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ChIPs assessments

Child Indicators of Performance
in mathematics

Repeating patterns

EARLY 
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The CHIPS activities are intended to enable educators to gather information about some key aspects of children's mathematical learning within informal and meaningful contexts, either individually or alongside peers. They help practitioners monitor children's progress and to plan. You may find it useful to select just one or two aspects, or to focus on a few children to gain insights into their understanding. The activities can be adapted to fit within routines, games, continuous provision or story contexts. They might also be presented by a toy character needing help or making mistakes. You will probably need to use them in several contexts, depending on children's responses, in order to be sure about their understanding. The mathematics sections of [Birth to 5 Matters](#) and [Development Matters](#) provide guidance on supporting children's further learning. See also ECMG [Mathematical Moments](#).

The activities here suggest ways to assess children's patterning, with aspects to look for in children's responses. While research shows that patterning is an important predictor of young children's mathematics (e.g. Rittle-Johnson et al., 2016), there is less consensus about assessment activities and progression. However, there is agreement about the significance of linear repeating patterns and identifying the core unit of repeat, so this is the key focus of these activities. We use letters to describe these pattern units, e.g. AB, ABC, ABBC. Whilst it is not necessary for children to describe patterns using letters, some find it helpful. The activities are based on assessments which are predictive of later achievement, mainly from Mulligan et al. (2015), Fyfe et al. (2015) and Lüken (2020). They are intended for children aged three to five who have had experience of copying, continuing, creating and spotting errors in patterns, with different materials, large and small scale, indoors and outdoors. Items suitable for more experienced 'pattern experts' are also included, in red font. Although the assessments are presented as focused challenges for individual children, the activities and observation pointers can be used in a wide range of contexts, including group activities and children's play. You may observe similar responses in children's spontaneous patterning, for instance when playing with collections outdoors or whilst mark-making. While children usually find it easier to copy static, visible patterns with objects, patterning activities can also involve actions, music, art, language, stories and routines. Once children have a disposition to spot patterns, they tend to see them everywhere in their environment.

Resources: here we have mainly used coloured wooden cubes, but it is important to provide a range of materials. These might be naturally varied items (like conkers, leaves, twigs or shells), or more uniform items but varied in size or orientation, like buttons or keys. Avoid distractors like favourite colours and toys, or interlocking cubes or bricks which children may find tricky or distracting to interlock. Try to make patterns using the type of object, shape, size or orientation as well as colours and avoid colours with children who may have a visual impairment.

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Column 1 describes the assessment activity. Start where you think the child may reveal their current understanding and stop when it becomes too difficult for them. *Suggested adult speech is in italics*. Feel free to adapt phrasing sensitively and to use hand gestures and signals alongside verbal instructions so that children understand what you are asking them to do.

Column 2 includes some prompts about what to look for, with space to note what the child does or says.

The accompanying videos show activities used in the development of these assessments, with some interesting responses from individual children (mostly three and four year olds). These videos are intended to stimulate discussion amongst colleagues about how young children's pattern understanding develops, and what we might observe when working with children on repeating pattern activities.

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Pattern assessments You may choose from or alter the order of these challenges, according to children's experiences Items in red include greater challenge for more experienced 'pattern experts'. <i>Words for the adult to say are in italics.</i>	Notes/observations
Same and different If a child is unable to identify 'same' and 'different', the pattern activities are probably not appropriate for them just yet. Here are two opportunities to check this: With a collection of objects where one is different to the rest (e.g. a snail shell among pebbles), ask: <i>Can you pick the one that is different / the odd one out?</i>  With a varied collection (e.g. knives, forks and spoons), separate one and ask: <i>Can you find one the same as this?</i> <i>Why did you choose that?</i>	

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Children's criteria for 'sameness' may not be obvious, so you may need to probe by offering objects which you think fit their criteria, to check if you have understood their criteria correctly).

AB pattern

You will need four groups of distinctly different objects (e.g. 40 cubes with 10 of each colour or 40 natural objects with 10 twigs, leaves, conkers and pebbles). It may be useful to model **copying** a pattern first e.g.: *I am going to copy this pattern and make one exactly the same. Look closely, is this exactly the same?* Make a few different patterns, copying some correctly and some incorrectly. This could be a group activity.

Copying - the child may...

not focus on the structure by:

- adding extra objects that are different (using more than the two in the original pattern)
- creating a different arrangement (not a line)

copy, but not focus on the unit by:

- copying one object at a time, just matching each one individually
- identify the unit by:
- picking up one unit (two objects) at a time
 - saying the unit objects, followed by a pause e.g. "yellow, blue.. yellow, blue.. yellow, blue..."

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Copying an AB pattern



Make a line of 6 using two different objects (e.g. blue cube, yellow cube, blue cube, yellow cube)

Look at this pattern. I would like you to make a pattern exactly the same as this one. You can use any of these.

Indicate the spare objects.

If the child does not copy exactly, prompt: *Look closely: is your pattern exactly the same? Can you make your pattern **exactly** the same as mine?*

Continuing an AB pattern

As previously, make a line of two types of things using 6 objects (e.g. yellow, blue, yellow, blue, yellow, blue or pebble, conker, pebble, conker, pebble, conker)

Point to the last object in the line and ask:

Suppose I made the pattern longer here, keeping the same pattern, what would come next?

If they only say one object ask, *What would come after that?*

And /or practically: *Can you continue this pattern?*

Encourage the child to add three more AB units.

Continuing - the child may...

copy, but not focus on the unit by:

- saying only one next object (not both objects in the AB unit)

identify the unit by:

- saying both objects
- adding two objects at a time
- adding objects at both ends, continuing the pattern in both directions

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Error fixing - an AB pattern



You might model this first, leaving a gap to start with, then repeating but with **no space where it should be**.

Make a new AB pattern, but with one object missing **and no space where it should be** (e.g. red, yellow, red, yellow, red, yellow, yellow, red, yellow or twig, leaf, twig, leaf, twig, leaf, leaf, twig, leaf)

Here is a pattern with something missing. Can you find the missing one? Indicate the spare objects.

Copying at a distance

Place the pattern to be copied at a distance from the objects (e.g. on another table or across the room) so the child has to move to go and see the pattern, memorise the pattern and then come back to recreate it.

*Can you make a pattern **exactly** the same as mine over there?*

Cover the pattern and ask them to copy it from memory.

Error fixing - the child may...

not focus on the structure by:

- not spotting the error

focus on the structure but not on the unit by:

- spotting the error, but not fixing it

identify the unit by:

- spotting the error and fixing it

Copying at a distance - the child may...

copy, but not focus on the unit by:

- going and looking at the pattern each time they add an object (matching one to one so not using the unit of repeat)

identify the unit by:

- picking up a unit at a time (2 objects)
- checking by saying the pattern, with pauses between units
- **copying from memory**

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Videos:

1. Adding cubes to the side
2. Matching with error (verbal mismatch)
3. Copying a little way away
4. Picking up units

Copying an ABC pattern

You will need four groups of distinctly different objects (e.g. 40 cubes with 10 of each colour or 40 natural objects with 10 twigs, leaves, conkers and pebbles).
Make a line of 9 objects (e.g. red, yellow, green 3 times or twig, leaf, conker 3 times)

Look at this pattern. I would like you to make a pattern exactly the same as this one. You can use any of these.

Indicate the spare objects.



Copying - the child may...

not focus on the structure by:

- using more than the three types of objects

copy, but not focus on the unit by:

- copying one object at a time, matching each object individually

identify the unit by:

- picking up one unit of three objects a time
- saying the unit, followed by a pause
e.g. "red, yellow, green.. red, yellow, green..."

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Continuing an ABC pattern

As previously, make a line of three objects, three times (e.g. red, yellow, green three times or conker, acorn, leaf, three times)

Suppose I made the pattern longer here, keeping the same pattern, what would come next?

And /or practically: *Can you continue this pattern?*
Encourage the child to add three more ABC units.



Present an incomplete final unit e.g. end with a red cube or an acorn



Continuing - the child may...
not focus on the structure by:

- saying only one or two objects (not the three objects in the unit of repeat)

identify the unit by:

- saying all three objects
- adding three objects at a time
- adding objects at both ends, continuing the pattern in both directions
- continuing from an incomplete unit

Error fixing - for each type of error (extra item, missing item, swapped)

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Error fixing - an ABC pattern

With ABC patterns, you can provide errors of increasing difficulty: an extra item is easier to spot than a missing item, or than two items swapped around so the order is incorrect.



extra

missing

swapped

Copying at a distance

Place the pattern to be copied at a distance from the objects (e.g. on another table or across the room) so the child has to move to go and see the pattern, memorise the pattern and then come back to recreate it. *Can you make a pattern **exactly** the same as mine over there?*

Cover the pattern and ask them to copy it from memory

You can then ask children to copy, continue and fix errors for units of increasing complexity: e.g.

items) the child may:

not focus on the structure by:

- not spotting the error

focus on the structure but not on the unit by:

- spotting the error, but not fixing it

identify the unit by:

- spotting the error and fixing it

Copying at a distance - the child may:

copy, but not focus on the structure

- going and looking at the pattern each time they add an object (matching one to one individually)

identify the unit by:

- picking up a unit at a time
- checking by saying the pattern, with pauses between units
- **copying from memory**

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AABB, AAB, ABBC, ABBA



Videos:

NB. These are easier activities,
without any extra colours.

5. Copying ABC

6. 1, 2, 3 pattern with an error

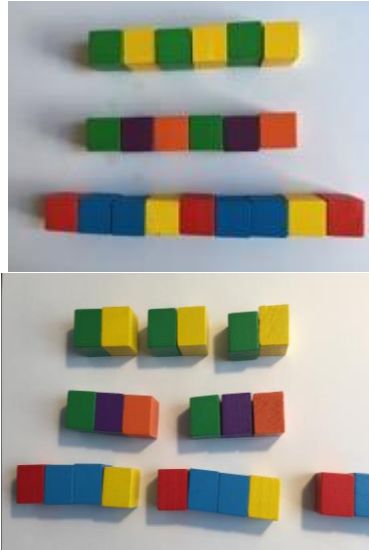
7. Talking through ABC, with errors

8. AABC instructing others

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Identifying the unit of repeat by splitting



(after Lüken, 2020)

Can you split the pattern into the smallest parts that are the same?

Repeat with a range of patterns e.g. AB, ABC, ABBC

Do this for an ABBA pattern

Videos:

[9. AB splitting](#)

[10. ABC splitting](#)

[11. ABBA splitting](#)

Identifying the unit of repeat by splitting - for each of AB, ABC, ABBC patterns the child may...

- split just one unit from the rest
- split into units, but not the smallest e.g. ABAB instead of AB

Identifying the unit of repeat by describing

Describing the pattern unit - the child may...

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Make a unit e.g. ABB and ask the child to make several the same and join them up to make a long pattern (for at least three units).

Or, show the child a pattern e.g. ABB

*Tell me what the pattern is:
What is the pattern unit / the smallest part that keeps repeating over and over / the little bit that keeps the same each time?*

Videos
12. Green and black
13. Building the pattern in units

copy, but not focus on the unit by:

- describing the whole sequence e.g. “red blue blue, red blue blue, red blue blue...”

identify the unit by:

- describing the pattern as the unit of objects, e.g. “It’s a red, blue, blue pattern.
- describing the pattern abstractly, using letters e.g. “It’s an ABB pattern”
- describing the pattern abstractly in some other way e.g. “It’s one, then two the same together”

Creating a unit of repeat

Creating a unit of repeat - the child may...

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Offer a range of different objects e.g. toys, pinecones
Can you make your own pattern, using any of these?
What is your pattern unit?



Videos

- 14. Creating an ABC pattern
- 15. Jumping number pattern

- making 3 or more consistent, repeated units
- describe the unit e.g. “stick, leaf, leaf” or “AAB”
- use their own criteria, e.g. size or orientation
- spontaneously make a pattern using a different context, e.g. drawing, collage or numbers

Action, words and picture patterns

Action words and picture patterns – the child may...

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Do an action pattern, saying the words at the same time, e.g. ABCD: *Heads, shoulders, knees and toes*
Invite children to:

- join in
- repeat from memory
- represent with pictures or symbols provided
- make up their own sequences and symbols



jumps, twirls, claps and stamps

Videos:

Banana, banana, meatball by Blazer Fresh

<https://youtu.be/BQ9q4U2P3ig>

16. Alternate arms tricky
17. 3 children get it.
18. Using pictures AAB
19. Using pictures AB
20. Row of bananas
21. Using words and pictures AAB

copy, but not focus on the structure by:

- joining in, with varying degrees of accuracy

identify the unit by:

- repeating from memory, with actions or words or both
- using pictures or symbols to represent
- describing or demonstrating the unit of repeat
- creating their own sequence, repeating for 3 units
- representing with own symbols

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Translating repeating patterns

Copy an AB pattern with different materials e.g. translating an AB pattern of large and small spoons by making an AB pattern using red and yellow bears



NB matching items with the same attributes (e.g. colours or sizes) is much easier than changing to completely different items (e.g. orientation). Changing modes (e.g. actions or sounds) is harder still.

Show a pattern made of objects of different types, colours, shapes or sizes (e.g. different size spoons)
Can you describe this pattern?

Offer other items with different object types, colours, shapes or sizes (e.g. red and yellow bears)
Can you make the same pattern, but using these?

Can you make an action or sound pattern to match?
e.g. clap, jump

Progress to ABC, then ABB, AABB etc. Vary items offered, e.g. all the same colour.



Translating patterns - the child may...

not focus on the structure by:

- describing the whole pattern instead of the unit e.g., *It goes pink, blue, blue, pink, blue, blue...*

copy, but not focus on the structure by:

- matching the items one at a time
e.g. *red becomes blue*

identify the unit by:

- matching a unit at a time
- describing the pattern as the unit of objects e.g. *"It's pink, blue, blue"*.
- describing the pattern abstractly using letters, e.g. *"It's an AAB pattern"*.
- describing the pattern abstractly in some other way e.g. *"It's two the same then one different"*.

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Border patterns

Offer a circular shaped paper plate, card/foam cut-out, tray or dish.

Can you make a pattern which keeps going on and on around this?

What is your pattern unit?

What else could it be? e.g. an ABB pattern in a joined-up border arrangement could be BBA or BAB



Then offer shapes with corners e.g. a triangle or rectangle: *Can you make a border pattern round this?*

Give children a frame with 12 squares (template provided):

Can you make a border pattern that fits in the squares?



Border patterns - the child may...

Identify the unit by:

- making a pattern which continues
- taking the pattern round a corner
- naming the pattern unit, using item names or letters
- making complex units e.g. ABBC
- giving alternative names for the unit e.g. ABB could be BAB or BBA
- finding different patterns which fit in a frame with 12 squares (as in template)

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- **Copying, continuing, identifying unit of repeat etc.:** objects of four different types, e.g. 10 each of four different colour cubes or 10 each of four different types of natural objects such as twigs, leaves, conkers and pebbles)
- **Action, word and picture patterns:** strips of paper and pens
- **Translating patterns:** objects which differ in object type, colour, shape or orientation e.g. all the same colour but different shapes
- **Border patterns:** paper plate, large card triangle or rectangle, 12 square frame (see below) & lots of each type of object to choose from

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References

These assessments are drawn from research identifying assessments which are predictive of later mathematical achievement.

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For further resources on developing patterning, see also:

Borthwick, A., Gifford, S. & Thouless, H. (2021). *The power of pattern: patterning in the early years*. Derby: Association of Teachers Of Mathematics.

Clements, D.H & Sarama, J. (2021). *Learning and teaching early mathematics: the learning trajectories approach*. Abingdon: Routledge.

Erikson Early Math Collaborative <https://earlymath.erikson.edu/ideas/pattern/>

DREME TE <https://prek-math-te.stanford.edu/patterns-algebra/assessing-patterns-algebra>

Photo acknowledgements:

Sharon Palfreyman Corrie nursery, Eastwood Nursery School, Holly Meadows Primary School, Long Melford Primary School, Catherine Carle the Mead Primary School, Jackie Lock Peaslake Free School, Wells-next-the-Sea Primary School.