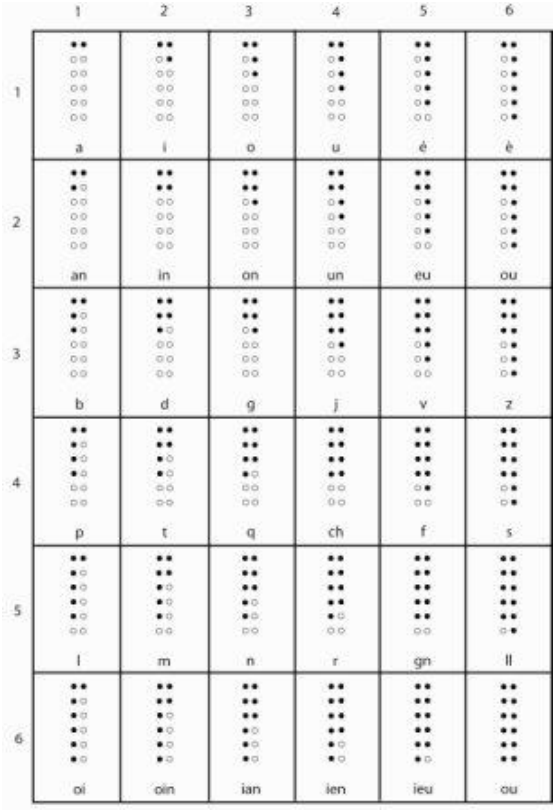
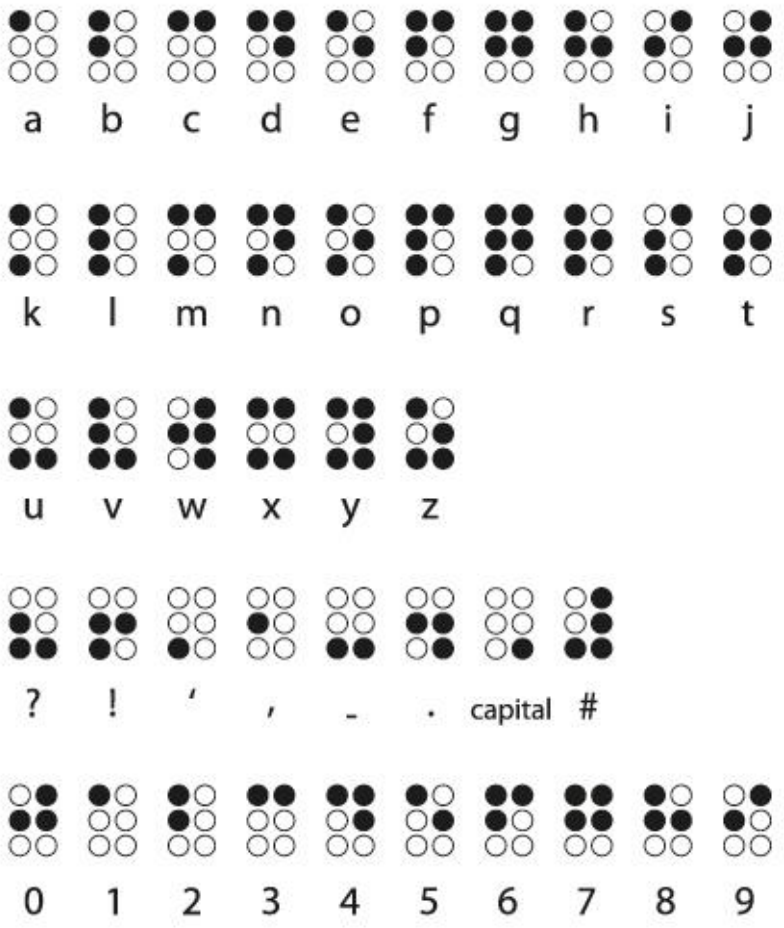
Braille – Teacher Notes

Background info

In Braille, there is a grid of six spaces. A space can either be raised or not. The system is around 200 years old and was based on something called 'night writing' used by Napoleon's army to communicate silently in the dark. Night writing had twice as many spaces, and only about half as many allowable combinations (36):



Braille improved on this by allowing dots in any order on a 2 by 3 grid. As well as the 26 letters, symbols are required for punctuation, symbols, capital letters and numbers. However, to make it more efficient, a, A and 1 all have the same symbol. They are distinguished by putting a # symbol in front if a number follows, or a Capital symbol if a capital letter follows (see below):



Introductory Task

A room has three light-switches (each of which can be either 'on' or 'off'), controlling lights at the front, middle and back of the room. How many different combinations can there be for these three switches? Use 1 for on, 0 for off.

*Have students write down as many as they can think of. Discuss how making a **systematic** list can make it easier to list the options.*

000	100
001	101
010	110
011	111

Optional Extension

How many different factors does the number 30 have? Use the fact that it is $2 \times 3 \times 5$. There are 8 combinations:

5s	3s	2s	Factor
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	6
1	0	0	5
1	0	1	10
1	1	0	15
1	1	1	30

Introducing Braille

Show students the pictures on the ***Photo Clues sheet*** (maybe one picture at a time), and see if they recognise Braille.

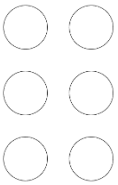
Describe the Night Writing system that Napoleon used, and ask if it is possible to make an alphabet using fewer spaces than 12.

Work out with the students how many combinations would be available if you only had 2 spaces available to use, and how many with 3 spaces (notice that with 3 spaces you get 8 options just like the light switches), then have students use the ***4 Spaces sheet*** to investigate how many letters they could write with 4 spaces available.

Would 5 spaces be enough? Why might we need more? (26 letters in the alphabet means we'd need a minimum of 26, but 32 combinations only leaves 6 spare for things like punctuation, capital letters, numbers, other symbols…)

Inventing Braille

How many different ways are there of filling 6 spaces? Students should use the ***6 Spaces sheet*** to investigate.



Total combinations: 64

Optional Extension

Breaking this down into 'how many ways are there to colour 0 spaces, 1 space, 2 spaces', etc, yields Pascal's triangle values: 1, 6, 15, 20, 15, 6, 1. By generating the first few as well (1, 1 1, 1 2 1, 1 3 3 1, 1 4 6 4 1, 1 5 10 10 5 1), a pattern may be found. Note that rows add up to a corresponding power of 2.

Using Braille

Students may find up to 64 combinations, but it is not necessary to find every possible combination. Using extrapolation they may derive the 64 possibilities from the pattern 2, 4, 8, 16, 32, ….

They can then compare the combinations they have found with the **Braille Alphabet sheet**. If they have been working systematically, they should have the 1-dot, 2-dot and 3-dot combinations, which accounts for many of the letters: only 7 include 4 dots (g, n, p, r, t, v, w, x, z), and 2 include 5 dots: (q and y)

Optional Extension

Why is there only one letter (a) made with a single dot? And what do you notice about the letters with 4- and 5-dot codes (g, n, p, r, t, v, w, x, z, q, y)?

Reading Braille blind, it is hard to identify, when there's a single dot, which one it is. This is also why many 2-dot codes are not included if they are the same shape as already included ones.

Writing a code

Using another copy of the ***6 Spaces sheet***, and referring to the ***Braille Alphabet sheet***, students are to write a code for a friend, and then attempt to decode that of their friend.

Resources Needed (for a class of 36)

Squared Paper **(36*: 1 each*)**
Photo Clues sheet A4 **(6*: 1 per table*)**
4 Spaces sheet A6 **(9*: 1 each, 4 per sheet*)**
6 Spaces sheet A4 **(36*: 2 each, printed back to back*)**
Braille Alphabet sheet A5 **(9*: 1 between 2, 2 per sheet*)**

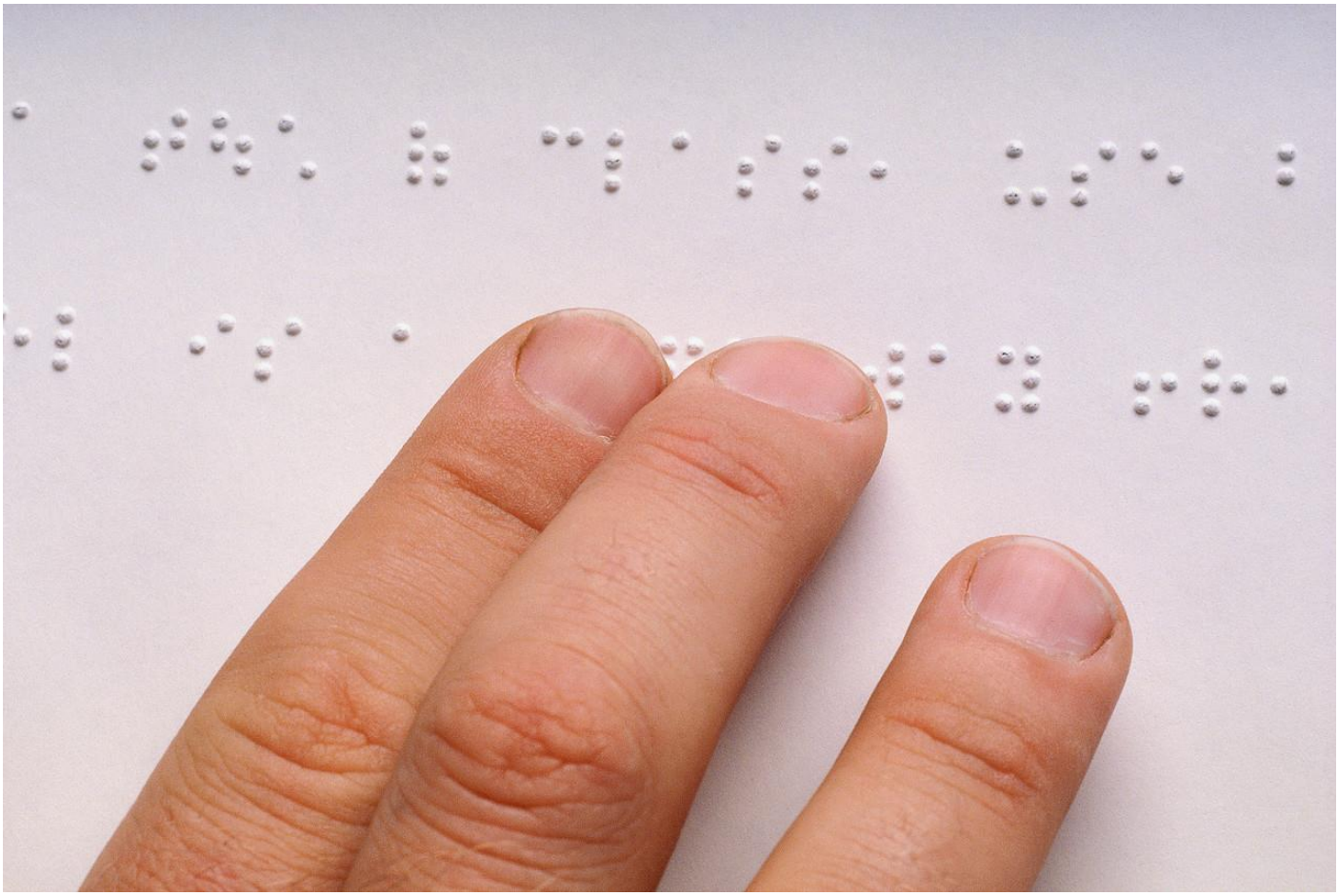
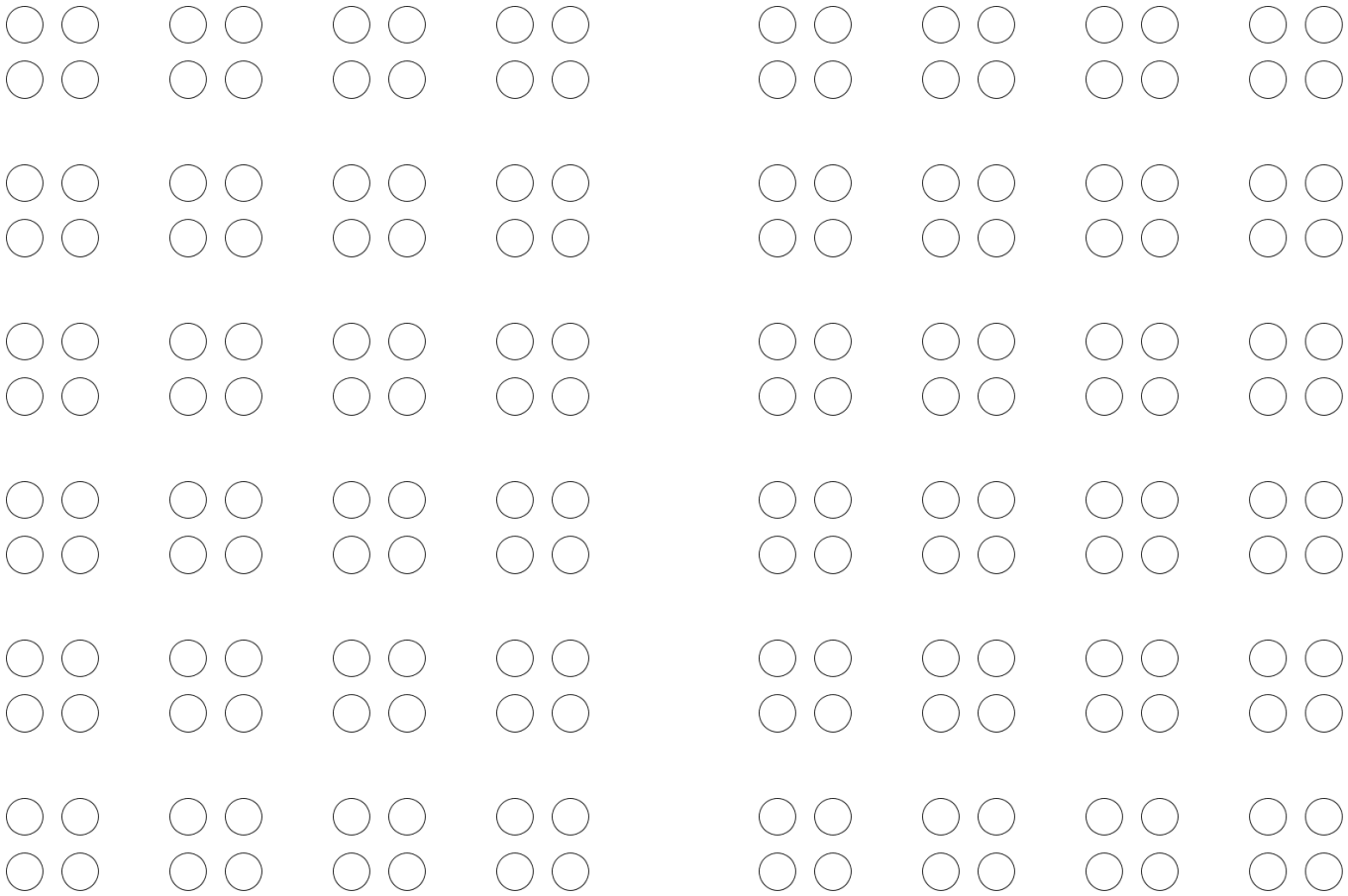
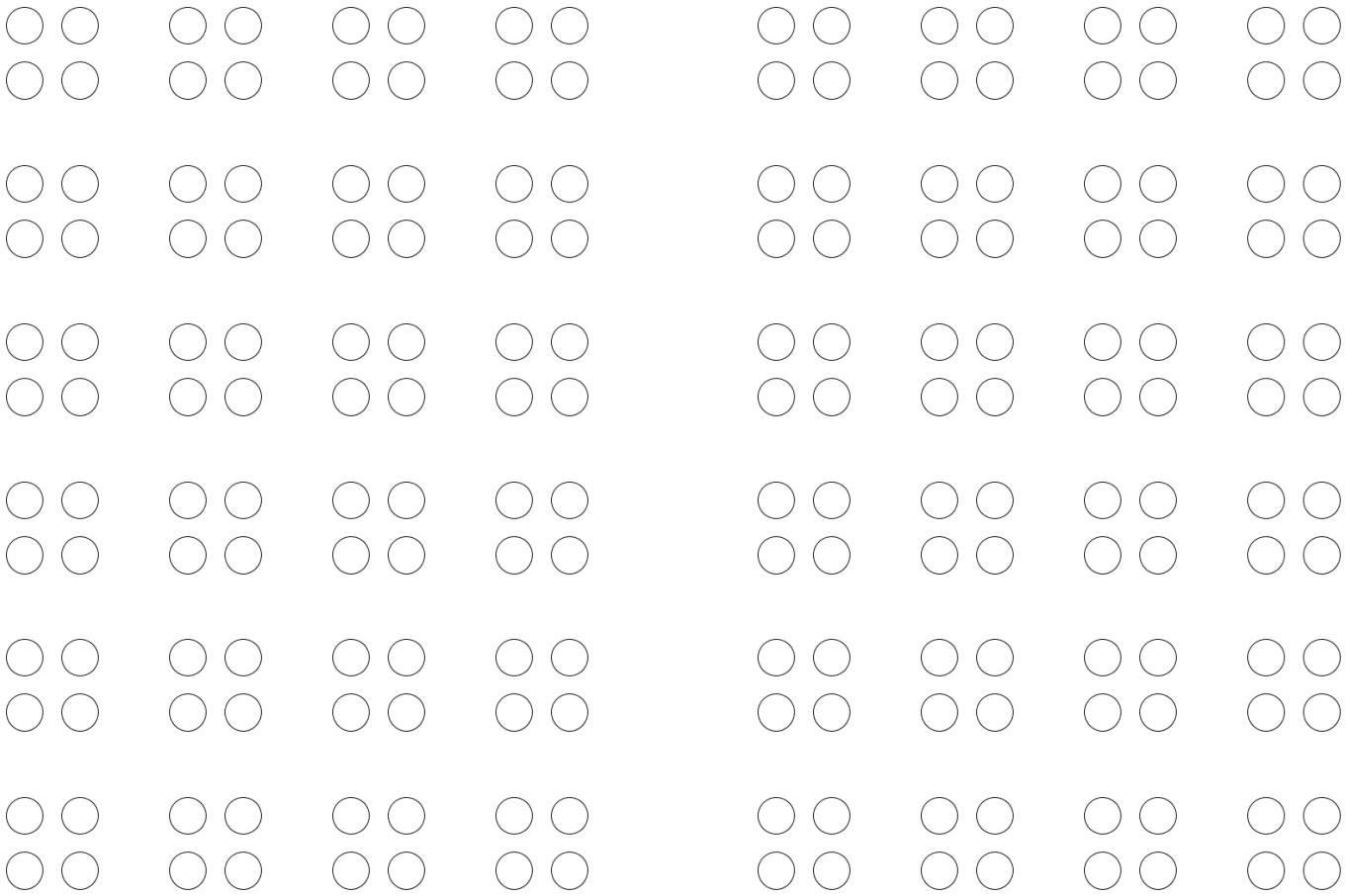
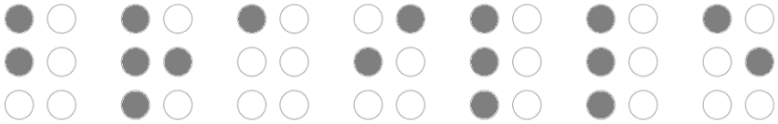


Photo Clues (A5)



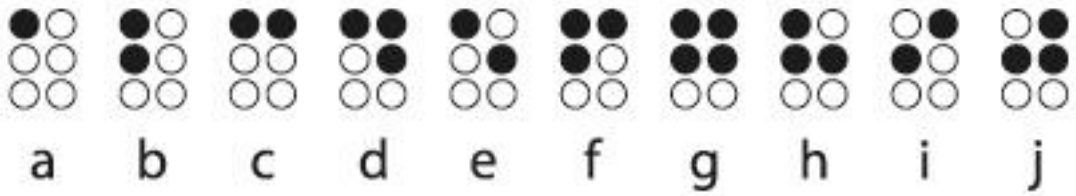


4 Spaces (A6)

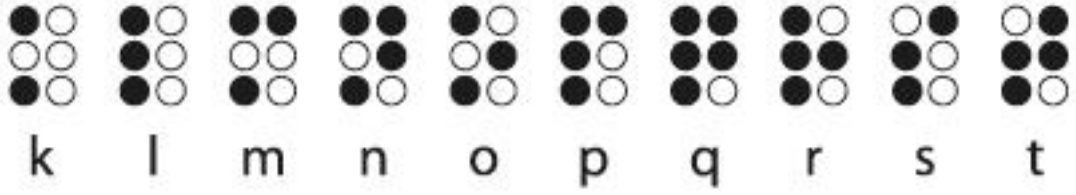


6 Spaces (A4)

Braille Alphabet



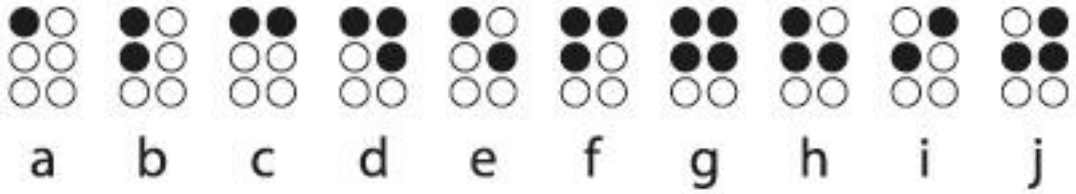
a b c d e f g h i j



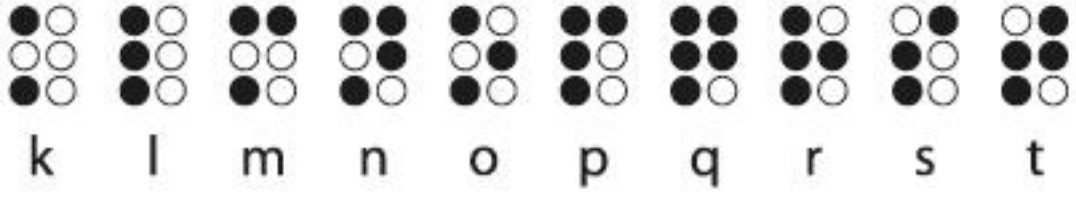
k l m n o p q r s t

u v w x y z

Braille Alphabet



a b c d e f g h i j



k l m n o p q r s t

u v w x y z