Conkers

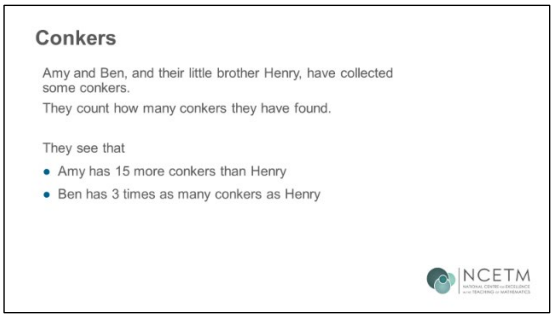
This sequence of activities provides opportunities to explore:

- **generalising**
- **structure**
- **graphical representation.**

The scenario

To begin with, pupils are encouraged to explore the statement on this slide and to experiment with numbers.

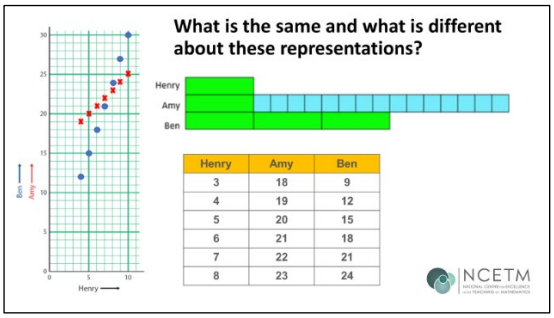
Ideas are then developed through a range of representations, including graphical representation, to allow pupils to explore the relationships in more depth and to become more familiar with the representations themselves.



Activity overview

Initially the pupils explore and discuss the scenario. Numbers that the pupils suggest are recorded along with other statements and ideas before the different representations are introduced.

The information is then represented in a table, a bar model and graphically, and pupils have the opportunity to explore the similarities and differences in the representations. Spotting where the moment when Ben has more conkers than Amy in each of the representations will support their understanding of the graphical representation in particular. This is likely to be the representation with which primary-aged pupils are least familiar, as graphs are mainly used to display data and are associated with statistics and not with relationships between numbers. This use of line graphs will be developed algebraically at secondary school.



Henry	Amy	Ben
3	18	9
4	19	12
5	20	15
6	21	18
7	22	21
8	23	24

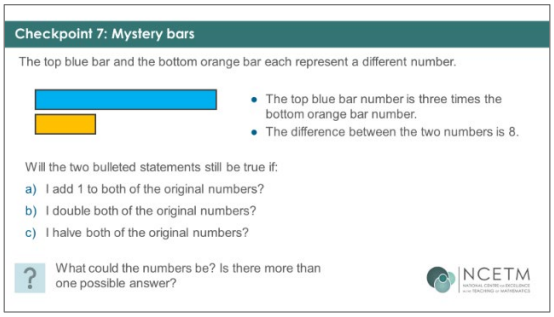
Through exploring the problem and then exploring the representations, pupils should be able to explain:

'Who has the most conkers?'

'Can Amy and Ben have the same number of conkers?'

'When does Ben have more conkers than Amy?'

This NCETM Checkpoints activity could be a good introduction to these resources:



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Language and representations

Representations introduced through the activity include tables, bar models and graphs. Pupils may make their own informal representations as they explore the scenario.

Any of these that support the introduction of the representations used in the following tasks may be highlighted, but the focus in this sequence is on the table, bar models and graphical representations. The use of these stem sentences has proved helpful in classroom trials of this activity sequence:

'If Henry has ___ conkers then Amy must have ___ conkers and Ben must have ___ conkers.'

When looking at the graph:

'If Henry has ___ conkers [pointing to the x-axis] then Amy has ___ and Ben has ___ [pointing to the y-axis].'

Misconceptions

Pupils may need some encouragment to see that different numbers of conkers can lead to different solutions to the question:

'Who has more, Amy or Ben?'

Some pupils may need guiding to realise that there are many possible answers or outcomes of the scenario.

Initially, some pupils might think that, regardless of Henry's number, adding 15 has a greater effect than multiplying by 3, as 15 is much greater than 3; others might think that ×3 has the greater effect, as multiplying is more 'powerful' than adding.

When using this activity with teachers and pupils, a discussion has arisen around x as a variable or x as a value to be found. This is not necessarily an outcome of this activity but it is an opportunity to assess whether pupils have this awareness and therefore inform future teaching.

Rationale and transition issues

This resource highlights a change in the use of graphing and plotting points from KS2 to KS3 to solve numerical problems. This will be developed in KS3 and KS4 to solve more complex problems including simultaneous equations.

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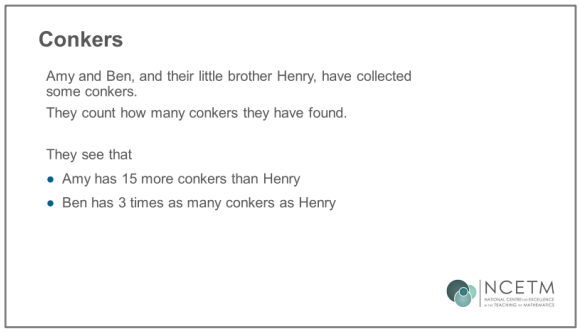
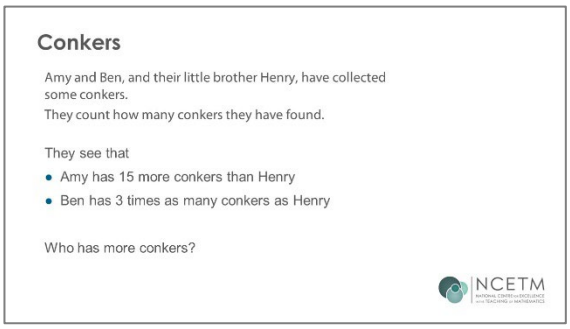
Task 1: The problem

The aim of this initial task is to allow pupils to introduce the scenario.

Slides 3 and 4	Commentary
Slide 3  	Display Slide 3. Give the class time to understand the Conkers story and think about the scenario.
Slide 4  Encourage pupils to try different numbers. The representations will be developed through further activities, but it is key that pupils have a good understanding of the situation so that they can then relate it to the different representations. It is likely that many pupils will come up with the statements listed on the right. These can be collected and recorded and the representations that follow can be used to justify these statements and to convince those who have not generated them that they are true. Two phases: • Realising that it depends on the number of conkers Henry has as to how many the other children have. • When does it switch from Amy to Ben having the most conkers?	When they have had a chance to discuss the problem, display/ask the question in Slide 4: *'Who has the most conkers?'* Get a few quick verbal responses from the class. Then give the class a few minutes to 'Think, Pair, Share'. The pupils may refer to or refine their representations and ideas when there is a specific question to answer. Record several sets of three numbers on the board (or similar) for the characters in the story, for the whole class to see. Write the characters' names as well as the numbers, as pupils are likely to give the three numbers in different orders. [Don't organise the information at this stage, and try to hold back from commenting on the contributions, but let other pupils in the class do so.] A lively discussion should soon develop from which these conclusions may emerge: • If Henry has a small number of conkers, Amy has most. • If Henry has a fairly large number of conkers, Ben has most. Some pupils may come to the following conclusions, which can be recorded but again without comment. These statements will be illustrated through the representations that follow. • If Henry has up to 7 conkers, Amy has most. • If Henry has 8 or more conkers, Ben has most. • If Henry has 7½ conkers, Amy and Ben have the same number of conkers (assuming the pupils are prepared to accept half conkers).

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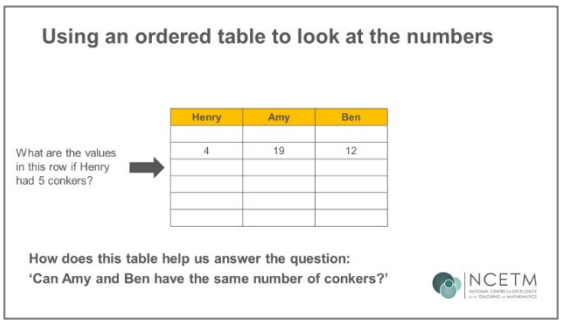
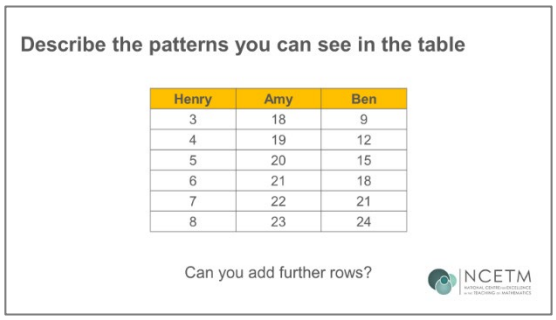
Task 2a: Tables

If pupils have used tables in Task 1, these could be displayed as a starting point and then refined into the version in the presentation.

A blank table is included in **Worksheet 1** (at the end of this document).

Tell the class that we are going to look at different ways to display and represent the information we have been discussing. Remind them to keep thinking about the statements we gathered in the first task and see if we can see them in the ways that we display the information.

Slides 6–8	Commentary
Slide 6  	To start with we will think about recording the numbers of conkers in an ordered table. To keep things simple, we have decided to start with Henry's number, then Amy's, then Ben's, as the information is introduced in the problem. Discuss what the values will be for the next row, i.e. when Henry has 5 conkers. Show the filled-in row. Ask pupils to complete the table (using Worksheet 1 or by copying the table into their exercise books). • Did they work across, row by row, or did they work down individual columns? • Did they start one way and then move to another? • Why did they choose to do it this way?
Slide 7  	Discuss the patterns in the table: *'As Henry's number increases by 1, so does Amy's, whilst Ben's increases by 3. Will this pattern continue? Could it change at some point?'* Relate the numbers in the table back to the story: • when Henry has a 'small' number of conkers, Amy has most • for 'large' numbers Ben has most • Amy and Ben have the same when Henry has 7½ conkers (if the class is willing to allow half conkers…). At this point, pupils can describe any patterns they can see in the values in the table and how they link to the information presented in the story. Encourage pupils to think about any statements that were made in Task 1. If no statements were collected, you may need to prompt pupils to consider who has the most conkers and whether this is always true.

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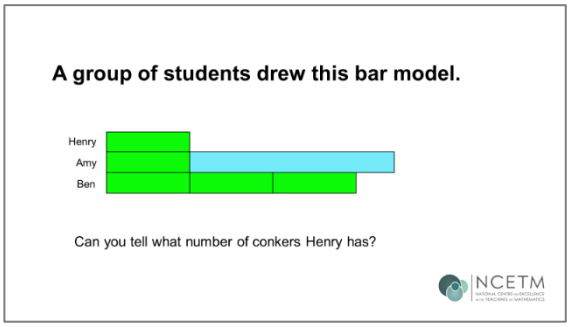
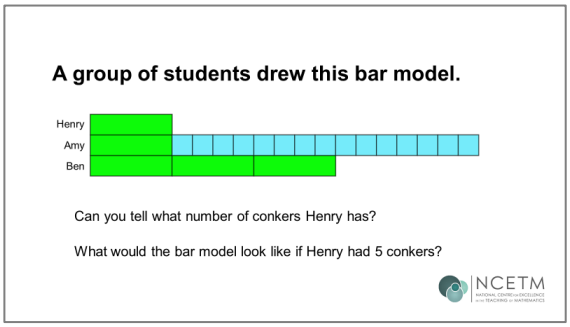
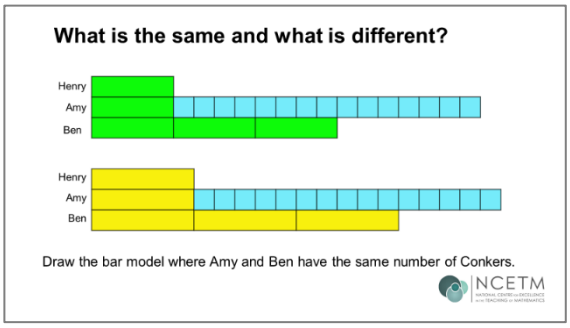
Task 2b: Bar models

Slides 10–14	Commentary
Slide 10 This first bar model is more of a sketch. It gives us some sense of what is going on and may be the sort of bar model that is familiar to pupils. The focus here is on whether this model gives us enough information to know how many conkers Henry has.  	*'Can you tell what number of conkers Henry has?'* Pupils may link this to the initial discussion and say that Henry must have fewer than 7 conkers as Amy has the most. It is possible to reason that Henry may have 6 conkers, but it is not obvious at a glance. The next slide shows how the representation can be developed.
Slide 11 This version of the bar model includes scale and accurately represents one starting number of conkers for Henry.  	Notice here that our bar model is drawn to scale. We are not using the bar model in the usual way – to solve a problem – rather, we are using it to illustrate a particular situation. This will allow us to represent accurately other starting numbers for Henry, e.g. when Henry has 5 conkers, 7½, or 8 conkers. *'On squared paper, draw an accurate bar model for the case where Henry has 5 conkers.'* It might seem odd to spend quite a lot of time drawing the bar model for h = 5, when we have already calculated the resulting numbers for Amy and Ben. However, it can be helpful for pupils to, in effect, revisit these calculations and to represent them visually, and perhaps also to get a sense of how addition (+15) and multiplication (×3) 'look different'. Also, having used the table to compare differences (going down the rows), it can be useful to reinforce this through this visual representation.
Slide 12  	Compare the two bar models. *'What is the same and what is different?'* *'How do the bar models convey the information and patterns that we observed in the table we drew earlier?'* Namely, when Henry's number increases by 1, Amy's increases by 1 also, but Ben's increases by 3. Ask pupils to draw the diagram where Amy and Ben have the same number of conkers, namely when Henry has 7½ conkers. [A hidden Slide 13 has this version of the bar model.]

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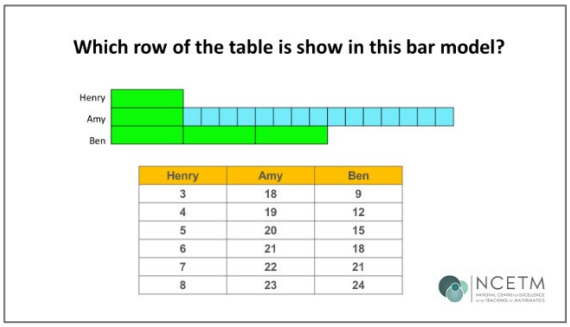
Slide 14



Henry	Amy	Ben
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Ask pupils to try to visualise the 'next' bar model, i.e. from 7½ to 8 conkers or 8 to 9 conkers.

Can they explain how each of the bars change and how the difference between Amy's and Ben's numbers changes?

They should also be given the opportunity to see how the same information is represented in the table and the bar model.

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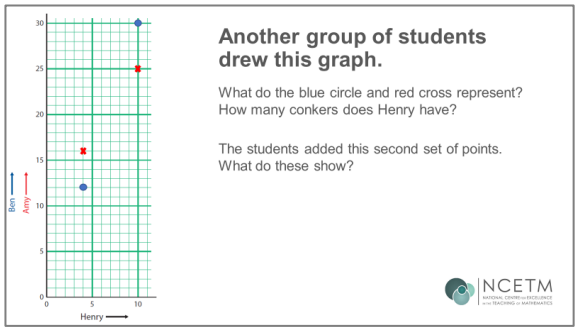
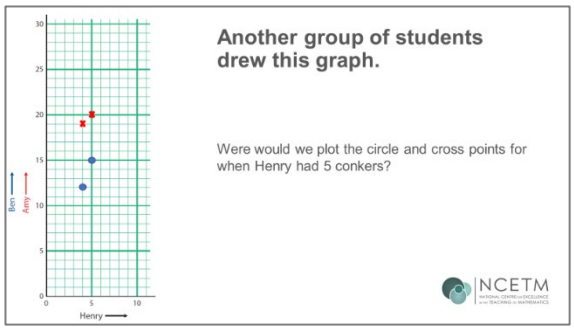
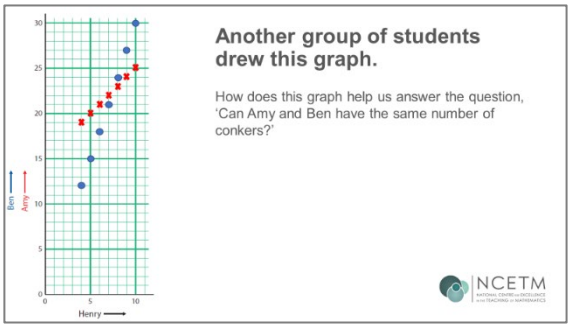
Task 2c: Cartesian Graphs

Here we use another representation, the Cartesian graph, to again examine what we have discovered about the numbers of conkers in our story. Pupils' growing familiarity with the conkers story should help them get a better understanding of how a graph 'works'.

Note: Here we are presenting pupils with points on a ready-made graph and are thus side-stepping important issues concerned with drawing axes and plotting points. Later in the lesson, you might want to get the pupils to construct the graph themselves.

Blank axes are available in **Worksheet 2** (at the end of this document).

A further lesson could include a different version of the story to help focus on the graphical representation in particular.

Slides 16–20	Commentary
Slide 16  	This slide is animated so the first pair of points are shown, and then the axis labels and the second set of points (when Henry has 10) appear on a click. Discuss how the graph represents the number of conkers for all three children but only uses 2 dots each time
Slide 17  	Discuss the position of the points for the case when Henry has 5 conkers. Show the points: these are animated and appear on the click. Examine the graph. *'What does it look like now?'* *'Where would the 'next' points go?'* **Worksheet 2** provides a set of blank axes so that pupils can discuss and plot the points themselves
Slide 18  	*'Can Amy and Ben have the same number of conkers?'* Once the pupils are familiar with how the graph represents the information, they are asked how the graph helps them work out if Amy and Ben can have the same number of conkers. There is an interesting discussion to be had around whether half conkers are allowed. We have not used lines to join Ben's and Amy's dots as the data may not be considered to be continuous (a concept first introduced in Year 4 of the National Curriculum). The data is discrete as we are thinking about whole conkers. But if you were to join the dots and crosses with lines, and allow for fractional conkers, they would cross (intersect) when Henry has 7½ conkers and Amy and Ben each have 22½ conkers.

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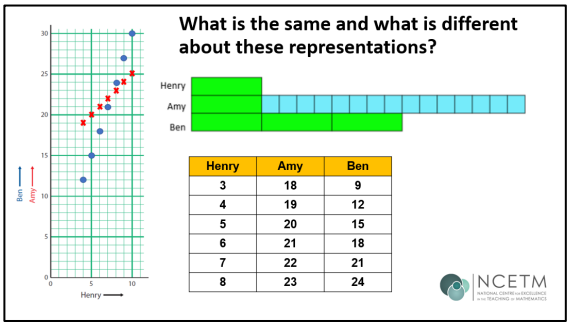
Slide 19



Henry	Amy	Ben
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The final slide shows the three representations together and gives pupils the opportunity to compare the way they display the data and also how they answer the questions and prove whether the statements made in the first task are true.

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Worksheet 1

Henry	Amy	Ben
4	19	12

Henry	Amy	Ben
4	19	12

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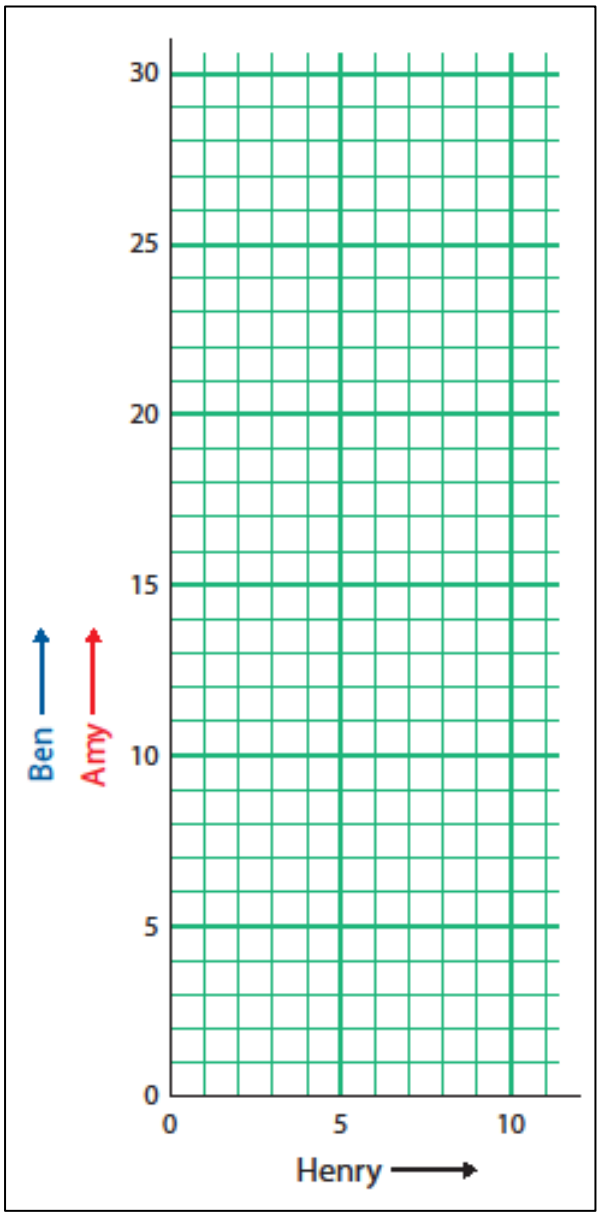
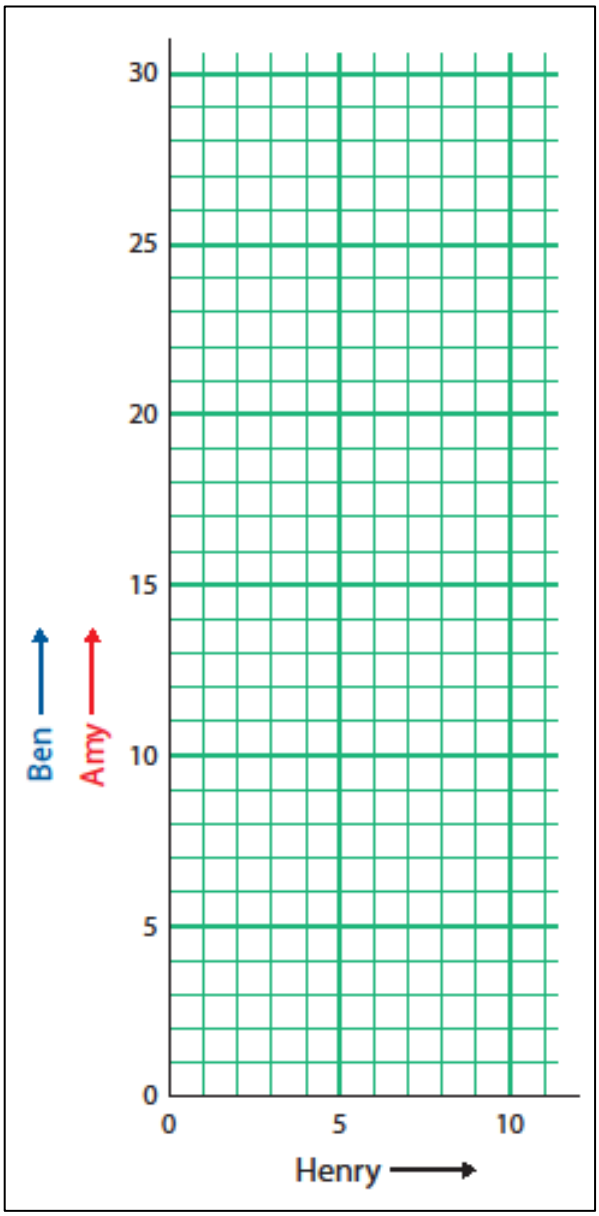
Worksheet 2





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