Exponent Project

“How thick is a pile of paper?”

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |
| --- |
| **Curricular competency being assessed: *Reasoning & Analyzing*****Content:****✓ Patterns with exponents****✓ Scientific Notation** |
| **BEGINNING** | **DEVELOPING**  | **PROFICIENT**  | **EXTENDING** |
|  | **I can…** * Use patterns to identify the relationship between number of folds and powers of base 2.
* Use indirect math skills to reasonably estimate height.

 (q3, q4)* Use mental math strategies to convert numbers into a more reasonable form. (q1)
* Use logic and patterns to make connections to apply mathematical strategies to a new situation. (q2, q5)
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**Problem:** Some objects/distances can be too small or too large to measure. Math can be used to indirectly determine measurements that are too difficult to measure directly. Your task is to calculate the height of a stack of paper using the knowledge that we have learned regarding exponents and exponent laws.

**Your work must show:**

* An understanding of the problem
* A correctly completed table.
* Expression of the pattern using exponents
* An accurate measurement of a known number of papers in mm
* Calculation for one sheet of paper in mm
* Calculation of the height of pile of paper after 25 folds
* Expression of the calculated height in many different SI units
* Relation of the calculated height to an object of similar size

**Step 1:**

1. Using a piece of standard sheet of 8 ½ x 11 paper, fold the paper in half to form 2 layers. Fold it in half again. Keep folding the paper until you cannot make the next fold.
2. Complete the attached table as you make these folds.
3. Look for the pattern in the number of layers. Express the pattern in the number of layers as a power.
4. Complete the table and write a power for number of layers after 25 folds. Calculate the power.



|  |  |  |
| --- | --- | --- |
| **Number** **of** **Folds** | **Number of** **Layers (Sheets)** | ***Number of Layers as a Power of Base 2*** |
| **0** | 1 | $$2^{\\_\\_0\\_\\_}$$ |
| **1** | 2 | $$2^{\\_\\_\\_\\_}$$ |
| **2** |  |  |
| **3** |  |  |
| **4** |  |  |
| **5** |  |  |
| **6** |  |  |
| **7** |  |  |
| **8** |  |  |
| **9** |  |  |
| **10** |  |  |
| **11** |  |  |
| **12** |  |  |
| **13** |  |  |
| **14** |  |  |
| **15** |  |  |
| **16** |  |  |
| **17** |  |  |
| **18** |  |  |
| **19** |  |  |
| **20** |  |  |
| **21** |  |  |
| **22** |  |  |
| **23** |  |  |
| **24** |  |  |
| **25** |  |  |

**Question:** What does this number represent?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

When you have completed the chart, watch this video: [(8) MythBusters Folding Paper Seven plus times - YouTube](https://www.youtube.com/watch?v=65Qzc3_NtGs)

**Step 2:**

1. Accurately measure the thickness of a known number of pages.

Ex/ 100 pieces of paper in your math textbook or a full ream of paper (500 pieces of paper) using a metric ruler. Record your measurement in mm.

**Thickness of \_\_\_\_\_\_\_\_ sheets (layers)**

1. Using the height of a known number of sheets of paper, calculate the thickness of just one piece of paper. Record your answer in millimetres.

*(Show your work)* **Thickness of one sheet (layer):**

1. Using your answers from the table and #2, calculate how high the layers of paper would be after 25 folds. Record your answer in millimetres.

*(Show your work)* **Height of stack of paper:**

 **In scientific notation:**

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. a) Why is using millimeters for this measurement not a reasonable way to express this number?

b) Convert this number into a more reasonable unit. Show your work!

*When you have completed the calculations, watch this video:*[(8) Exponential Growth: How Folding Paper Can Get You to the Moon - YouTube](https://www.youtube.com/watch?v=AmFMJC45f1Q)

***Independently answer the following questions on a separate piece of paper and staple your responses to this assignment. Remember to communicate clearly, be thoughtful, be specific as well as thorough in your discussion.***

**Conclusion:**

1. Do some research and give an example of something in real life that is approximately this height or length.
2. Reflect on everything you’ve learned throughout this unit and describe what you have learned about powers.
3. Why was it necessary to use math to indirectly determine the approximate height of a piece of paper with 25 folds?
4. Explain how exponents were useful in calculating this height.
5. The idea behind this project can be applied to bacterial growth. When bacteria reproduce, a single bacterium divides into two. Just like each fold of paper doubles the height of the stack each time, the same happens with the number of bacteria. Each division results in double the number of bacteria – this is exponential growth of base 2.

A single bacterium in a glass divides in two at 11:00 am. One minute later, the two new bacteria have fully grown and divide in two. There are now four bacteria. The bacteria continue to grow and divide every minute. At noon, the glass is completely full of bacteria. At precisely what time was the glass half full of bacteria? Explain.