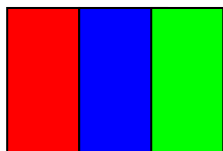


Finding All Possibilities

Flags

Year R / 1:

- This flag has to be coloured using red, blue and green paint
- Each stripe is one of the colours and there are no repeats of colour on any one flag



R	R	B	B	G	G
B	G	R	G	B	R
G	B	G	R	R	B

- How many different flags can be made? (6 flags)

Year 2 / 3:

- As above, but allow repeat colours (27 flags)

R	R	R	R	R	R	R	R	R
R	R	R	B	B	B	G	G	G
R	B	G	R	B	G	R	B	G

9 flags with red as first stripe

9 flags with blue as first stripe

9 flags with green as first stripe

Year 4:

- Have the option of 5 colours (red, blue, green, yellow, orange)
- No repeats allowed (60 flags)

R	R	R	R	R	R	R	R	R	R	R	R
B	B	B	G	G	G	Y	Y	Y	O	O	O
G	Y	O	B	Y	O	B	G	O	B	G	Y

12 flags with red as first stripe

12 flags with blue as first stripe

12 flags with green as first stripe

12 flags with yellow as first stripe

12 flags with orange as first stripe

Year 5 / 6:

- 5 colours with repeats allowed (125 flags)

5 flags with RR_

5 flags with RB_

5 flags with RG_

5 flags with RY_

5 flags with RO_

R	R	R	R	R
R	R	R	R	R
R	B	G	Y	O

25 flags with red in first stripe → 25 flags for each colour in first stripe

General Patterns

3 stripe flag with no repeats

3 stripe flag with repeats allowed

Number of colours used	Pattern	Total number of flags
3	3x2x1	6
4	4x3x2	24
5	5x4x3	60
6	6x5x4	120
N	$N \times (N-1) \times (N-2)$	

Number of colours used	Pattern	Total number of flags
3	3x3x3	27
4	4x4x4	64
5	5x5x5	125
6	6x6x6	216
N	$N \times N \times N$	N^3

Linked Problems:

- Three flavours of ice-cream: how many different cones can be made using 1, 2 or 3 scoops
- Football strips: top, short and socks in three colours. How many different strips?
- Clown Hats: three bobbles on the front of the hat in three colours. How many different hats?
- Party invitations: from a list of names choose 3 people to invite to a party. How many different guest lists can be made?
- Menu choices: from a menu of three drinks, three main dishes and three puddings - how many different dinners can be chosen?
- Sandwich fillings: from a list of ingredients, how many different sandwiches can be made?
- Baby Names: make up names for a baby from a shortlist of suggestions

Finding all Possibilities

Colouring Flags

Level Guidance

Appropriate strategies for Finding All Possibilities
• Have a system for finding the possibilities e.g. start with the smallest number, keep one colour fixed)
• Organise the recording of possibilities, e.g. in an ordered list or table
• Use a method of tracking what has been included and what has not
• Have a way of deciding when all possibilities have been found

Level 1

- able to find examples of flags which satisfy the rules of the problem
- able to record flags found in objects (multilink) or pictures (colouring)
- through discussion with an adult can recognise flags with similar characteristics and group them (first stripe red), may use this information to find missing flags or repeats

Level 2 *(a secure level 2 would need to tackle the repeat colour problem)*

- able to find examples of flags that satisfy the rules with some independence
- able to record flags found as a simple diagram
- able to organise flags into groups with similar characteristics (possibly after adult suggestion)
- able to use organising and recording information to find repeats and missing flags
- able to describe verbally why they are sure they have found all the flags

Level 3

- begin to tackle the problem systematically (after initial attempts) by grouping similar flags
- independently check for repeats
- record using appropriate diagrams (quickly drawn) or symbols (for the more able BRG, BGR, ...)
- begin to look for missing flags by referring to their systematic working
- be able to give some justification for why all possibilities have been found

Level 4

- aware that problem should be tackled in a systematic way (initial attempts may not be systematic, but approach should change once problem is understood)
- record flags in an organised and clear way, using a suitable shorthand system (initial letters, coloured dots in a list or table)
- use a method of tracking what has been included and what has not
- aware that all possibilities do not need to be recorded, able to predict with mathematical justification from results already obtained
- able to make reasoned predictions about other linked problems (orange has run out, there are now 6 colours)

Level 5:

- have a system for finding all possibilities which involves checking for repeats and missing answers
- communicate findings in an appropriate way, with sufficient detail to enable others to interpret their work
- independently explore other linked problems with a view to developing a generalised solution (flags with 4 stripes, more / less colours)
- be able to describe the solutions to the problems investigated in words and symbols as appropriate
- able to construct formulae for finding all possibilities using letters as symbols (*most able Level 5*)