Key points

- Ensure that the breadth of the shape and space curriculum is covered
- Look at the content of the yearly teaching programmes of study for all year groups
- Draw on work you have done as a staff group to list activities appropriate to each key stage
- Always plan from clear objectives and review the activity to ensure that there is opportunity for all children to participate





Final questions

- Do we, as a school, teach the breadth of the shape and space curriculum?
- Do all of us know what other teachers cover in shape and space?
- Does our planning and monitoring system allow us to avoid repetition?
- What more do we need to do to complete the work we have done today on planning for progression?



Handout 5.1

P levels for shape and space

P1(i)	Encounter activities and experiences. May be passive or resistant. May show simple reflex responses. Any participation is fully prompted.	
P1(ii)	Show emerging awareness of activities and experiences. May have periods when they appear alert and ready to focus on certain people, events, objects or parts of objects. May give intermittent reactions.	
P2(i)	Begin to respond consistently to familiar people, events and objects ... Begin to show interest in people, events and objects. Accept and engage in coactive exploration.	
P2(ii)	Begin to be proactive in their interactions. Communicate consistent preferences and affective responses ... Cooperate with shared exploration and supported participation.	
P3(i)	... Seek attention through eye contact, gesture or action ... Participate in shared activities with less support. Sustain concentration for short periods. Explore materials in increasingly complex ways.	
P3(ii)	... May initiate interactions and activities. Remember learned responses over increasing periods of time and may anticipate known events. May respond to options and choices with actions or gestures. Actively explore objects ... for more extended periods. Apply potential solutions systematically to problems.	
P4	Demonstrate interest in position and the relationship between objects.	
P5	Explore the position of objects.	
P6	Show understanding of words, signs or symbols that describe positions.	
P7	Use familiar words to describe position.	
P8	Begin to use mathematical vocabulary such as 'straight', 'circle', 'larger' to describe the shape and size of solids and flat shapes.	

From *Towards the National Curriculum for Mathematics: examples of what pupils with special educational needs should be able to do at each P level* (DfES, 0637/2001)

Handout 5.2

Planning for progression

Group activities for movement, position and direction which can be accessed by pupils working across a range of levels

Age range	Movement, position and direction
Foundation Stage	<p>Stories – for example <i>The Three Bears</i>: put spoons in bowls; bowls on the table; teddies in the beds, on the chairs, etc.</p> <p>Stacking beakers</p> <p>Playing with cars and garages ('Which car will fit in which garage?')</p> <p>Make garages to fit the cars</p> <p>Experiencing body movement – the feeling of being rolled, turned around and around, pulled along the floor on a large cloth</p>
Key Stage 1	<p>Nesting boxes; Russian dolls (language of 'inside', 'put in', 'take out', 'line up')</p> <p>Moving in different directions – walking backwards, forwards, turning</p> <p>Playmats with roadways and pathways</p> <p>Eye-tracking vehicles along the pathways</p> <p>Rolling vehicles down ramps</p> <p>Wooden railways – watching the trains go 'around and around'</p> <p>Playground swings, roundabouts, slides</p> <p>Wheelchair swings</p> <p>Riding tricycles and bicycles</p>
Key Stage 2	<p>Use of playmats to develop the skill of giving and following directions</p> <p>More varied and complex pathways, e.g. model-car racetracks</p> <p>Use of ICT, e.g. programmable floor robots</p> <p>Making own pathways, perhaps drawn in the hall</p> <p>Using thick paint and vehicles with wheels to roll through the paint and print a roadway on a sheet of card. Building this up to make a town, discussing where to place a school, shop, park, etc.</p>
Older Key Stage 2 moving into Key Stage 3	<p>Sensory trails for following direction – these could be established trails or put together with the children for the activity, e.g. a trail of cotton wool balls placed at hand height on the wall, a trail of smells leading to a room with baking biscuits</p> <p>Orienteering</p> <p>Map making</p> <p>Kitchen equipment for sorting into sizes, sets of pans, spoons, etc.</p> <p>Dancing: square dances, circle dances, and wheelchair dancing</p>

Handout 5.3 page 1 of 3

Planning for progression

Group activities for properties of shapes which can be accessed by pupils working across a range of levels

Age range	Properties of 2-D shapes and 3-D shapes
Foundation Stage	<p>Play with and handle shapes in the classroom, e.g. bricks, balls, poleidoblocs, feely bags with shapes in, containers and boxes</p> <p>Make shapes in sand, use buckets and various moulds, hide shapes in the sand, fill containers with sand and/or water, etc.</p> <p>Home corner, plates, cups, blankets to fold and fit on the bed, tablecloths for the table, etc.</p> <p>Print with 3-D shapes to make 2-D pictures</p>
Key Stage 1	<p>Make shapes with play dough, etc. Use construction bricks and play shapes (buckets of shapes) to build and explore properties</p> <p>Sort shapes according to those that roll, do not roll; with corners, without corners; flat faces, curved faces; solid or hollow</p> <p>Sort 2-D shapes; draw faces on the 'faces' of the shapes as the children are introduced to the vocabulary</p> <p>Match lids to boxes</p> <p>Use balls to roll, hoops to roll and to crawl through, cylinders to roll balls through, to roll on, over, etc.</p> <p>Have a shape table in the classroom: ask the children to find shapes in the classroom or school to add to it, or bring items from home</p>
Key Stage 2	<p>Use paint and brushes or fingers to produce straight line pictures or curved line pictures</p> <p>Use construction sets to explore how shapes fit together. Make models with boxes and containers. Can the children think about what their finished model will look like before building it?</p> <p>Follow a 2-D picture to produce a given 3-D model</p> <p>Use clay, play dough, etc. to make several shapes from the same piece of dough</p> <p>Use paper cut-out 2-D shapes to make pictures</p> <p>Make shape biscuits</p>

Handout 5.3 page 2 of 3

Age range	Properties of 2-D shapes and 3-D shapes
	<p>Sort shapes according to their properties. Make families of shapes. Use a tabletop sorting track for sorting shapes according to their properties</p> <p>Use a Venn or Carroll diagram for sorting</p> <p>In PE play circle games, dances in a circle, wheelchair dancing</p> <p>Make books and pictures in the shape of squares, triangles, circles</p> <p>Use a model to produce a 2-D picture</p> <p>Tangram pictures, puzzles</p> <p>Explore tessellation; make tiles that tessellate</p> <p>Make skeleton shapes with straws, spills or narrow paper strips; this will help children to focus on the 'edges' of the shapes</p> <p>Match 3-D shapes to 2-D pictures of them</p> <p>Make animals or figures from shapes, e.g. a triangular girl, a triangular cow, etc. These can be 2-D or 3-D</p>
Older Key Stage 2 moving into Key Stage 3	<p>Roll out icing and cut into shapes</p> <p>Sort shapes according to their properties</p> <p>Tessellation: use real-life objects, e.g. fit stock cubes into a box; snooker balls into a triangle; dominoes into a box, etc. Look at shapes in the environment that tessellate: windows, brick walls, tiled worktops, etc.</p> <p>Make tiles in a medium such as 'salt dough', with each child producing their own pattern on the tile, every tile made to the same measurements to tessellate. Tiles could be triangular, rectangular or square. Focus on edges and corners</p> <p>Identify simple nets of shapes; make boxes of various shapes</p> <p>Make 3-D models from pictures of them, 2-D drawings</p> <p>Shapes in the environment, road signs, safety triangle</p>

Handout 5.3 page 3 of 3

Notes

ICT programs can also be written into the progression document to ensure that the same programs are not being used throughout the age ranges. Each school will need to look at their range of programs to see if they have any which match particular areas of shape and space. Popular programs that are readily available include simple switch programs where each click of the switch reveals another section of a shape. These can be used as an activity to discuss what shape the children think it will be, referring to the properties as appropriate, or, where language is problematic, using a selection of shapes where children can point to or choose which shape they think will be revealed. For older pupils, consider software which shows, for example, road signs, and enables them to investigate shape in real-life, age-appropriate situations.

The National Numeracy Strategy publication *Guide for your professional development: using ICT to support mathematics in primary schools*, available free to all schools (DfEE 0261/2000) contains a chapter entitled 'ICT supporting work in shape and space'. This includes work on positional and directional vocabulary, pattern and symmetry, and could provide a useful starting point for schools. The accompanying CD-ROM (DfEE 0267/2000) also includes samples of some shape and space software which teachers will be able to incorporate into their planning.

If you have difficulty finding suitable programs, it is worth looking at some of the software that accompanies some of the published schemes for Key Stage 1. Look at the Key Stage 2 software too, as you will be able to use some of this but at a simpler level.

Handout 5.4

Planning for progression

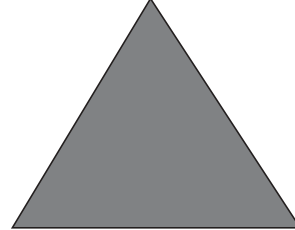
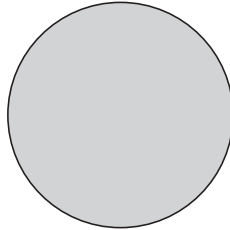
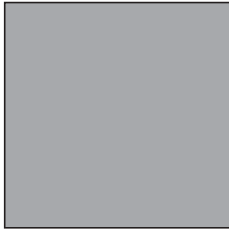
Group activities for pattern and symmetry which can be accessed by children working across a range of levels

Age range	Pattern and symmetry <i>Include reflection, rotation and translation</i>
Foundation Stage	
Key Stage 1	
Key Stage 2	
Older Key Stage 2 moving into Key Stage 3	

Handout 5.5 page 1 of 3

Rhymes and songs

The square rhyme



Square, square, square and square,
Four sides, four corners too,
Straight and straight and straight and straight,
This is what we do.

Hold up the square, point to
the sides and corners.
Use a finger to draw the four
straight edges in the air.

Circle, circle, circle, circle,
No sides, no corners too,
Round and round and round we go,
This is what we do.

Hold up the circle.
Use a finger to draw
circles in the air.

Triangle and triangle,
Three sides, three corners too,
One, two, three we go,
This is what we do.

Hold up the triangle, point to
the sides and the corners.
Use a finger to draw the
shape in the air.

Handout 5.5 page 2 of 3

In my bag

(To the tune of 'There's a hole in my bucket')

There's a square in my bag, my bag, my bag.

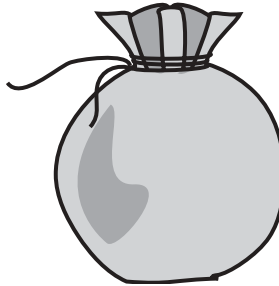
Come find it dear

A square in my bag.

There's a circle in my bag, my bag, my bag.

Come find it dear

A circle in my bag.



Have a soft bag with a selection of shapes inside. Insert a child's name into each verse and they can feel in the bag to find the required shape.

I can see the shapes

(To the tune of 'If you're happy and you know it')

I can see a cube, I know it.

Touch the cube.

I can see a cube, I know it.

Touch the cube.

I can see a cube, I know it.

I have really got to show it.

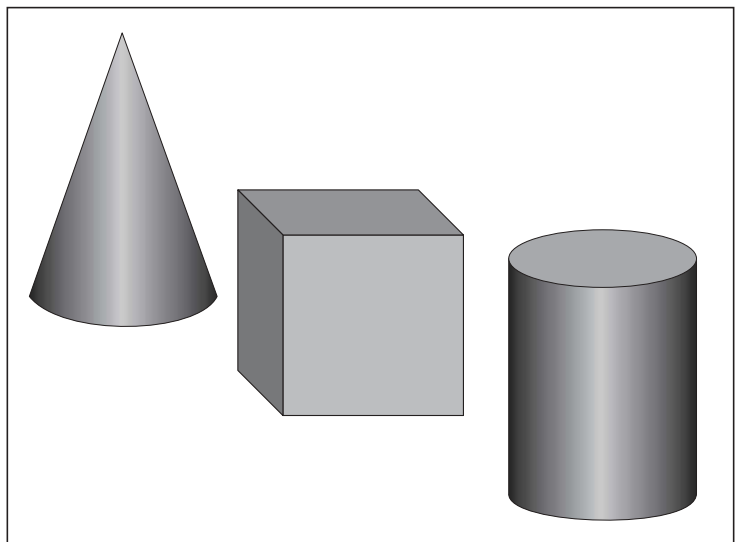
I can see a cube, I know it.

Touch the cube.

I can see a cylinder, I know it.

Touch the cylinder.

(etc.)



Repeat as many times as required for any shape. If children have severe visual impairment, 'I can see' can be changed to 'I can feel' or 'I can touch'.

Handout 5.5 page 3 of 3**Draw a curve**

(To the tune of 'If you're happy and you know it')

Make your fingers draw a curve, draw a curve.

Make your fingers draw a curve, draw a curve.

Make your fingers draw a curve, let them go round and round,

Make your fingers draw a curve, draw a curve.

Put your knee at an angle, at an angle.

Put your knee at an angle, at an angle.

Put your knee at an angle, move it this way and that.

Put your knee at an angle, at an angle.

Let your arm make a line, make a line.

Let your arm make a line, make a line.

Let your arm make a line, can you join it with mine?

Can we make our two arms a straight line?

Let your arm make an angle, make an angle.

Let your arm make an angle, make an angle.

Let your arm make an angle, can you change that angle?

Let your arm make an angle, make it 'right'.

Can your foot draw a square, draw a square?

Can your foot draw a square, draw a square?

Draw one, two, three and four, join all the sides together now.

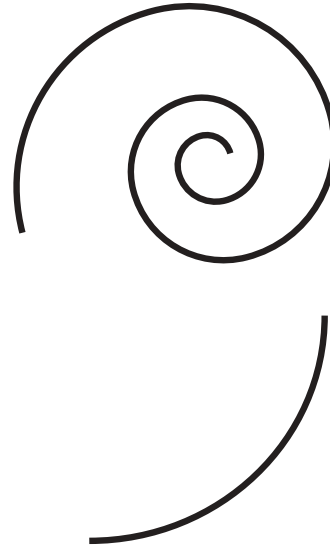
We use right angles for a square.

Draw a circle with your nose, with your nose.

Draw a circle with your nose, with your nose.

Draw a circle with your nose, no right angles or straight lines.

Draw a circle with your nose, with your nose.



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