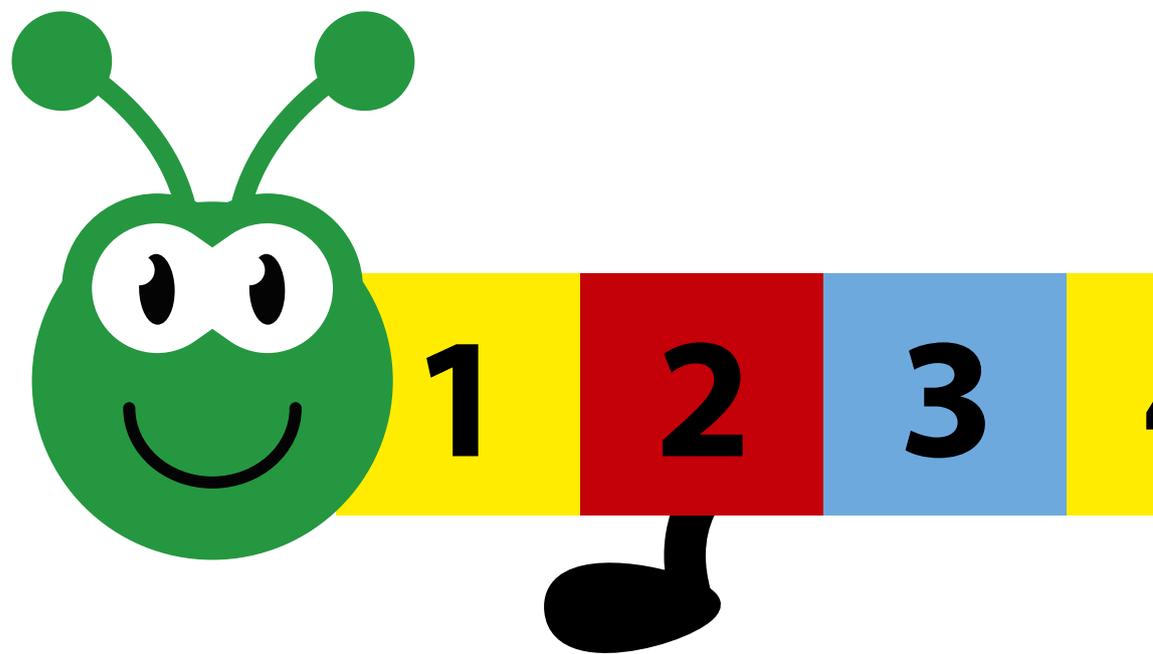


# **Centipedes and caterpillars**

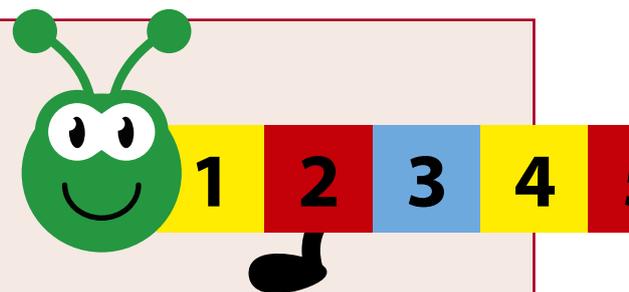


**Support materials for teachers**



## Year 5 Reasoning in the classroom – Centipedes and caterpillars

These Year 5 activities start with an item that was included in the 2014 National Numeracy Tests (Reasoning). They continue with a linked activity, in which learners use the context of the transformation from caterpillar to butterfly to explore colour combinations and patterns.



### Activity 1

#### Playground centipede

Learners use their reasoning skills to work out when two conditions are next met within a sequence.

Includes:

- Playground centipede question
- Markscheme

### Activity 2

#### Butterfly

Learners design patterns for their butterfly, complying with given conditions.

Includes:

- Explain and question – instructions for teachers
- Whiteboard – Caterpillar 1
- Whiteboard – Caterpillar 2
- Whiteboard – Butterfly
- Resource sheet – Butterfly
- Resource sheet – Our butterfly

## Reasoning skills required

### Identify

Learners choose their method, and in Activity 2 decide on their design.

### Communicate

They explain their reasoning and give feedback to their peers.

### Review

They review their own work and that of their peers.

## Procedural skills

- Simple sequences

## Numerical language

- Pattern
- Adjacent
- Segment
- Rule

Activity 1

# Playground centipede

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## Activity 1 – Playground centipede



### Outline

This Year 5 activity is based on a centipede drawn in a playground. Learners continue two independent patterns to find the next square that is both red and has a leg.



### You will need



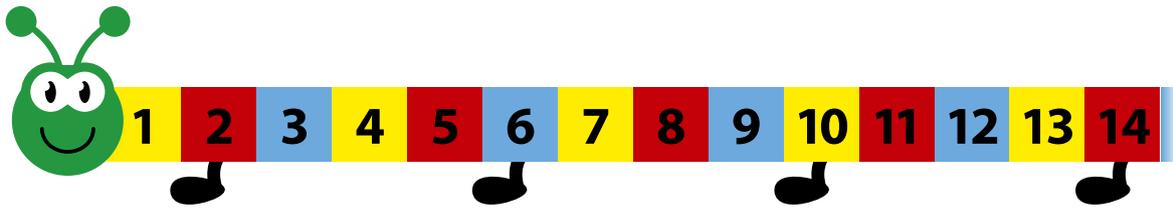
#### Playground centipede question

One page for each learner



#### Markscheme

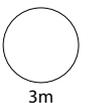
This is a playground centipede:



**14** Square **14** is red and has a leg.

The pattern continues.

**?** Work out the **next** number that is red **and** has a leg.



## Activity 1 – Playground centipede – Markscheme

Marks	Answer
3m	<b>26</b>
Or 2m	<p>Identifies at least the next <b>two</b> numbers in <b>both</b> repeating patterns, i.e.</p> <p>Red 17, 20 Leg 18, 22</p> <p>Or</p> <p>Shows understanding that as 2 and 14 are red and have legs, the next number must be <b>12 more</b></p>
Or 1m	<p>Identifies at least the next <b>two</b> numbers in <b>one</b> repeating pattern</p> <p>Or</p> <p>Identifies the next number in <b>both</b> repeating patterns, i.e.</p> <p>Red 17 Leg 18</p> <p>Or</p> <p>Describes <b>both</b> repeating patterns correctly, e.g.</p> <ul style="list-style-type: none"> <li>Reds are every 3, legs are in 4's</li> </ul>

## Activity 1 – Playground centipede – Exemplars

14 | 15 | 16 | 17 | 18 |  
 red & leg | blue | yellow | red | blue & leg |  
 19 | 20 | 21 | 22 | 23 |  
 yellow | ~~X~~ red | blue | yellow & leg | red |  
 24 | 25 | 26 | 26  
 blue | yellow | red & leg |

Correct; **3 marks**

- Slow but sure!

25

Incorrect; **0 marks**

- This learner may have miscounted but because no working is shown we cannot be sure. This learner needs support to understand the importance of showing working.

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17  
 18 ~~X~~ 20 21 22  
 19  
22

17, 20 and 18, 22 identified; **2 marks**

- The shading and legs show how both patterns continue but the shaded number after 20 is incorrect.

There is 2 between reds  
 and 3 between legs

Describes both repeating patterns; **1 mark**

- These statements would allow the patterns to be continued so are acceptable.

Legs are on 2 then 6 then 10 then 14  
 so it must be 18  
18

Incomplete; **0 marks**

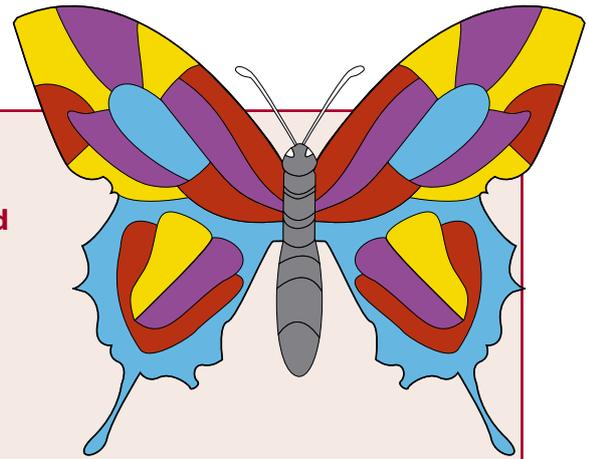
- Only one next number is identified.

Activity 2

# Butterfly

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## Activity 2 – Butterfly



### Outline

This Year 5 activity sees the centipede from **Activity 1 – Playground centipede** transformed into a caterpillar and then into a beautiful butterfly.

Learners create designs, exploring the minimum number of colours needed to ensure no segment is the same colour as adjacent segments.

### You will need



Whiteboard – Caterpillar 1



Whiteboard – Caterpillar 2



Whiteboard – Butterfly



Resource sheet – Butterfly

Two sheets for each pair, with spares



Resource sheet – Our butterfly

One sheet for each pair, with spares



Coloured pens, pencils and erasers

## Activity 2 – Butterfly



### Explain

Show **Caterpillar 1** on the whiteboard and explain that this is the centipede from **Activity 1 – Playground centipede** magically transformed into a caterpillar! Discuss the colours and ask them to remind you of the repeating pattern in the colours (*yellow, red then blue*). Say that squares that are next to each other must be different colours, then ask if the caterpillar could have been coloured using fewer colours, and if so how. Show **Caterpillar 2** to demonstrate that only two colours are needed.

Ask what happens to a caterpillar – what does it change into? (*A cocoon first, then a butterfly*) Show **Butterfly** on the whiteboard and explain this is our caterpillar, now turned into a butterfly. They are going to colour in the butterfly, but they must stick to the rules – all segments (*parts of the shape*) that are adjacent (*share a boundary*) must be different colours. Ensure understanding by colouring in (*or notating, using 'b' or 'r' for example*) one area of the butterfly on the whiteboard.

Once you are confident they understand the rules, give each pair one copy of the resource sheet **Butterfly** and ask them to colour it in – using only three colours (*and ignoring the shaded body*). Encourage them to plan their design notating the segments with pencil, rather than immediately colouring in, so they can amend as they go. Allow time for them to attempt this then bring the class back together. Ask if anyone has achieved the task – they should not be able to as it is impossible! Ask them to show why it was not possible and encourage them to articulate their reasons (*a key element of numerical reasoning*).

Give out the second copy of the resource sheet **Butterfly** and ask if they can colour it using four different colours, but sticking to the rules. Again, encourage them to use a pencil before colouring. Once completed, ask each pair to check another pair's work, to make sure the rules have been kept. Then challenge them to create a design that needs only three colours. Give each pair a copy of the resource sheet **Our Butterfly** reminding them that no adjacent segments can be the same colour.

### Or

Replace the final part of this activity by asking learners to create a design that needs five colours instead. (*This is not possible – see [www.nrich.maths.org/6291](http://www.nrich.maths.org/6291)*)



### Question

- What does adjacent mean? (*Shares a border with*) What segment of the caterpillar is adjacent to xx? And xx?
- How are you going to plan your design? Where are you going to start? Are you confident you will get it right first time? Why/why not? So what are you going to do to make sure you can change your design as you go?
- Can you show me where you needed more than three colours? Can you explain why you needed more? Is there anywhere else that also needed more than three? Why?
- (*When starting the second design*) How are you starting this task? Can you build on the learning from the previous butterfly?
- (*For a design that needs three colours*) How are you approaching this task? What do you need to avoid? Are you checking that your design can't be made using only two colours?
- (*Or, after attempting to find a design that needs five colours*) Why doesn't your design need a fifth colour there? (*Choose an area that is most complex.*) Or there?

