Maths

Teaching for Creativity Taster Cards

Quick challenges to practice creative habits

A NEW DIRECTION
We create **opportunity**

How to use these cards

These Taster Cards can be used as ice breakers, starter activities, class assembly prompts, ways to start and end the day, or as stand-alone 10—15-minute activities.

They are suitable for all settings, and even though the activity examples are pitched at Key Stage 2 Primary, they can be adapted for the age and level of Maths you are teaching. Most can also be adapted for remote learning easily, too.

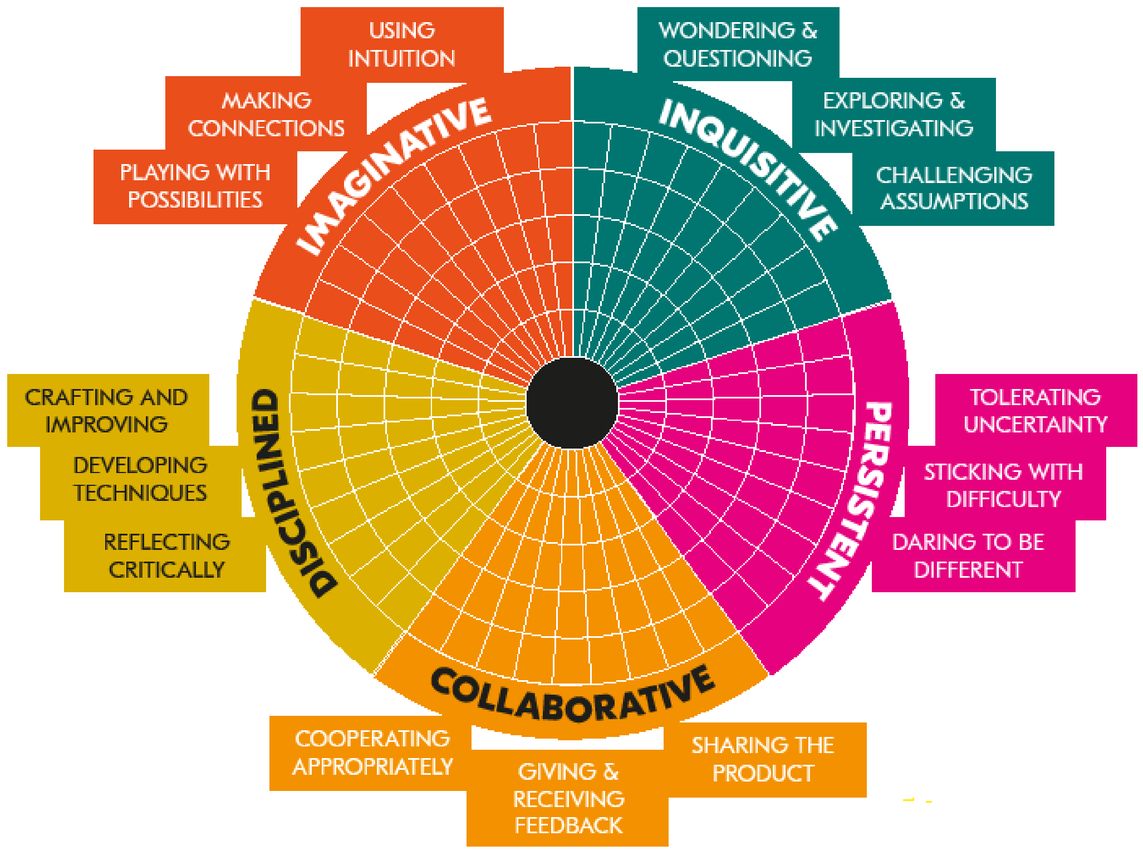
They were developed in partnership with Maths on Toast and in consultation with the Nrich Project.

- Maths on Toast's mission is for everyone in the UK to enjoy and feel positive about maths, and provide playful, hands-on, creative experiences of maths for families and communities.
- The Nrich Project, run by University of Cambridge, aims to enrich the mathematical experience of all learners.

This set includes some general tips and ideas for each of the five habits, in addition to activity cards.

We hope this resource helps you to think about how to use pedagogies for the 5 creative habits of mind across the curriculum, and how you might already be teaching creativity in maths without realising.

The Five Creative Habits of Mind



A New Direction, like many others, believes that creativity can be taught, and we want to support schools and teachers to feel equipped to do just this.

The pedagogies underpinning our Teaching for Creativity work come from the five Creative Habits of Mind – a concept developed from decades of research by Bill Lucas and colleagues which has now been widely adopted into learning policies across the globe. The Creative Habits of Mind are a great tool for tracking the development of your students' creativity.

To find out more, visit: **anewdirection.org.uk/teaching-for-creativity**

Inquisitive

To work on being inquisitive, provide opportunities for:

- **Wondering and questioning**

What questions do they have about maths topics, or what do results make them wonder? The taster cards include steps to help students ask interesting and productive questions, and you can try out strategies such as **See-Think-Wonder, Chalk Talk and Think-Puzzle-Explore** to start off conversations about maths problems or topics. You could even ask them '*What question do you think a Maths teacher might ask?*'.

- **Exploring and investigating**

Use **Nrich** style problems and puzzles that are **open-ended**. Ask students to make conjectures about problems before they tackle them. Ask them to **estimate** and **predict** outcomes.

Provide other people's mathematics for them to examine, encouraging them to challenge their solutions to problems. Can they propose problems to solve themselves? When proposing a maths problem, students could **work backwards** from a possible solution to see if it fits, repeating this until they can puzzle out an answer.

Give them time and space to observe, notice, explore and investigate at their own pace, trying different methods. This encourages lateral thinking and problem solving and helps build positive, confident, resilient learners. Can they find examples of **maths in everyday life?**

- **Challenging assumptions**

When students provide a hypothesis, elicit reasoning by asking: "*What makes you say that?*" and use strategies such as Connect-Extend-Challenge as plenaries to reflect on the learning that has taken place.

Sorting Cereal

1. Divide the students into groups and give each group a bowl of multi-shape cereal (coloured beads/shapes/counters/toy animals work just as well).

2. Ask the students to estimate, just by looking, how many of each shape there is and record.

3. Next, ask the students to count the shapes and record. Finally, they should work out the difference between their estimation and count. For a sorting sheet, *see Maths on Toast's website.*

4. Ask students: '*How accurate were your estimations?*'

Reflection: Is there anything that could have helped you when making your estimation? How might you use this information or skill? What else could you explore in this way?

Go Further: Ask children to think about how they could present their findings. For example a simple tally, a bar graph, pictogram (pictures of each shape/bead type/animal etc) sized according to how many they recorded. Can they work out the number of each shape/type as a fraction?

Inquisitive: Exploring and Investigating

This activity offers the opportunity for learning through hands-on play. Exploring and investigating space, shape and measure in this way can support more abstract mathematical thinking and understanding later.

Magic Maths - Hexaflexagon

1. Make 'Hexaflexagons' using this video tutorial and template from Maths on Toast.

2. Show students the video first.

3. Give each student a template for them to create their own hexaflexagon. They will need paper, coloured pencils, scissors and glue. Using a ruler to fold will help too!

4. After adding their own designs to the template, they should cut out the template, number it and fold it as shown in the video. You may need to show the video a couple of times!

5. They can then flex their hexagons to reveal hidden faces. How many faces can they find? Ask:
What is happening to allow the faces to disappear and reappear like this?

Reflection: How do you think this creation challenges assumptions or is surprising? How would you explain your creation using mathematical language?

Go Further: Are there any other investigations they could carry out? For example, how many ways to flex?

Inquisitive: Challenging Assumptions

The hexaflexagon is not what it seems, there are hidden faces waiting to be revealed. This activity provides the opportunity for students to question and investigate the maths behind the magic.

Maths of Me

1. Give each student a piece of paper, a pen and some sticky notes.

2. Ask them to write their name in the middle of the paper and some number facts about themselves spaced out around their name. *For example: 3 for size of shoe, 58 for house number, 9 for age etc.*

3. Students cover each number with a sticky note. On each note they should write or draw a clue or a challenge for a partner to work out the number below. *For example, 12 ÷ 4 = ?, 60 – 2 = ?, 3 x 3 = ? etc.* **Encourage them to be creative – don't just use calculations; how else could they show or represent a number pictorially or using data?** You may wish to use this template**.**

4. Divide students into pairs and ask them to swap sheets and work out the maths of their friend.

Reflection: Did you discover any new ways to write or draw calculations?

Go Further: Can they do the same exercise for the maths of someone or something they have been learning about in school?

Inquisitive: Wondering and Questioning

Maths of Me encourages students to find creative ways to ask questions and find answers. It gives students the opportunity to see how another person may solve problems in a different way to them – and they can both be right.

Collaborative

To work on being collaborative, provide opportunities for **cooperating appropriately, giving & receiving feedback** and **sharing the product**. Two heads are better than one is a helpful article reflecting on the value of communication and collaboration in a maths classroom.

Set students problems to work on together using frameworks such as Circle of Viewpoints, Chalk Talk and The Microlab Protocol. Try assigning roles to group members (like a mini/alternative version of Six-Thinking-Hats) E.g. Someone focuses on the calculations, someone focuses on looking for errors, someone focuses on asking questions, someone focuses on if the strategy is efficient/other strategies to try etc.

When you use **Think-Pair-Share**, you are encouraging students to work together and share ideas. Try reflecting on how successful this strategy is for them in maths. How can they use this tool more effectively? How can you scaffold it to improve actively listening to a partner?

Play maths language games and encourage students to work on being able to describe processes and concepts/ideas to other people.

Exploring maths together can be a fun, enjoyable experience. When students feel comfortable with maths they become more confident, and a positive mindset enables learning. Sharing ideas, giving and receiving feedback and learning from mistakes are important maths and life skills.

Students could write out proofs, their opinions and design presentations to share their learning and findings. What creative ways are there to showcase a mathematical concept, or their answers to a maths problem? Can students convince others about a mathematical hypothesis? Do other students have any feedback on how they could have worked on the problem differently?

Multiple Heartbeats

1. Show students how to find their own heartbeat. Once they are confident they can feel it, ask them to practice counting the beats.

2. Time one minute and tell students to count the number of times they feel their heartbeat.

3. Let the students experiment by counting heartbeats following a walk or jumping up and down or lying down. *What happens to your heartbeat if you change your level of activity? How long does it take your heart to return to the first number of beats that you recorded?*

4. Give the students a piece of paper, a pencil and some scissors so they can record and display their results on multiple hearts. Create a class display of the heartbeats. Here's an example.

Reflection: How else could we display this information creatively/artistically? Is there any other ways to plot our findings mathematically?

Go Further: Why not try the same experiment counting the number of your breaths?

Collaborative: Sharing the Product
This activity allows students to showcase their shared class findings in a creative way.

NB – This activity may raise possible sensitivities for children with heart issues including irregular heartbeats or family members undergoing procedures. Depending on your class, you might find it helpful to explain that this is something doctors can help with if necessary.

Tetrahedron challenge

1. **Divide the students into groups and give each group 12 straws.**

2. **Show the students how the straws join together by squashing/folding the end and pushing it inside another straw. Give them a few minutes to join all 12 straws.**

3. **Set them the challenge of turning their loop of 12 straws into a tetrahedron. A tetrahedron is a shape made of four equilateral triangles (triangles where all 3 sides are the same length). Here's an example.**

4. **Review the creations and spend some time reflecting on the activity.** *Did anyone succeed? How do we know?*

Reflection: Did you work well as a group? Did you have a process? What words and phrases helped you? What could you have done differently?

Go Further: How many straws would you need to make an icosahedron — a shape with 20 equilateral triangle faces? Can students make one?

Collaborative: Co-operating Appropriately

Constructing a tetrahedron from a loop of straws needs collaboration and cooperation. It's important for students to ask questions, listen to feedback and talk about what is happening. This activity helps them realise that struggling is normal, being wrong is ok and mistakes are part of learning.

Engineer a Rocket

1. Divide students into pairs and give each pair a pencil, a straw, some scissors and a printed template on paper. You can use this template**.**

2. Ask students to follow the instructions to build a small rocket by cutting out the rocket 'body' rectangle and triangular 'fins' and taping these together around a pencil. They then replace the pencil with a straw, and tape the end shut.

3. Join pairs together to fly and test their two rockets, asking them to record a prediction by estimating how far it will fly before they launch it. The rockets are launched by blowing into the straw.

4. Encourage each pair to give feedback (on build, flying technique etc.) before repeating several times to see the effect of any changes. They could think about whether any other variations might change the distance. *E.g. Whether inside or outside, getting better at launching it etc.*

***5.* Use class discussion for students to share findings.**

Reflection: What worked and what didn't? If you were to do a similar activity again, would you approach it differently?

Go Further: Ask students to think about the shape of their rocket. Can they think of any objects/living things that are shaped in a similar way to reduce drag?

Collaborative: Giving and Receiving Feedback

This activity provides the perfect opportunity for students to test, retest and improve, taking into account feedback and reflecting on what went well and what not so well. Exploring ideas and concepts and problem solving are important skills both in maths and everyday life.

Disciplined

To work on being disciplined, provide opportunities for **crafting & improving, developing techniques,** and **reflecting critically**.

Ask students to invent a maths game and come up with rules — they may need to test them out a few times to get them right (**crafting and improving**). Students could invent and set maths problems for other people to solve, invent their own form of notation, or play around with algorithms (even using it for coding like Scratch).

When you model a maths problem, ask students to copy it but with slightly different values — this is an example of **developing techniques**.

Use **frameworks for self-reflection** such as Exit Ticket Questions, Traffic Light Reflection, and Four-square Criterion Reflection.

When you ask students to reflect on their work and learning, they are practicing being disciplined. This might be considering: What will they do differently next time for a similar problem? Was their approach the most efficient? How can they apply this learning to future maths problems?

Ask students to tackle tricker problems than they might usually go for and identify what is hard about them. It's normal to get stuck! Mathematicians often take years to work something out — including the maths we learn in school! Taking on challenges encourages students to persevere, it's through making mistakes and finding new ways of doing things that they learn and grow in confidence. If students get a wrong answer, encourage them to talk about it, keep trying and consider different methods. Remember there can be more than one way of getting to the right answer.

Make your own Maths Trail

1. Divide students into pairs and ask them to plan a maths trail around a space *(E.g. Classroom, playground, hall, park)* **for another pair to try.**

2. You could suggest that students include a maths question on each of the following:

- *Number (e.g. How many...)*
- *Shape (e.g. What shapes can you see in the...)*
- *Measurement (e.g. Which is longer...)*
- *Data collection (e.g. Find...)*

3. Give each pair a piece of paper to draw a simple map. See this example.

4. Ask students to swap trails and test them out.

Reflection: Was the trail you tested easy to follow? Were the questions interesting and fun to do? How could it be improved? Was there an area of maths that you found easier/trickier to think of questions for? What did you learn from the feedback about the trail you designed?

Go Further: Use the feedback and tips from your peers to improve your trail and re-test with another pair of students.

Disciplined: Crafting and Improving

Creating a maths trail is a great way for students to craft an activity for others, gain feedback and identify what works and what doesn't. Learning from mistakes, improving and applying to future problems helps students build positive, can-do attitudes and create their own strategies.

Inventing Notation

1. Show some examples of notation/representation i.e. numbers, Roman numerals, the 4 operations – addition, subtraction, division and multiplication symbols, equals, more than/greater than, percentage symbol, brackets, a number squared or cubed. Discuss why notation is helpful and when it is used. *How does it help you understand the sequence of steps in a mathematic process or calculation?* **Point out that when students show their working out in maths, that is an example of notation.**

2. Challenge students to come up with a new maths symbol in small groups. Ask them to think about:

- *What will the symbol represent i.e. an unknown fact (like how many pencils are in the pots on the table), an action (like adding), a collection or series of actions (like counting then adding), a very large or very small number etc.*
- *How could you show a long calculation/working out in a much smaller space or show how it could be done quickly?*
- *Is the symbol easy to understand or draw?*
- *Why will the symbol be helpful or why do you think it is needed?*

3. When children have thought of a symbol, ask them to show how it can be used in their maths, writing down their notation.

4. Groups then write a simple maths problem for another group to solve using their symbol and their example notation, spending a couple of minutes teaching them about it.

Reflection: Did your symbol make the maths problem easier/quicker to solve (or harder)? How did you find using another group's symbol?

Go Further: Show students examples of very different notations solving the same maths problem (one example is Dear Data). What is the most creative way they can show some difficult notations/representations?

Disciplined: Developing Techniques

This activity encourages students to break down and think about maths techniques and how they communicate them to others as an 'expert'.

Construction Challenge

1. Divide students into small groups and give them some cocktail sticks and sticky/gummy sweets like mini marshmallows or mini gems.

2. Set them the challenge of building a structure that will hold a 1kg bag of sugar.

3. Ask them to think about the shapes they are using and why they think their design will work.

4. Test each group's construction. *Did any structure hold the sugar? What design worked best? What shape is the strongest?*

Reflection: What skills did you need to use to make this work? Do you think there is a way to systematically try out ideas or techniques? How could you record your thinking process?

Go Further: Rebuild and improve the structures after reflecting on what works/doesn't work.

Disciplined: Reflecting Critically

This activity gives plenty of opportunity to reflect, improve and rebuild as each group will have their own ideas as to what will work best. Students will discover that there are some key components to building a strong structure as they investigate and problem solve. Making mistakes and trying again helps students to become confident, resilient learners.

Imaginative

To work on being imaginative, provide opportunities for playing with **possibilities, making connections,** and **using intuition**.

Playing with maths — experimenting, using props and taking part in creative, hands-on activities helps students to understand (and enjoy) maths. This aids students' abstract mathematical thinking and understanding as they get older. Presenting maths as something real and relevant to everyday life can change students' perception of maths just being a 'school subject'. They begin to realise that maths is everywhere and in everything and is something they can make, touch and do!

Can they find hidden patterns in daily life? How can maths concepts work in the real world? Can they think of when/where they've seen friends and family use maths in the real world?

Use guessing as an initial research strategy, having a go at Nrich style puzzles and approaching problems playfully. Encourage students to think differently about a problem rather than the most straight forward answer. You can use frameworks for organising ideas such as Generate Sort Connect Elaborate Concept Map and E3.

If you use visualisation tools for problem solving such as bar methods and drawing, can you take this further and challenge them to come up with other creative ways to visualise a theoretical task?

Ask students to represent the same results in different and creative ways e.g. a maths story, different types of diagrams or 3D models, artworks or Colour-Symbol-Image — there are lots of examples on Maths on Toast.

Build in opportunities for making connections, ask 'what does this remind you of?' and allow time for mind-mapping during reflection time before coming up with an answer (E.g. You could do this on mini whiteboards).

Create mathematical experiences for students — E.g. Art, STEM and cross-curricular projects that require maths.

Tessellations

1. Show the students the work of the artist M.C. Escher and explain how he took a regular polygon such as a square, changed it slightly to make a new shape and then repeated it to create beautiful artwork.

2. Give each student a small square piece of paper or card to use as a template and a larger piece of paper to create their artwork on.

3. Ask the students to draw and carefully cut out a shape from one edge of the small square, for example, a triangle. Slide it across and stick it with tape to the opposite side of the square to make a new shape

4. Get the students to draw around the new shape on the larger piece of paper using it as a template to create a tessellation – a repeating pattern with no gaps. See this example.

Reflection: What do you think of when you look at the pattern? Does it make a difference if you rotate the template before creating your repeating pattern? Can you think where else maths could be, or is used, in art?

Go Further: Get students to repeat but using a different polygon e.g. what happens if you use an irregular polygon?

Imaginative: Playing with Possibilities

The possibilities are endless with this activity, each student is given a simple square but using their imagination, playing with patterns and making connections will result in unique pieces of mathematical art.

Fractals

1. Get the students to take a really good look at a tree and ask them if they notice anything special about the branches. *Can they spot a pattern?*

2. Discuss as a group how each branch is in fact a smaller tree shape. A tree is like a fractal – a never ending pattern of self-similar shapes.

3. Divide the students into pairs or small groups to make their own fractal tree using modelling clay/ newspaper/sticks etc. Or just drawing!

4. *By how many branches does your tree increase each time you add a level? What maths techniques can you use to work this out?*

Reflection: How does it feel to connect nature and maths? Are there other ways you can connect maths to the natural world?

Go Further: Nature is full of fractals - can they think of more examples? Can students think of examples of fractals in man-made inventions or designs? You might find this article Pattern Power useful to read before you have this discussion.

Imaginative: Making Connections

Exploring spatial maths and connecting it to everyday life and the world around us helps students to recognise that maths really is everywhere. This activity provides a creative opportunity to show that maths is real and relatable.

Make your own Foot Ruler

1. Discuss how a foot was based on the average size of a Roman man's foot. The foot is broken into twelve smaller units, inches - about the same length as the top joint of a man's thumb.

2. Ask students if they think using their foot would be an accurate measuring tool.

3. Get students to carefully draw around their foot and cut it out. They may choose to decorate their foot ruler with pens/paints or craft materials.

4. Ask students to:

- **Measure something using their foot ruler.** *Do they all arrive at the same length? If not — why do they think that is? What's the difference between the size of their foot and a Roman man's foot?*
- **Predict how many of their feet it will take to measure something (maybe the length of the classroom).** *Can they work out the size using a standard unit of measurement? Who can get closest to the actual number?*

Reflection: What are the challenges with this method of measuring? When might it be helpful? Understanding how to estimate a measure when you're out and about can be an important life skill, because we don't always have measurement tools handy. However, a standard unit of measurement is more reliable than everyone using their own footprint to measure! Did making your own foot measurer help you discover why?

Go Further: A main measurement 5,000 years ago for the Egyptians was the cubit. This was the length from the fingertip to the elbow. Can students think of other measurements they could use?

Imaginative: Using Intuition

The foot ruler experiment is a creative, fun activity providing an opportunity for students to test their intuition by examining results and challenging their findings.

Persistent

To work on being persistent, provide opportunities for **daring to be different, sticking with difficulty,** and **tolerating uncertainty**.

For example, if providing problems, try starting slowly without revealing all of the problem first and place value on individual, different or multiple outcomes.

Have a go at taking things apart and putting them back together.

Try some thought experiments, encouraging students to come up with experimental results and debate them, challenging and interrogating them. Encourage them to take risks with their thinking!

Provide opportunities for them to stick with a difficult task — one that they are fully equipped to do that is pitched at their maths ability, but that might at first not seem so straight forward e.g. the strategy needed might not be obvious, a word problem, a task that takes time.

If setting a problem or puzzle, don't provide hints or scaffolds on how to solve it to begin with, to encourage them to work in an unstructured way and find paths for themselves.

Flip the task and give the answer — students have to find out what the question was.

Encourage students to take the maths further in a direction they have chosen themselves, helping students experiment and investigate maths in their own way and at their own pace increases their willingness to make mistakes and try again. It's important to remind students that different people solve problems in different ways, there's not one right way of doing something.

Debate mathematical concepts and ideas, you can use frameworks such as Hot Spots, Circle-of-Viewpoints, and Tug-of-War.

Support Your Claims

1. Choose a topic to debate. For example:

Concepts:
- *What can't we divide by zero?*
- *Why is area squared and volume cubed?*
- *Why do we use symbols and notation in maths?*

Philosophical:
- *What is a number?*
- *Is 0 a number?*
- *Why do we need a decimal point?*

Opinion:
- *What will replace the calculator?*
- *Is metric better than imperial measurement?*
- *Do students need to learn times tables?*

2. Divide students into pairs and give *5* minutes to agree an answer to present. They should focus on making a claim, then backing that up with evidence/a clear argument about what they see/feel/know.

3. Give pairs a couple of minutes to think about: *What haven't you explained? Why would someone disagree with you?*

4. Spend *5* minutes debating as a class or in small groups. Encourage students to self-select when they present their claims and to refer back to another's claim: 'I disagree/agree with _____ because_____'.

Reflection: Which claim was the most unique? How can we know who is right and who is wrong (is anybody?) What further issues have your debates raised?

Go Further: Pose a research-based question e.g. Why do we have 60 seconds in a minute, 60 minutes in an hour / Why do we use the decimal numeral system (base 10)? After debating, allow students to go away and research the answers then present their findings for further debate in a creative way.

Persistent: Tolerating Uncertainty
Students are given the opportunity to explore complex ideas that might not have straightforward answers, voicing their own opinions that may be different to others' and encouraging them to back-up claims they make.

Write a Pi Poem (Piem) or Story

1. This activity can be used to have some fun exploring the digits of Pi. You can introduce the concept of pi and talk about the maths concepts and vocabulary: perimeter, diameter, radius; digits. Bring the terminology to life, by exploring and measuring using circles and string or tape measures.

2. Ask students to work in pairs to create a Piem - it's made of words where the length of each word is equal to each digit of pi. *Can they write a poem or story using the digits in pi to 20 decimal places?*
It's a challenge!

Rules for the Piem:

- **π = 3.14159265358979323846**
- **The poem or story should start with a 3-letter word**
- **Then a 1-letter word**
- **Then a 4-letter word (and so on...)**

Here's an example.

3. Have partners check each other's Piem!

Reflection: Did you find it tricky only using words with a set number of letters? Why? What did you do if you made a mistake?

Go Further: Can you think of a visual way to represent the digits of Pi? Could you create something 2D or 3D?

Persistent: Sticking with Difficulty
This is a key place to talk about resilience: having the confidence to test different ways of doing something and being happy to make mistakes and try again is crucial to learning. In maths there is often one correct answer but there are many different ways to reach that answer. Puzzles are a great way to practise persistence and try out multiple methods. This Piem puzzle brings numbers and words together - and each person's attempt is likely to be unique!

Paul Klee Inspired Maths

1. Give each student a piece of paper and ask them to draw some simple 2D shapes i.e. circles, triangles, squares, rectangles.

2. Ask them to think about how the shapes can fit together to create a scene, perhaps a city, a castle or a train.

3. Show students an example of the work of Paul Klee.

4. Invite students to colour their shapes to create their own Paul Klee inspired artwork.

Reflection: Did you start with an idea of the scene you wanted to create? If so, did it turn out as you imagined? Or did you use the properties of the shapes (sides and corners) and the patterns they formed to design your scene? How did it feel to use shapes as a starting point before knowing what scene to create?

Go Further: Students could count the number of each shape they have used and present the data as a tally or in a bar graph. Can they think of any other ways to show the results?

Persistent: Tolerating Uncertainty

This activity provides students with no hints as to how to arrange the shapes or as to what they may be used for. Once drawn, students must work with what they have, think creatively and dare to be different in order to create their scene. It may not be how students would have planned but great things can still come when they don't give up.

We hope you enjoy exploring the activities in these Taster Cards!

To find out more about our Teaching for Creativity work & browse more free resources, visit:
anewdirection.org.uk/teaching-for-creativity

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