English Light Orchestra

a module on patterns and expressions

Teacher guide

CORNERSTONE MATHS

About the cover

Once upon a time, a design collective came upon the idea of creating art installations made of lights and developed the English Light Orchestra campaign.

The stories in this work are fictional. All characters and events appearing in this work are fictitious. Any resemblance to real persons, living or dead, is purely coincidental.

English Light Orchestra - A module on patterns and expressions
Developed jointly by SRI International, Center for Technology in Learning (United States) & UCL Knowledge Lab, UCL Institute of Education (UK)

For more information about Cornerstone Maths, please visit www.ucl.ac.uk/cornerstone-maths

Designing a lighting pattern

Key Ideas
→ A variable is an unlocked number that represents the index for the stage of the pattern displayed in a figural pattern.
→ Variables can be linked to create expressions for figural patterns that have several building blocks.

Main Activity   45 minutes total
Discussion   Whole Class | 5 minutes

- In the software there are four 'windows': The **Pattern Player**, the **Designer's Grid**, the **Expression Builder** and the **Graph/Table** window. In this activity the pupils will learn how to create a figural pattern in the **Designer's Grid** and develop an algebraic expression that correctly describes its structure and its *dynamic behaviour*.

Questions 1 - 5   Group | 15 minutes

- The **Pattern Player** shows a lighting pattern that is playing in a random order. Encourage pupils to use the **Pause** and **Step** buttons to investigate the pattern - to try to understand its structure and how it is built.
- The name 'building block' is used to identify the basic structure of the different coloured parts of the lighting pattern.

Questions 6 and 7   Group | 20 minutes

- Most pupils will build the pattern using two different colours and use two different variables in their expression. If this happens, the Pattern Player will not give feedback that the pattern is matching. The mismatch can be made explicit when pupils drag the variable sliders in the Designer's Grid. Help pupils think of a way to ensure that their variables are the same and let them come up with methods to try. This 'linking' of the variables can be done by dragging one variable's name on top of the other *or* by naming the second variable with the same name as the first.
- As you circulate, note the issues pupils are having for a whole-class discussion during the plenary. You may identify particular pupils to share their solutions at the end.

Software suggestions:
- Both the pattern in the **Designer's Grid** and the algebra in the **Expression for Total** need to "match" the pattern in the Pattern Player for the pattern in the Designer's Grid to be coloured brightly.
- Patterns "match" if they match for any value of the figure number, i.e., if their nth figures are congruent, for all n. (not language for pupils).
- An expression "matches" a pattern if it generates the total number of lights needed for figure n in terms of n. (not language for pupils.)

Plenary   Whole Class | 10 minutes

Encourage pupils to share with each other the issues and insights that came up during the activity and to give reasons for their responses.

The software gives pupils feedback that they have an expression that represents the pattern in the **Designer's Grid**. Ask how else they know they have the right expression. For example, by using the slider to check that the variables are linked.

Points to make:

- Each repeating block of colour led to a part of the **Total expression**, which comprised a number multiplied by a variable.
- The variable used for each of the building blocks had to be the same. Why?

Pupil Difficulties

- Pupils may unlock numbers and give them different names. But variables that represent the same thing need to be linked, i.e. have the same name.
- Pupils may use incorrect operations to relate the variable and term in the expression.
- Pupils may not have dragged the icons for the two parts of their expression to the **Expression for Total** and included the correct operator.

Designing a lighting pattern
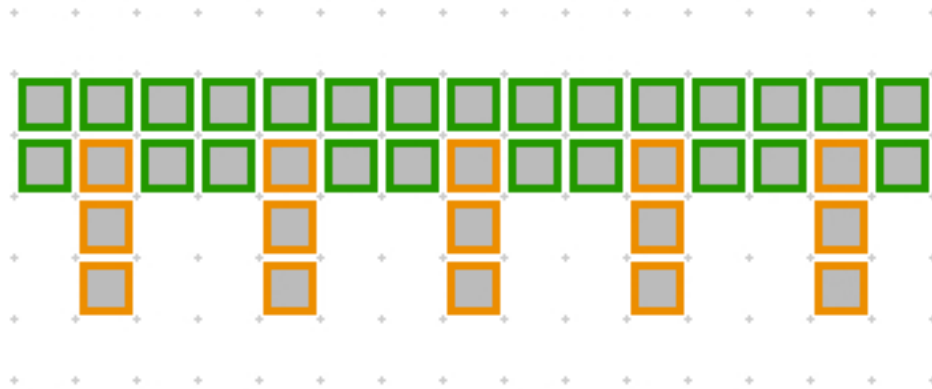
It is great to have you as part of our English Light Orchestra Campaign Team. As a lighting designer, you need to understand the structure of patterns that you will be making in lighting displays.

Open the Demo Activity Patterns and Expressions.
The Pattern Player window shows a lighting design that is playing in a random order. Someone has begun to create the pattern in the Designer's Grid - they need your help to complete this task.
You will need to build an expression for the total number of lights needed to make any figure in the pattern.
If you are successful, the original pattern will light up brightly.

1) Watch the pattern playing in the Pattern Player. Describe the pattern.

> Accept multiple answers.
> The pattern looks like a tree. There are 5 green lights and 3 orange lights.

2) Describe the pattern that has already been started in the Designer's Grid.

> Accept multiple answers.
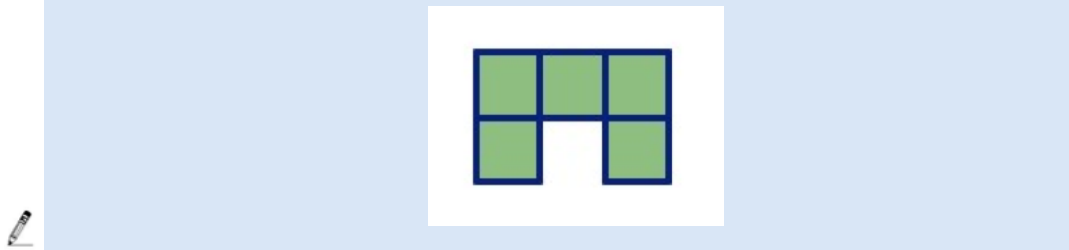> The pattern looks like the tops of the tree. There are 5 green lights.

In the Expression Builder, select the name 'tops' and drag the slider that appears.
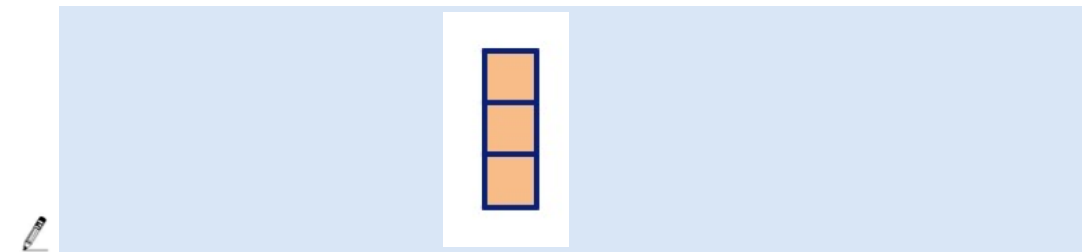
3) Describe what happens.

4) Sketch the building block for the 'tops' below.

5) Think about the building Block that you will need to create using orange lights in order to complete the whole pattern. Sketch this below.

Drag the orange lights and use the Block and Pattern buttons to recreate the whole pattern.

   i)   Use one colour to create the building block for the orange light pattern.

   ii) Use the **Block** and **Pattern** buttons to recreate the pattern.

   iii) You should now see something in the **Expression Builder** that relates to your pattern.

   iv) Edit your expression so that it gives you the total number of lights for your particular figure in the Pattern Player.

   v)   Drag the icon for your block to the **Expression for Total** row.

6) Record your **Expression for Total** and **Check**: Did your expression colour in the pattern you made in the Designer's Grid? If not, why not? Modify your expression to ensure that the pattern colours properly.

Accept multiple answers.

(5 X tops) + (trunk X 3) – no it did not colour the tree brightly – I have too many trunks and not enough tops.

(5 X fred) + (3 X fred) – yes the tree lit up brightly – I had to link the 'freds' so that the variables had the same value and the number of tops and trunks always stayed the same.

7) **Explain** how the numbers and variables in your expression are related to the lights in the pattern.

Accept multiple answers.

My expression is (5 X fred) + (3 X fred).
The 5 is the number of green lights in each of the 'tops'
The 3 is the number of orange lights in each of the 'trunks'
'fred' is the variable that stands for the number of trees in the pattern.