

Proportion collages

Key vocabulary

- proportion: comparative share of a whole
- approximately: nearly; almost; round about, but not exactly
- estimate: a sensible guess based on the available information

Organisation

- groups of four to six working in pairs on one collage rectangle at a time

- at least two adults present
- possibly more adult supervision for less-able children

Advance preparation

Resource sheets

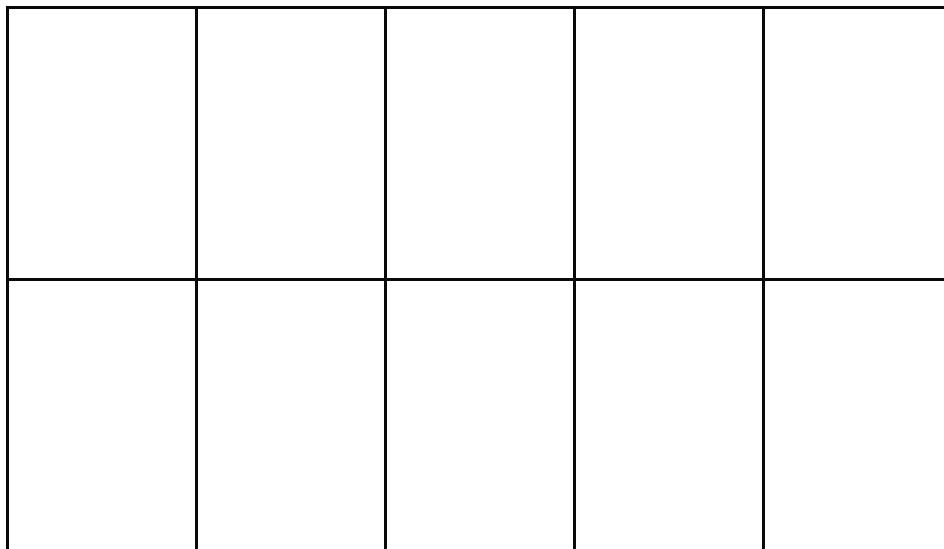
Shapes for proportion collages (page 43)

Recording estimates (page 44)

Proportion collages evaluation sheet (page 45)

Demonstrating how to fit as many as possible of a given object or shape into the area of one rectangle (for the teacher). You will need:

- for the base, a large piece of paper, 80 cm by 60 cm, divided into ten equal rectangles (see Photograph 3.1 on previous page, and the grid below);



- from **Shapes for proportion collages** (page 43) five copies of **A**, sixteen copies of **B** and three copies of **C**;
- a range of suitable collage materials (objects and shapes), especially those with tessellating potential, such as pegs and stars.

Proportion collages

Investigating the reliability of the estimates

Skilful questioning is now needed to draw out the fact that when the confining grid lines are removed from the collage (i.e. when we talk of the area as a whole rather than as ten separate areas), extra room is created. (The children are perhaps already familiar with the fact that you can seat more children on a long bench than on a row of chairs that is the same length as the bench).

- Why are the numbers we've been working out for the whole sheet just estimates, and not exact amounts? Is this true even when the things in a rectangle are easy to count, and we've multiplied properly by ten?

Have the children look carefully at the spaces around the black circles, the cars and the lolly sticks in Photograph 3.1.

- Suppose all the things that make up the collage were suddenly the same (for example, all black circles, or all cars, or all lolly sticks). Suppose too that we'd rubbed out all the lines that divide the sheet into ten separate rectangles. We could then think of the sheet as just one big rectangle. What difference would that make?

Explain that we would still have ten times the number of things that were in a single rectangle before, but we'd also have ten times the spaces left over.

- Look at the cars in the photograph again. Each of the four spaces left in that rectangle is room for about an eighth of a car. That adds up to half a car. Multiply that by ten, and that's five more cars that we might find room for if we packed our cars differently into the one big rectangle. In the same way, we might find room in the one big rectangle for more than our estimated numbers of the other things, once we removed the dividing lines.

Explaining how pupils should complete their activity sheets

Before the groups begin their own proportion collages, make sure they are clear as to how they will have to complete **Recording estimates** (page 44) afterwards. Each group of children will need two copies so that they can practice first, working from the collage in Photograph 3.1.

Guide them as they fill in each row. The figures below in the second column are typical average estimates. You should insist that each group of pupils agrees on an estimate before actually doing the count.

For the fourth column, a minimum estimate is of course a straightforward multiplication by ten of the figure in the third column, but some children might already be taking into account the extra space created by the removal of the grid lines (see **Sample questions** at the end of **Plenary**).

Shape or object	My estimate for the rectangle	My count for the rectangle	My estimate for the whole sheet
Black shapes	3	4	40
CDs	2	2½	25
Pegs	15	20	200
Lids	10	17	170
Car shapes	3	4	40
Triangles	18	16	160
Spoons	14	11	110
Black circles	2	2	20
Pasta pieces	100	140	1400
Lolly sticks	36	40	400

Proportion collages

Children's activity (1–1½ hours)

Making the collage

Children should be reminded that:

- the shapes and objects should all be stuck within the rectangle, and must not go over the lines;
- there should be no overlapping of shapes or objects;
- they should thoroughly investigate all the possible arrangements of a particular shape or object before deciding on the final arrangement and sticking it down;
- their estimates for 'filling' any one of the ten rectangles should be based on investigation with just two objects or shapes (more only if they are small ones), otherwise it's a count rather than an estimate.

Making the square visually effective

The fact that each group's collage is differently arranged will in itself create a visually effective display, but equally important is the mixture of objects, materials, shapes, textures and colours. Colours should be complementary, and it's a good idea to include some reflective or shiny materials, such as foil or silver card, as these stand out from the materials around them to provide a pleasing contrast.

Within the limits of the resources available, it should be left to each group to decide how they want their collage to look, although there is no harm in suggesting options for the children's consideration, such as (in Photograph 3.1):

- the use of alternating colours within rectangles (e.g. the triangles);
- contrasting colour and tone from one rectangle to another;
- opposite orientations (e.g. the mainly vertical lolly sticks but horizontal spoons) in different rectangles (although of course within rectangles the orientation is determined primarily to obtain the best fit).

Difficulties

Mixed-ability or similar-ability groups?

Preferred groupings will depend on the make-up of the class, but if you have similar-ability groups, then the less-able children will require more supervision when investigating the tessellating potential of certain shapes and objects. Also, if you decide to allow halves, the children will need help in deciding how to halve irregular-shaped items, and in the subsequent calculations on the resource sheet.

In mixed-ability groups, the less-able children will gain confidence in their estimation skills once they see patterns appearing in the way the shapes and objects can be arranged (see the pegs and spoons in Photograph 3.1) and they will benefit from the vocabulary generated during the session. More-able children will be stretched by having to decide when it is that they have discovered the optimal arrangement within a rectangle.

It is the role of the teacher and other adults to ensure that the groups investigate thoroughly before they begin to stick items down, and that their recording on the resource sheet is accurate.

Plenary (20 mins)

Comparing the finished collages

Ask each group in turn to hold up their proportion collages for the rest of the class to appreciate and discuss. It may be that some groups have used the same materials but different orientations, and/or that they have managed to fill the space more economically.

Sample questions

An adaptable question to exploit this activity is:

- *If your collage was made up of only eight rectangles, and you found that nine spoons could be fitted into one of the rectangles, approximately how many spoons would be needed to cover the whole area? ($8 \times 9 = 72$)*

Before the end of the plenary, make sure the children are properly aware that their estimates for the whole sheet are minimum ('lowest possible') estimates:

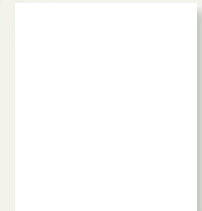
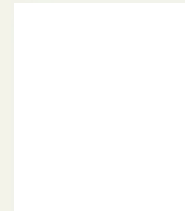
Proportion collage

evaluation sheet

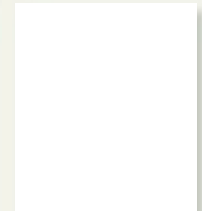
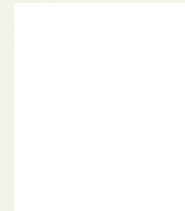
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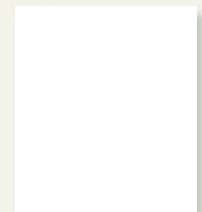
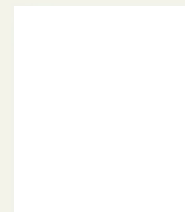
I know that 'estimate' means 'sensible guess'.



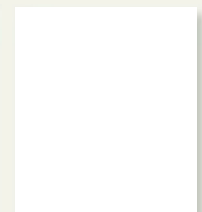
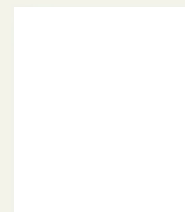
I know that 'approximately' means round about, or nearly, but not exactly.



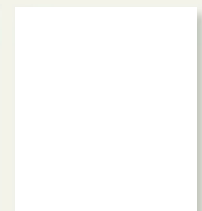
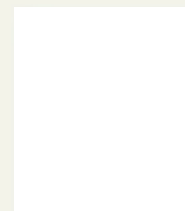
I know that by turning shapes over and around you can find ways of fitting more of them in.



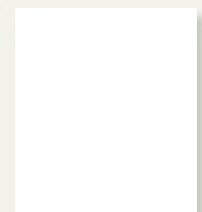
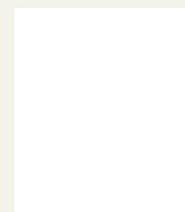
I know that you can sometimes fit far more shapes into an area than you first thought.



I know that by counting shapes in one rectangle, I can estimate how many will fit on the whole sheet.



I know that if I can fit eight shapes in one rectangle, I can fit at least 80 into ten rectangles.



Monster problems

Monsters help make calculation more palatable



Photograph 4.1: Monsterscape collage made by Year 4 children

Aims

- Bring mathematical problems to life by placing them in a tangible and amusing context.
- Solve problems of proportion systematically.
- Use problems to reinforce 'times' tables.

NNS objectives (Years 3 and 4)

- Know by heart the 2, 3, 4 and 5 times-tables.
- **Solve problems** in 'real life'.
- Begin to use ideas of simple proportion, for example, 'one for every...'

Learning outcomes

At the end of this activity, the majority of the children should be able to:

- approach a simple proportion problem systematically;
- use appropriate vocabulary (e.g. 'For every three-eyed Doggite there is a five-eyed Zoggite').

Key vocabulary

- proportion (:share)
- for every (e.g. 'for every Doggite there are two Zoggites')

Organisation

Groups of three or four. Less-able children may require extra adult supervision.

Advance preparation

Resource sheets

Demonstration problem (page 52)

Target sheet 1 (page 53)

Target sheet 2 (page 54)

Target sheet 3 (page 55)

Target sheet 4 (page 56)

Monster problems evaluation sheet (page 57)

To demonstrate solving the problem you will need the following resources to make some simple monsters:

- red and yellow A4 paper or thin card for the monster shapes;
- felt-tip pen or collage materials for their eyes;
- A3 version of **Demonstration problem** (page 52)

As the children are going to make their own designs, it is more appropriate for them to watch the teacher make his or her own, without the use of a template. This should not pose a problem, as they can be very basic shapes without any special features apart from the eyes – see examples: