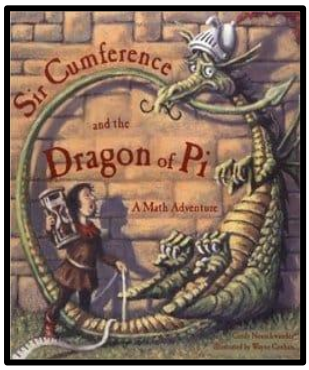

Story: Sir Cumference and the Dragon of Pi: A Math Adventure
Author: Cindy Neuschwander
Illustrator: Wayne Geehan

Teacher: Rebecca Turvill
Setting of the class/school: A state primary school in West Sussex, England
Age group: 8-10 year olds
Number of children in the class: 10 children

Learning intention: To become familiar with key circle vocabulary. To investigate and establish relationship between radius, circumference and diameter. To work accurately in a practical context.
Key mathematical vocabularies: radius, diameter, circle, circumference, ratio, relationship, accuracy, division
Resources needed: A copy of the 'Sir Cumference and the Dragon of Pi' story picture book, several thin strips

Synopsis by the publisher:
Sir Cumference, Lady Di of Ameter, and Radius are back in their second Math Adventure! This time, a potion has changed Sir Cumference into a fire-breathing dragon. Can Radius change him back? Join Radius on his quest through the castle to solve a riddle that will reveal the cure. It lies in discovering the magic number that is the same for all circles.

Starter / Teaching input (5 minutes):
To begin the lesson, we talked about what children already knew about 2D shape in terms of area and perimeter.

Main activity (40 minutes):
Then, we quickly moved on to the practical aspect of the lesson and the children were given four strips of coloured paper and challenged to find a way to use them to make a star, with the centre of each strip overlapping. They were given the idea that this would look like the spokes of a bike wheel, after some discussion. Overlapping the strips in this way was very challenging; in fact many students struggled to find the centre of their strip at all. The students easily identified the middle of the length, however finding the middle of the width was very challenging. This seemed to be related to the fact the strips were very thin, only one centimetre wide – consequently, folding the strip in half to find the middle was very difficult (although not impossible) and students did not think to measure immediately. This activity created much discussion around approach to solve the challenge; many of the students found it very difficult to find the very mid-point of the strips and even more challenging to overlap them exactly at this point. In a curriculum increasingly dictated by arithmetic skill, such practical skills may be being overlooked and this activity was very revealing in terms of students' confidence to complete a practical activity (see Figure 1).

Once we had completed this task, the children were given strips of paper, equal in length to those which they had made the star with. They were tasked with creating a "ring" around the edge of their star – like a wheel, using only lengths of the strips of paper. They had to tear the paper into pieces which fitted across each gap (see Figure 2). The children came to realise that they needed "3 and a bit" strips of paper. We finished the last "bit" of paper in a contrasting colour, so that we could clearly see this extra section.

Finally, the children were challenged to work out what fraction of a strip of paper the "bit" was. This was challenging and the children were creative in their methods, eventually settling for marking out the "bit" they used along a new strip and counting up the fractions (see Figure 3).

Each child then recorded the circumference of their circle in terms of diameters, which were all between 3 and 3 and a half. Finally, as a group we converted these fractions into decimals and compared them with pi. This allowed us to practically understand the value of pi and the concept of the relationship between the diameter and the circumference. To explore this further, we then drew several circles with compasses and measured the diameter and the circumference (using string). The children then divided the circumference by the diameter to discover that pi is constant for circles of any size (allowing for human accuracy!) (see Figure 4).

Plenary (15 minutes):
Once we had completed these activities, we then read the story. The story uses these mathematical activities to solve the puzzles included in the story. Having undertaken these activities ourselves, the children were well aware of what was happening in the story. The story reinforced the learning and the children were able to understand the mathematical concepts from their practical experience.

Reflection:
The story book really drew the lesson together. Having explored the concepts practically first, the students were ready to understand them in the context of the book. This was particularly useful as the book often reverts to imperial measures, so having explored the idea of pi as a ratio and a fractional quantity was supportive at those points. Although it was a fun way to end the lesson, I would also consider using the book in the middle – prior to drawing and measuring circles. This would allow the book to introduce the idea that pi is the same for circles of any size, which could then be developed into the investigation of this fact. Alternatively, it would have been interesting for students to start with paper strips of different lengths, and see whether they all will arrive at the same conclusion that the circumference is always the same as about three and a bit diameters, regardless of their starting point. This could be a good way to shorten the lesson, if an extended period of time was not available.

Figures:

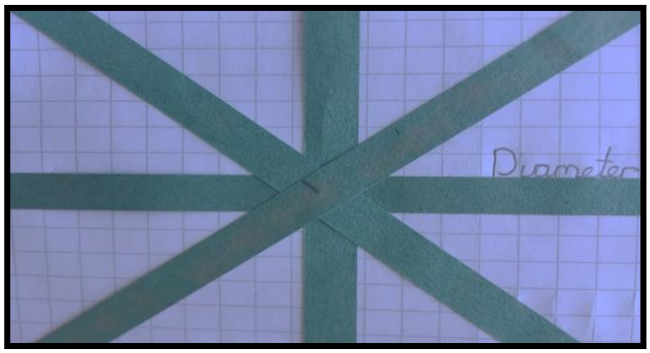

Figure 1: Overlapping the strips of paper at the very centre

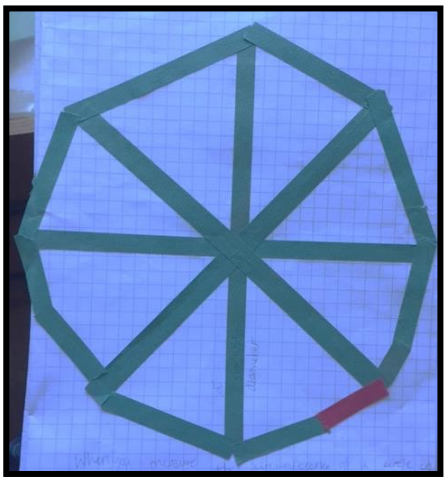

Figure 2: What fraction of a full-length strip of paper is the red section?

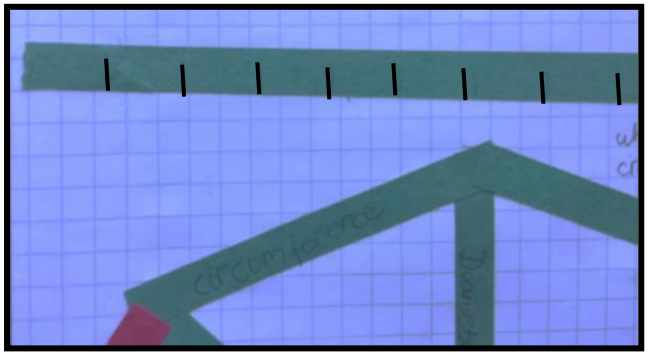

Figure 3: Joining the circumference of the circle

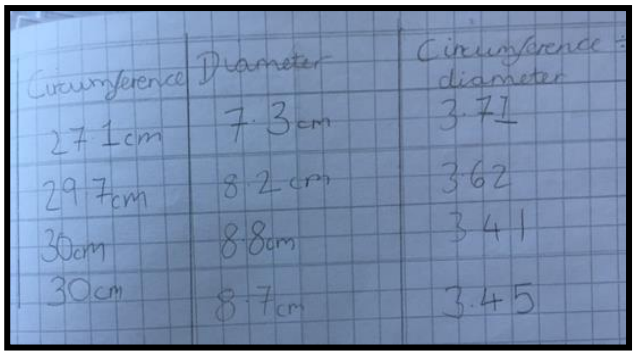

Figure 4: Calculating pi from different sized circles