YEAR 10-12

Cracking the Code: DNA coding analogy activity

Teacher Notes

Overview

In this activity, students identify an unknown code (Activity 1) and then apply it to identify the message in an unknown text (Activity 2). Discussion questions consolidate the learning,and draw out the relationship between the model presented in this activity and DNA as an actual code.

Syllabus links

Australian Curriculum

Year 10: The transmission of heritable characteristics from one generation to the next involves DNA and genes (ACSSU184)

Years 11-12: (Biology, Unit 3) Genes include 'coding' and 'non-coding' DNA, and many genes contain information for protein production (ACSBL078)

NSW Biology

Blueprint of Life, Section 3: Chromosomal structure provides the key to inheritance

Blueprint of Life, Section 4: The structure of DNA can be changed and such changes may be reflected in the phenotype of the affected organism

VIC Biology

Signatures of Life: The nature and importance of bio-macromolecules in the chemistry of the cell

Continuity and Change: Molecular genetics (the nature of genomes, genes and the genetic code)

SA and NT Biology

Macromolecules: The chemical unit of genetic information in most organisms is DNA.

Macromolecules: Change in the base sequence of DNA can lead to the alteration or absence of proteins

WA Biological Sciences / Human Biological Science

2BBIO Continuity of species: Structure and function of DNA, genes and chromosomes

2BHBS Human form and function: Structure of DNA; role of DNA in the cell

3AHBS Human diversity and change: Mutations: causes; changes in the DNA sequence

TAS Biology
The chemical basis of life: DNA the code of life (structure and role of DNA)

ACT Biology:
Unit 3 Heredity and Continuity of Life: Mutations in genes and chromosomes can result from errors in DNA replication

QLD Biology:
In most organisms, coded instructions within the DNA molecule account for their inherited characteristics.

Materials (provided)

- Student Activity Sheet 1
- Student Activity Sheet 2

Note: these sheets may be cut up before the class, so different words/parts of the message can be split among the students

Lesson flow

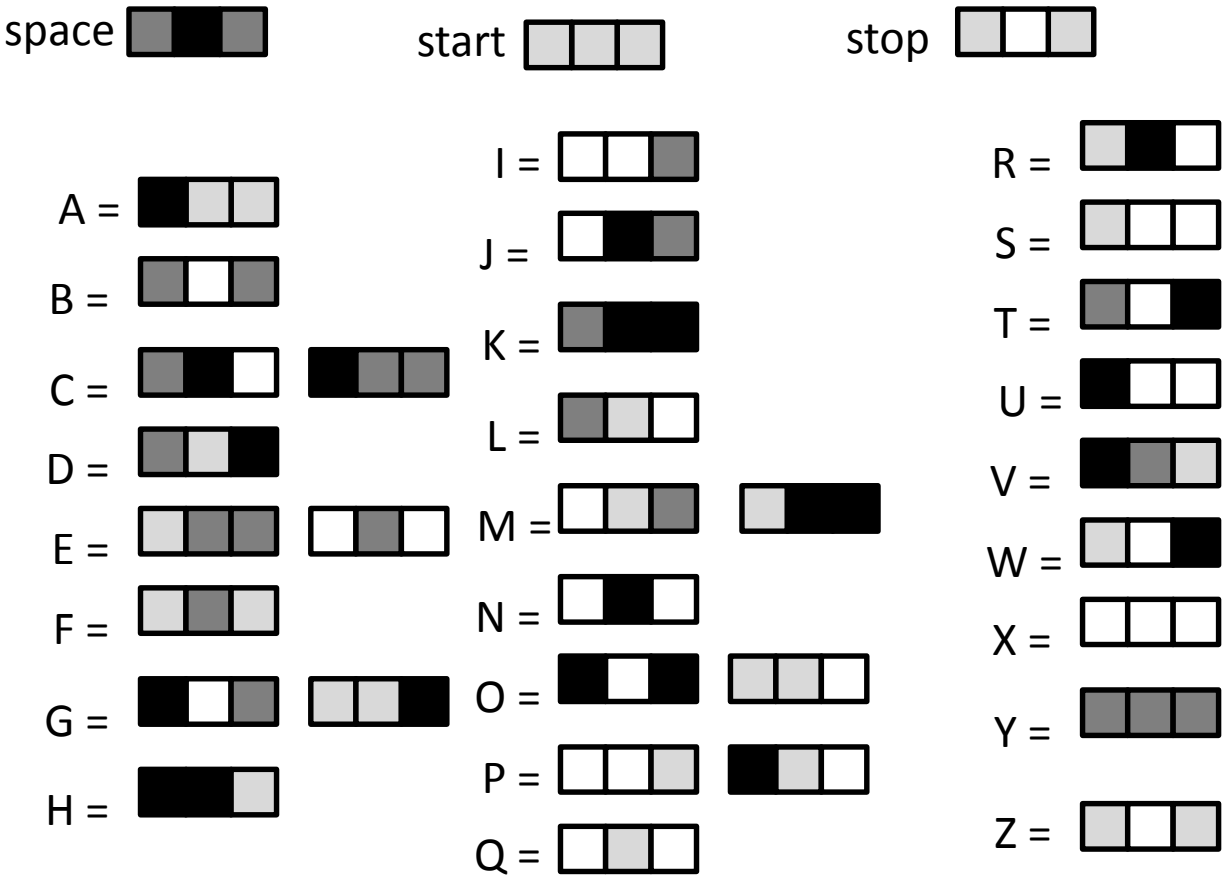
Setting the scene
The script below can be used to create a fun scenario for the class to work with:

The police have just left the School Principal's office. It appears the inmates at a local jail have been communicating with friends on the outside using coded messages embedded in the bracelets and necklaces they are making in craft classes. The bracelets and necklaces are made of sequences of square tiles. The Principal has asked if we could use thetemplates of the bracelet designs that the police have provided, to work out what the coded message is. But before we can work out the message, we need to work out the code that's been used to write it.

***Activity 1* - Identifying the code**

1. Give each student, or pair of students, one set of CMRI code identifying words (see Student Activity Sheet 1). A total of 19 sets are provided. By splitting these up among the class, all students will need to work together as a collaborative team to crack the code. Depending on the class size, some students may have more than one set of words.

2. Explain to students thatin the words they have been given, each letter corresponds to a set of 3 squares in a certain colour combination (e.g. the letter 'A' might correspond to the squares:'black-light grey-light grey'). To work out the code, students match each letter of the known word (i.e. 'cancer') with 3 squares of the code.There is also a set of 3 squares that represents the beginning of each sequence of words, a set of 3 squares to show a space, and another 3 squares to show the end of a sequence.
3. While students are working on the code, write the letters A to Z in a column or two on the left hand side of the board. Leave room after each letter for students to write or draw the matching code next to it.
4. If students need some help, a few clues can be given, –e.g. a space between words is represented by 
5. As students finish identifying the code for each letter, they can come and draw them on the board. Note: There is more than one code for some letters.
6. The correct codes are provided here for reference:



Activity 2* – *Applying the code to work out the message

1. Give each student, or pair of students, one or more sections of the message to decode (see Student Activity Sheet 2). The 18 different sections can be cut out before the class.
2. Write the numbers 1 to 18 in a single column on the right hand side of the board.
3. As students decode their section of the message, using the code they have compiled, they can write it on the board next to the number of the section they completed.

For your reference, the coded message reads:

1. CMRI conducts important
2. medical and biological research in
3. order to gain important
4. answers. CMRI scientists study
5. the causes of cancer and whether (mistake included so it reads 'the causes
   of dancer and whether')
6. cancer can be stopped. Some
7. research teams are concerned with
8. what might go wrong during
9. development and how we can
10. prevent things from going
11. wrong. CMRI scientists ask how
12. the brain works and whether what
13. we have learned about brain
14. cells can be put to use to treat epilepsy
15. and other neurological disorders.This
16. knowledge will enable us to build a
17. better future and light the spark
18. that will lead to tomorrow's discoveries.

Discussion

At the end of the decoding, some or all of the following questions can be asked of the students (depending on their level of knowledge) to encourage them to relate the code analogy/model they have just used, to the actual DNA code.

1. Which parts of the model you used could represent:
   i. an amino acid
   ii. a codon
   iii. a gene

iv. a polypeptide
v. DNA
vi. a chromosome
vii. a mutation

2. Did you find any mistakes?* What kind of mistakes were they? What happened to the coded message at the end when there were mistakes?
3. Can DNA contain mistakes? What kind of mistakes can DNA have? What are the consequences of DNA containing mistakes (mutations)?
4. What were the strengths of this model? How was it a useful teaching and learning tool to explore DNA as a code?
5. What were the limitations of this model? How was it different to actual DNA?

*Teacher note: mistakes were deliberately created (and the students may add in their own) as part of the model and to provide a point of discussion around the consequences of coding errors in DNA.

Teacher testimonial: 'This lesson runs itself and is one of my top 5 that I do with students whenever I can fit it in, either in Year 10 genetics or Yr 12 biology. It never fails to engage students as they work both collaboratively and independently to identify the code and then apply it.'

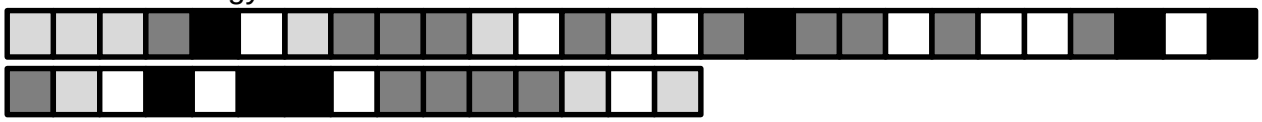
Student Activity Sheet 1
Identifying the code

Task: Each of the 19 sets of words below is a research unit or fundraising event at the **C**hildren's **M**edical **R**esearch **I**nstitute (CMRI). Each of the CMRI words has been written in code, using sequences of shaded squares.

Can you work out which sequence of boxes represents each different letter of the alphabet?

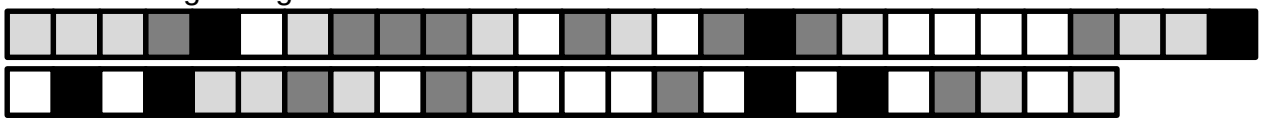
1. cancer

2. cell biology



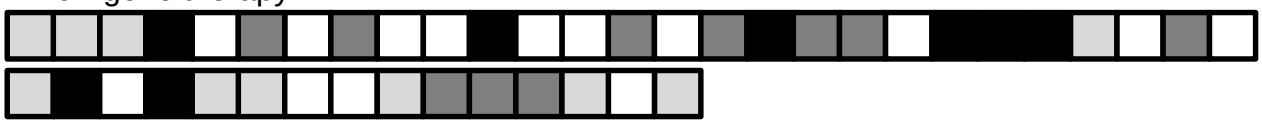
3. cell cycle

4. cell signalling

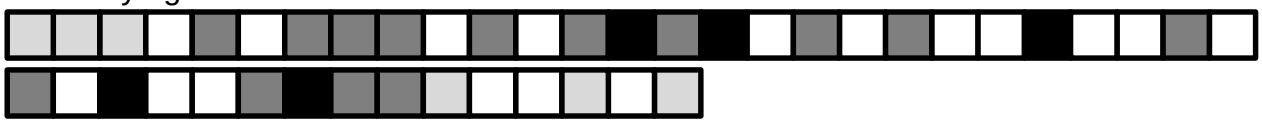


5. embryology

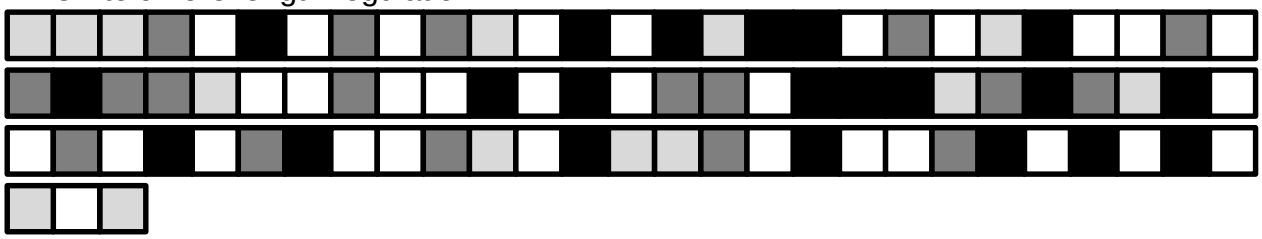
6. gene therapy



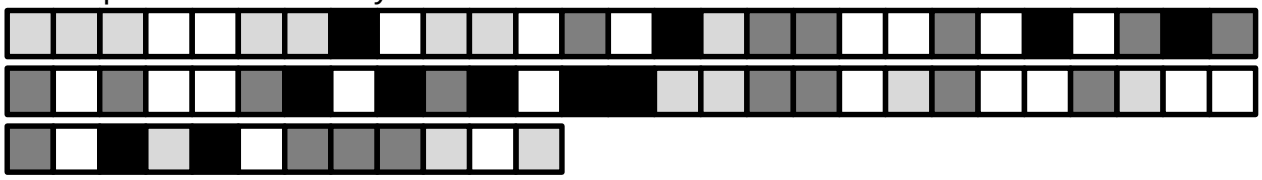
7. eye genetics



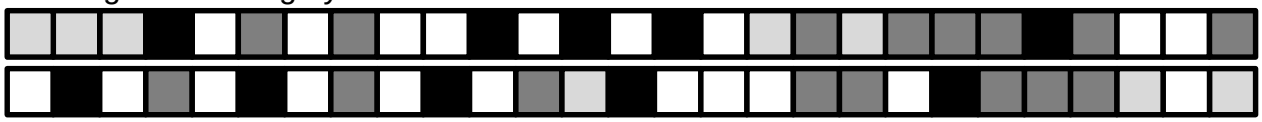
8. telomere length regulation



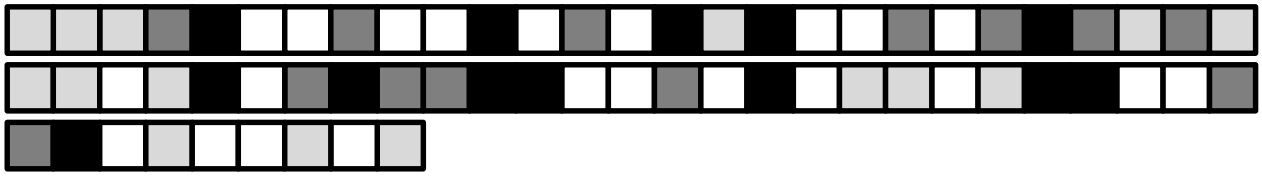
9. protein biochemistry



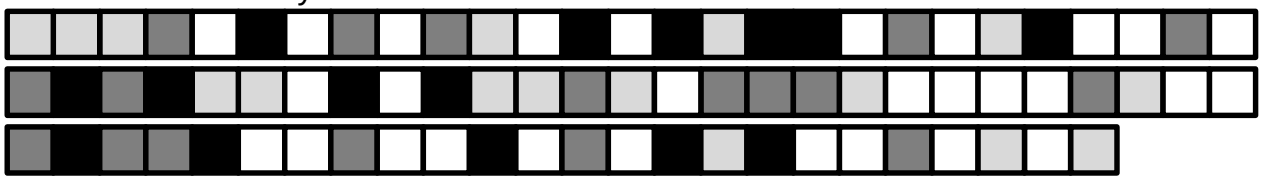
10. genome integrity



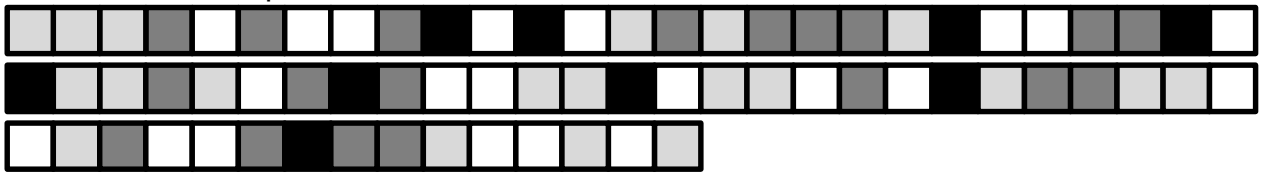
11. centre for kinomics



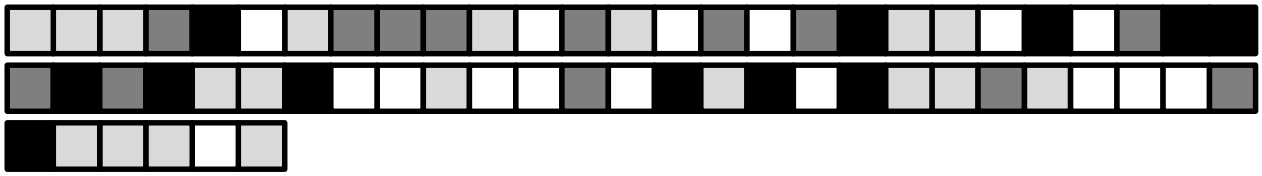
12. telomere analysis centre



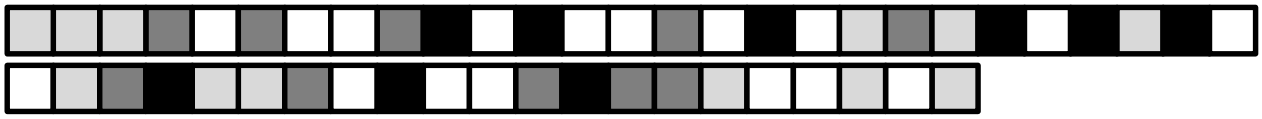
13. biomedical proteomics



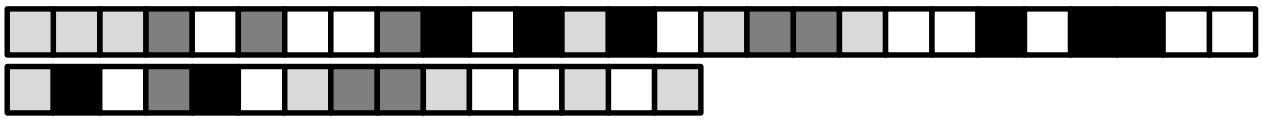
14. cellbank australia



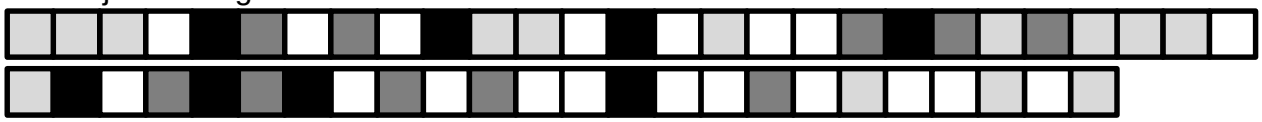
15. bioinformatics



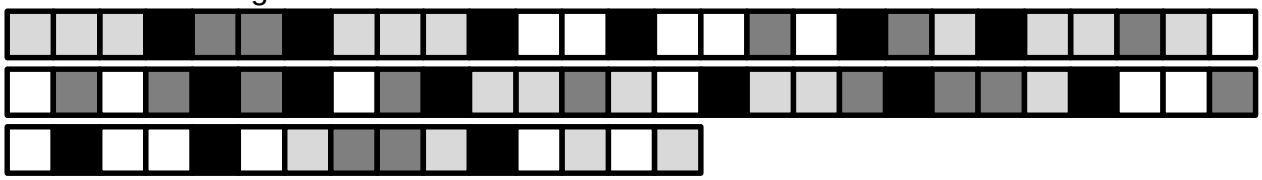
16. bioresources



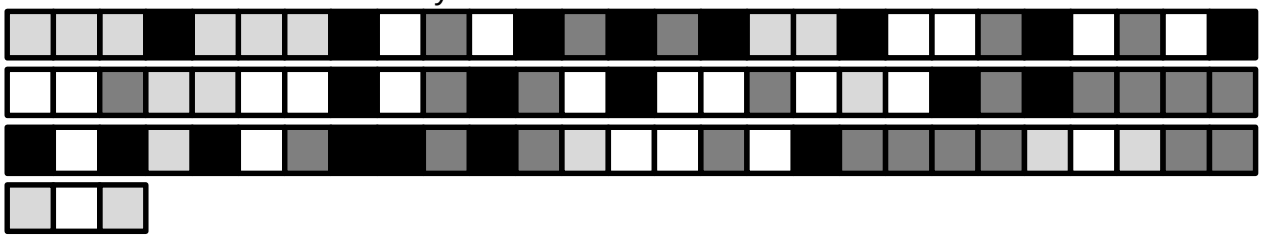
17. jeans for genes



18. carnevale gala dinner



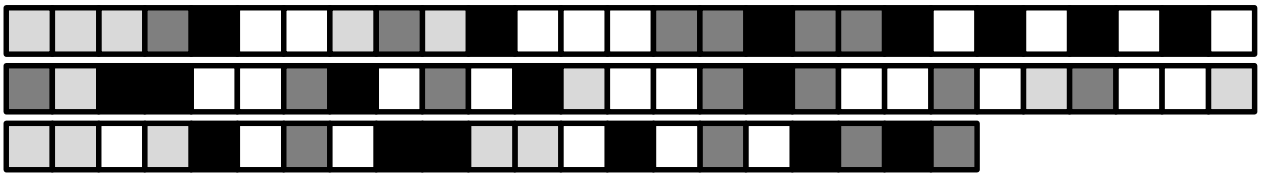
19. art auction New York style

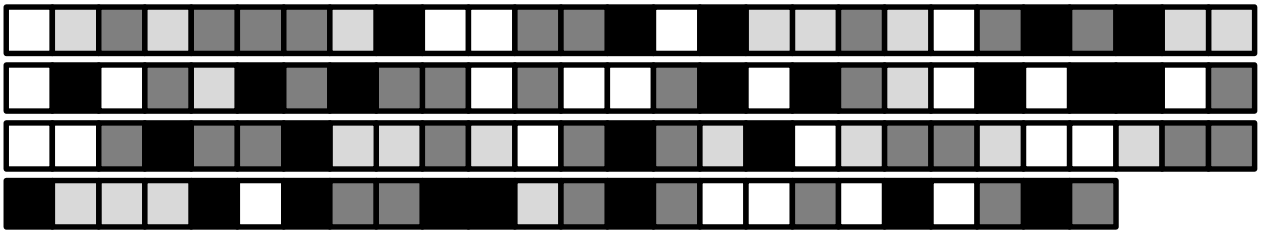


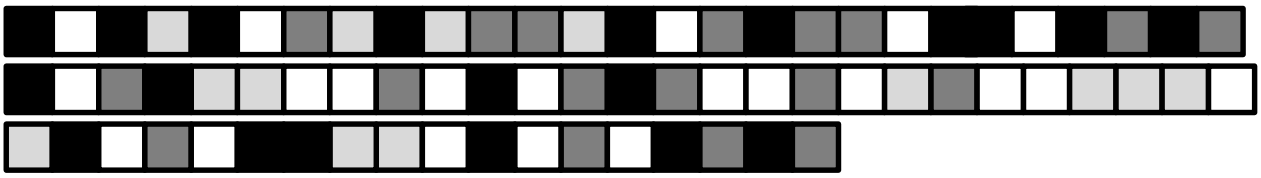
Student Activity Sheet 2

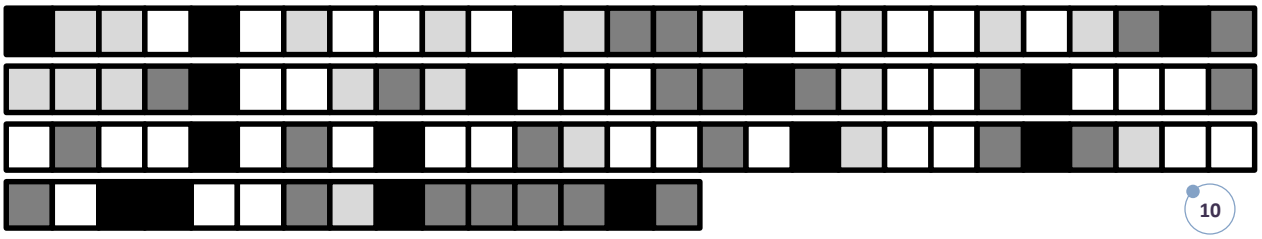
Applying the code to work out the message

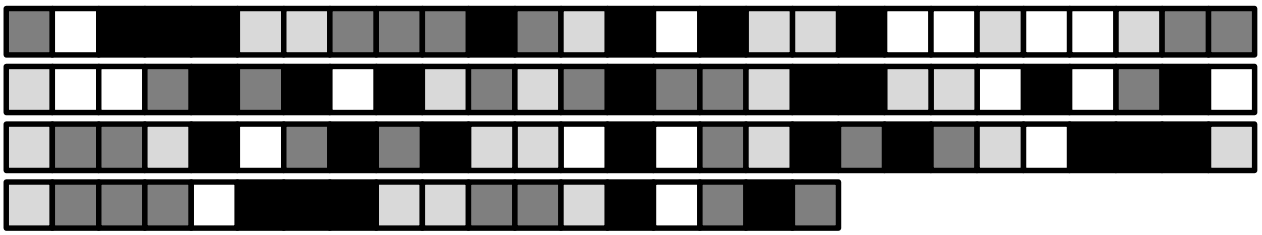
Task: Decode the sequence of words you have been allocated. Once you have worked out this part of the message, write it up on the board next to the corresponding number.

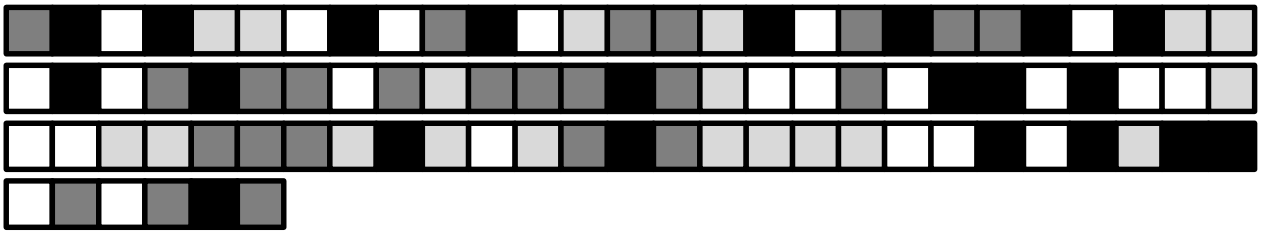
1. 

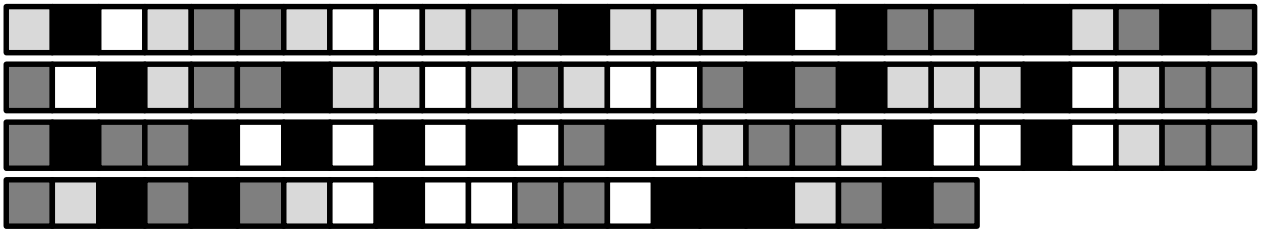
2. 

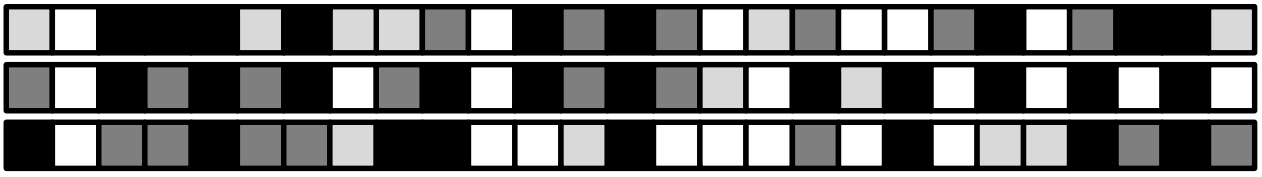
3. 

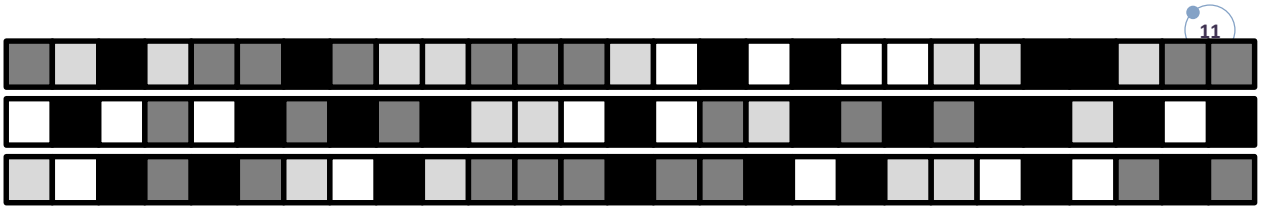
4. 

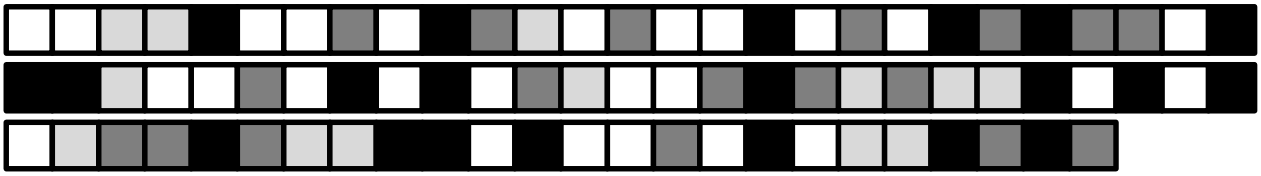
5. 

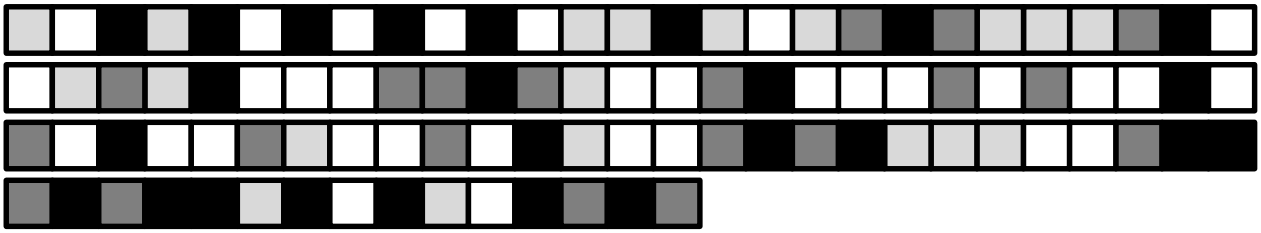
6. 

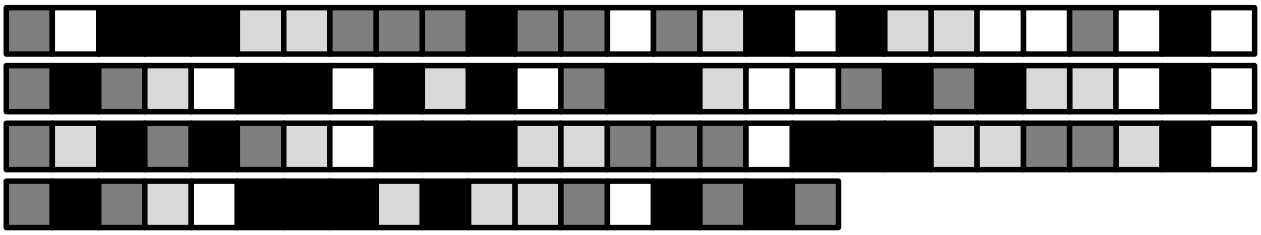
7. 

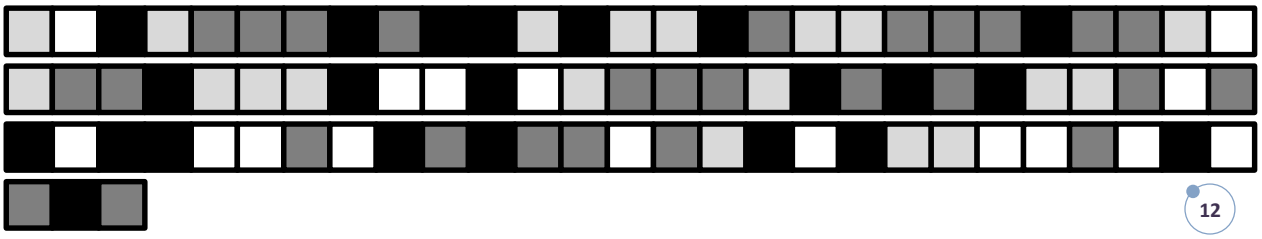
8. 

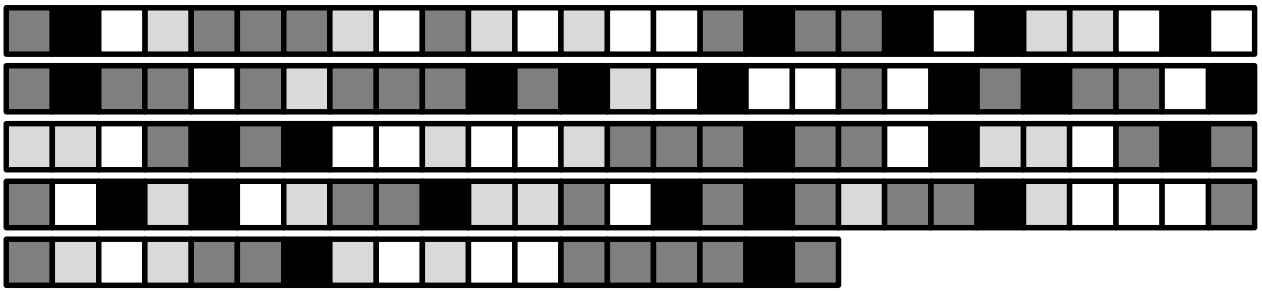
9. 

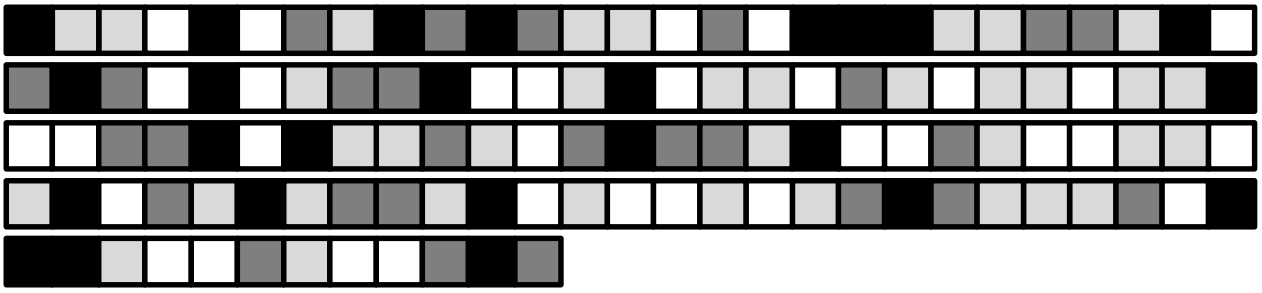
10. 

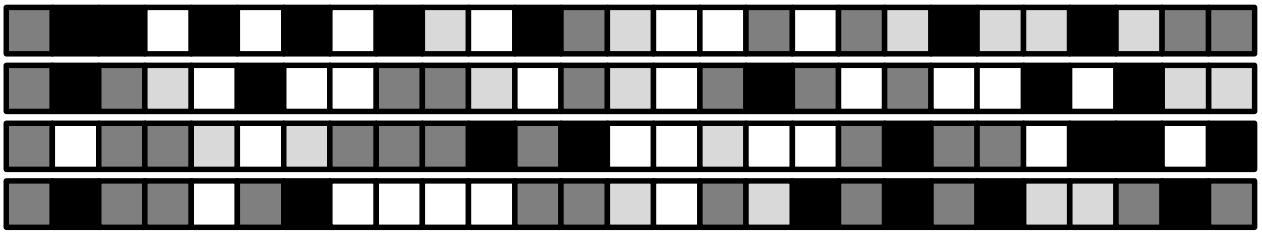
11. 

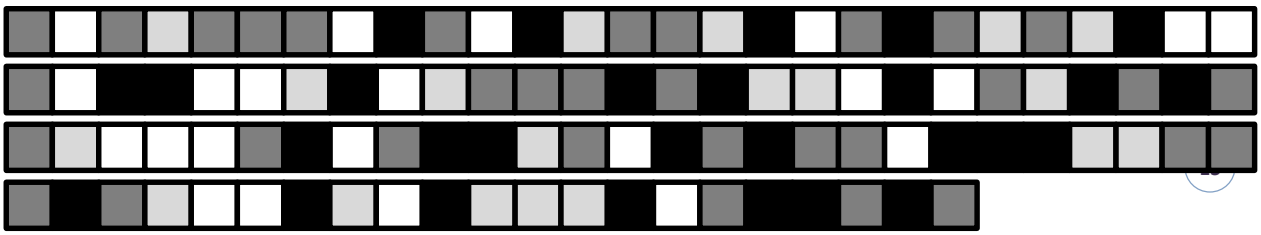
12. 

13. 

14. 

15. 

16. 

17. 

18.