PANCAKE NUMBERS

LESSON PLAN

GRADE:	SUBJECT:	DATE:

LESSON FOCUS AND GOALS:
To investigate what pancake numbers are, practice demonstrating systematic thinking and problem solving. Practice of listing permutations and combinations

MATERIALS NEEDED:
Lots of paper
Projector (if possible)
These slides

LEARNING OBJECTIVES:
Problem Solving practice
Presentation of mathematical thinking, listing permutations

STRUCTURE / ACTIVITY:

The Set Up (5-10 minutes):

Students to try and flip the pancakes from the order given on the slides and try to place them in order from smallest to largest. If possible print out 4 pancakes of differing sizes for each of the students/groups.
Try to encourage the students to write down the sequence of flips os they can recreate it if asked.

The Investigation (30 - 40 minutes)

Ask - what is the quickest way to get back to the correct order?

"What other questions can we ask?"

Discuss some of the investigation possibilities, explain that in maths sometimes we aren't just looking for one answer, but lots of answers and more questions. This problem came from a mathematician who was organising his towels in his bathroom cupboard! He asked further questions about how he can flip towels and what would be the best strategy - and it developed into this famous unsolved problem!

How many ways are there to stack four pancakes? Perhaps it is easier to simplify the problem, how many ways to stack three pancakes, or two? From there we can discover the quickest ways to stak any arrangement of 3 or 4 pancakes.

Then give the challenge of five pancakes - remind them - use their four pancake strategy and list of combinations to help solve the problem

It starts to get quite difficult to not only list all the combinations but work out how to flip them. One strategy in a class is to split the problem into smaller parts - decomposition.

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THE INVESTIGATION (CONTINUED)

Split the problem into five groups. One group has the largest pancake always on top, one group has it second from top, one group who has it third etc..

Praise strategy of students - not answers.

The Follow Up

Give time for the write up (below), about ten minutes (depending on age). There is a digital version where the students can have a go at flipping any number of pancakes to 30. If you have devices, have everyone trying to flip 13 pancakes and see who can do it quickest. It also leads to the next step of trying to understand why this is considered unsolved for pancake stacks greater than 20

There is a further step where you can consider the burnt pancake problem. This is where you have to try and hide the burnt side of a pancake at the bottom - this makes the problem much more difficult as you don't know which way round the pancakes are - the permutations and combinations means much more complex problem solving.

This problem is an open maths problem for pancake stacks greater than 20 however we do know that the most flips needed for n pancakes is definitely less than 18n/11

ASSESSMENT:

Have the students create a simple paragraph explaining how pancake numbers are found and an example with three pancakes.

Finally ask them to write down why they think it is unsolvable for stacks greater than 20

This task does not require much assessing, though you could assess their abiility to systematically set out their work and list permutations.

For further videos about pancake numbers click here