

“McNugget Numbers”

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Topic: Number & Operations

Curriculum Competencies:

- Develop, demonstrate, and apply mathematical understanding through play, inquiry, and problem solving
- Demonstrate and apply mental math strategies
- Use tools or technology to explore and create patterns and relationships, and test conjectures
- Use logic and patterns to solve puzzles and play games
- Explain and justify mathematical ideas and decisions
- Use mathematical arguments to support personal choices
- Communicate mathematical thinking in many ways
- Represent mathematical ideas in concrete, pictorial, and symbolic forms
- Connect mathematical concepts to each other and to other areas and personal interests

Content Objectives:

- Ways to make 10 (extended to 43) (Grade 1)
- Addition to 100 (Grade 2)
- Pictorial Representation (Grade 2+)
- One-step addition and subtraction equations with an unknown number (Grade 3)

Grade Levels: K-12

Resource: *How to order 43 Chicken McNuggets - Numberphile.* (2012).

Retrieved from <https://www.youtube.com/watch?v=vNTSugyS038>

Coin Problem - Wikipedia. (2019).

Retrieved from https://en.wikipedia.org/wiki/Coin_problem

Wah, A., & Picciotto, H. (1994). *Algebra: themes, tools, concepts*. Mountain View, CA: Creative Publications.

Suggested Materials: 2 and 5 unit coins, Stand-ins for chicken nuggets, containers representing different sizes

Description:

McDonald’s has become a global powerhouse in the fast food industry. Across the world, there are regional specialties found in local McDonald’s including the likes of Stroopwafel McFlurries in the Netherlands, Sesame Ebi Filet-O Sesame Buns in Japan, and Taro pie in China. However, one item found universally is the humble McNugget. How one orders McNuggets internationally does, however, vary from country to country. For example, in the United Kingdom, McNuggets can be ordered in boxes of 6, 9, and 10.

Originally posed by Picciotto and Wah (1994), the McNugget problem asks, given these 3 types of boxes, what is the largest number you *cannot order* with the available options? Of course one would be able to order 6, 9, or 10 but they would also be able to order 16 McNuggets precisely. The numbers which cannot be obtained from different combinations of 6, 9, and 10 are known as McNugget numbers.

Finding McNugget numbers are a more fun and personalized version of the *Coin Problem*. The coin problem asks what the largest amount one cannot obtain with only 2 and 5 pence coins. That number is of course 3 as every number after 3 can be made from 2s and 5s. The problem of finding the *largest* number from a set of numbers is referred to as a *Frobenius* problem after the mathematician Ferdinand Frobenius.

In our activity, we ask students to find the original McNugget numbers asked by Picciotto and Wah (1994) but we also extend it to include a box of 4 McNuggets available from the kid's menu. We also ask what the McNugget numbers are for boxes available in Canada where we are from. The options in Canada being 4, 6, 10, and 20.

Solution:

Coin problem with 2 and 5: 1 and 3 cannot be made but 4,5,6,7,... can be made.

Original McNugget Problem with 6, 9, 10: 1, 2, 3, 4, 5, 7, 8, 10, 11, 13, 14, 16, 17, 19, 22, 23, 25, 28, 31, 34, 37, and 43 cannot be made but every other positive integer can be made

Modified McNugget Problem with Kid's Menu 4, 6, 9, 10: 1, 2, 3, 5, 7, 11

Non-U.K Problem with 4, 6, 10, 20: There is no largest McNugget number as any odd number cannot be made.