

Formation of Powers of Numbers

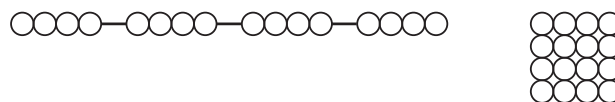
Materials:

- chains, squares, cubes, arrows from the Bead Cabinet
- labels with the powers of numbers
- black pen

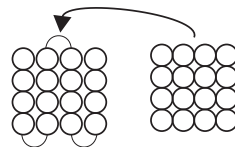
Aim: For the child to move from a review of the bead chains to a sensorial understanding of bead squares and bead cubes, which are made by folding the bead chains.

Presentation:

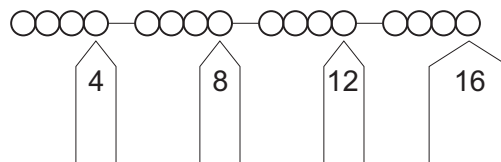
1. Take a short bead chain and a bead square of a number, for example, the bead chain of 4. Show the bead chain and the bead square.



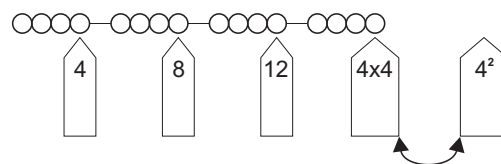
2. Fold the bead chain into a bead square; superimpose a bead square on it.

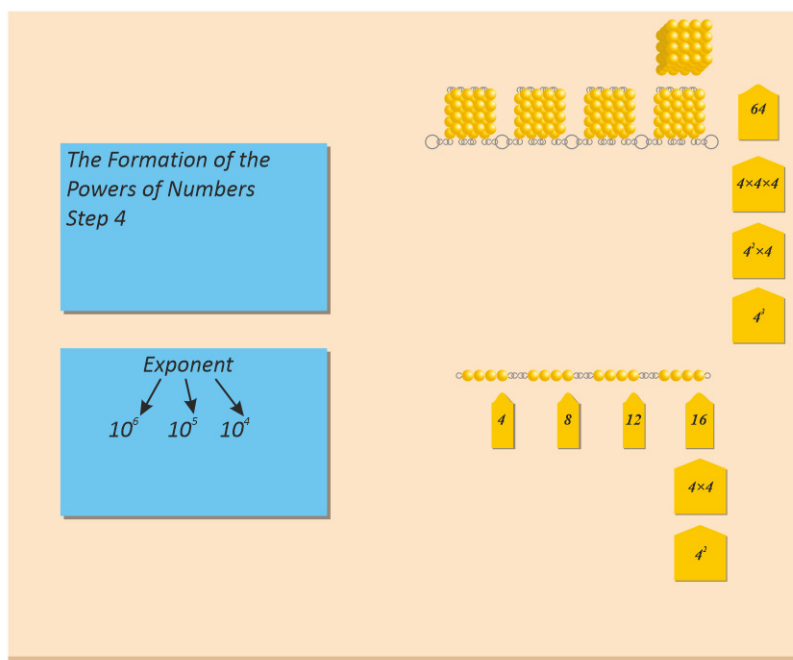


3. Open the bead chain and place the arrows at the correct points of the bead chain:



4. Turn over the label 16. On the reverse is 4×4 .





Take the second label 16. On the reverse is 4^2 . How can we read this second label?

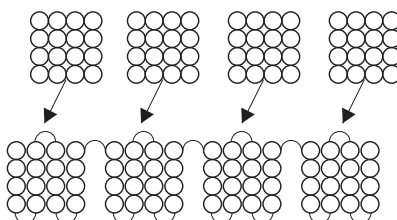
- “4 squared”
- “4 to the second power”
- “4 raised to the second power”

Leave this work out.

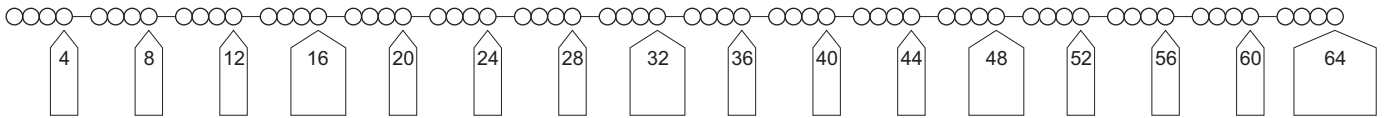
5. Take the long bead chain of 4, the four bead squares of 4, and the bead cube of 4. Open the bead chain and place the four bead squares along the bead chain and the cube at the end.



6. Fold the chain to correspond to four squares; superimpose the squares.



7. Open the long chain and ask child to place arrows. 4, 8, 12, 16, 20, 24,.....64



8. The last arrow for 64 has on the reverse: $4 \times 4 \times 4$.

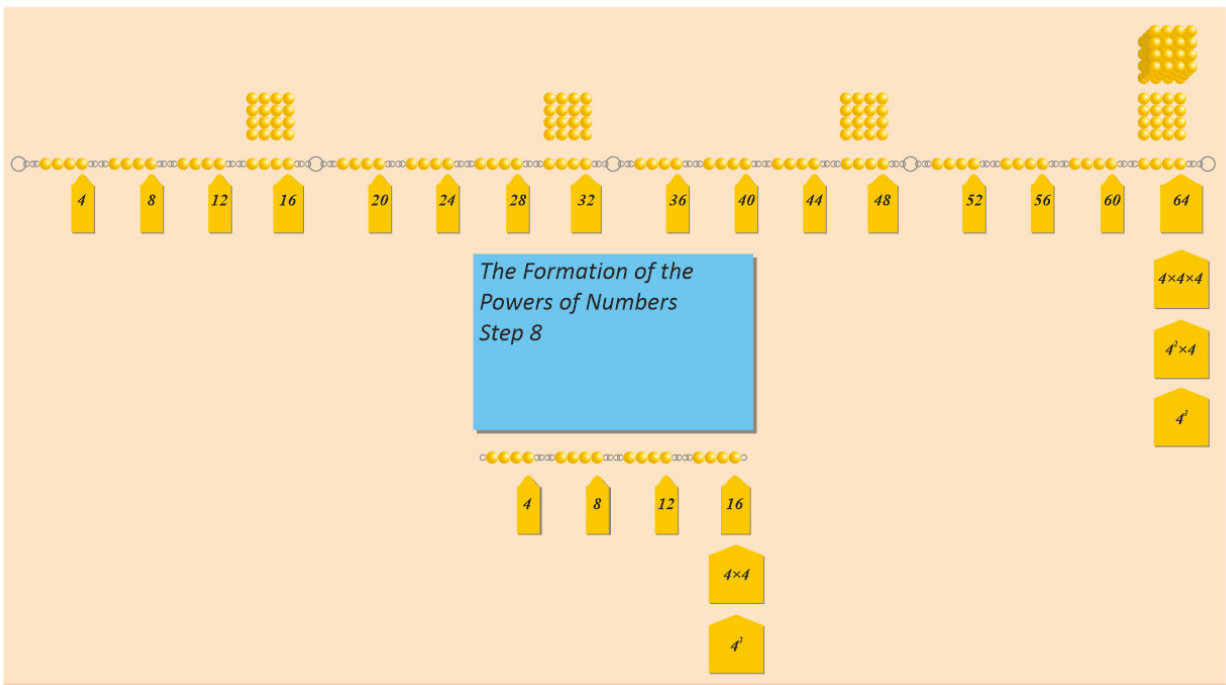
The second arrow for 64 has on the reverse: $4^2 \times 4$

Pointing to the “ 4^2 ,” ask: “What does this mean?” “How many times did we lay down the square?” Four times.

The third arrow for 64 has on the reverse: 4^3 .

How can we read this third label?

- “4 cubed”
- “4 to the third power”
- “4 raised to the third power”



9. Tell the child: “This is the material of the Powers of Numbers. Powers means to multiply a number by itself a certain number of times.”

Reinforcement Lessons

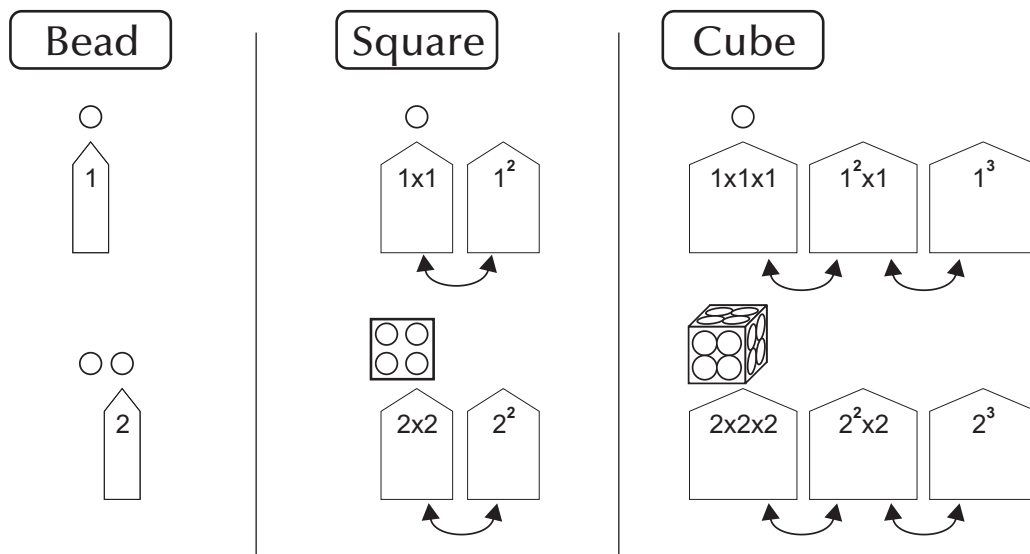
Materials:

- chains, squares, cubes, arrows from the Bead Cabinet
- Decanomial Bead Bar Box
- Geometric Hierarchy of Number (Hierarchical material)
- numeral cards from the Bank Game
- black pen

Aim: To give the child practice in forming squares and cubes—reinforcement of the concept of powers.

Presentation: First Passage – Powers of Numbers with Beads

1. Take the bead, square, and cube of each number plus the arrows from the bead cabinet.
2. Lay out the material in columns with the appropriate arrow:




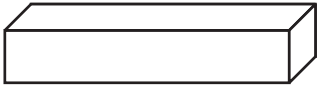
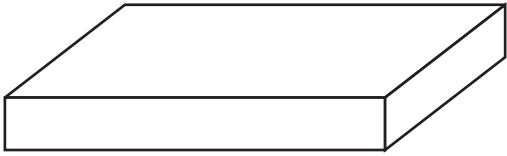
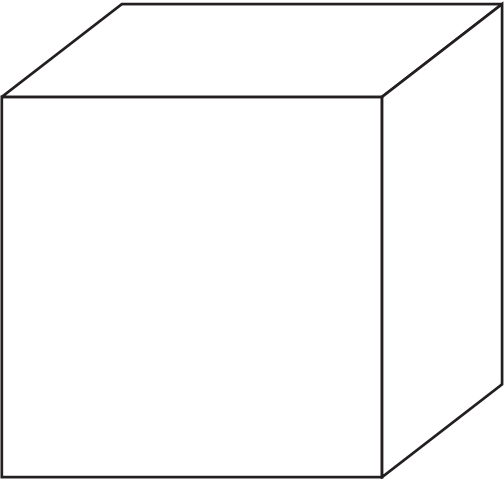
3. Continue in the same manner through 10.
4. Record this work in a notebook, drawing the beads desired.

The diagram illustrates the powers of numbers 1, 2, and 3 using beads and geometric shapes. It is organized into three main columns: **Bead**, **Square**, and **Cube**.

- Number 1 (Red):**
 - Bead:** 1 bead, labeled 1 .
 - Square:** 1 bead (1), 1x1 square (1×1), 1x1x1 cube (1^3).
 - Cube:** 1 bead (1), 1x1x1 cube ($1 \times 1 \times 1$), 1x1x1 cube ($1^3 \times 1$), 1x1x1 cube (1^3).
- Number 2 (Green):**
 - Bead:** 2 beads, labeled 2 .
 - Square:** 2 beads (2), 4 beads (4), 2x2 square (2×2), 2x2 square (2^2).
 - Cube:** 2 beads (2), 4 beads (4), 6 beads (6), 8 beads (8), 2x2x2 cube ($2 \times 2 \times 2$), 2x2x2 cube ($2^2 \times 2$), 2x2x2 cube (2^3).
- Number 3 (Red):**
 - Bead:** 3 beads, labeled 3 .
 - Square:** 3 beads (3), 6 beads (6), 9 beads (9), 3x3 square (3×3), 3x3 square (3^2).
 - Cube:** 3 beads (3), 6 beads (6), 9 beads (9), 12 beads (12), 15 beads (15), 18 beads (18), 21 beads (21), 24 beads (24), 27 beads (27), 3x3x3 cube ($3 \times 3 \times 3$), 3x3x3 cube ($3^2 \times 3$), 3x3x3 cube (3^3).

Reinforcement Lessons
First Passage: Powers of Numbers with Beads

Presentation: Second Passage – Geometric Hierarchy of Number: The Power of Numbers (Geometric Form)

	Power	Number	Geometric Form
Units	10^0	= 1	● point
	10^1	= 10	— line
	10^2	= 100	□ square
thousands	10^3	= 1000	 cube - a new point of 1 (thousand)
	10^4	= 10,000	line - a new line of 10 cubes 
	10^5	= 100,000	square - a new square of 100 cubes 
millions	10^6	= 1,000,000	cube - a new point of 1 (million) 

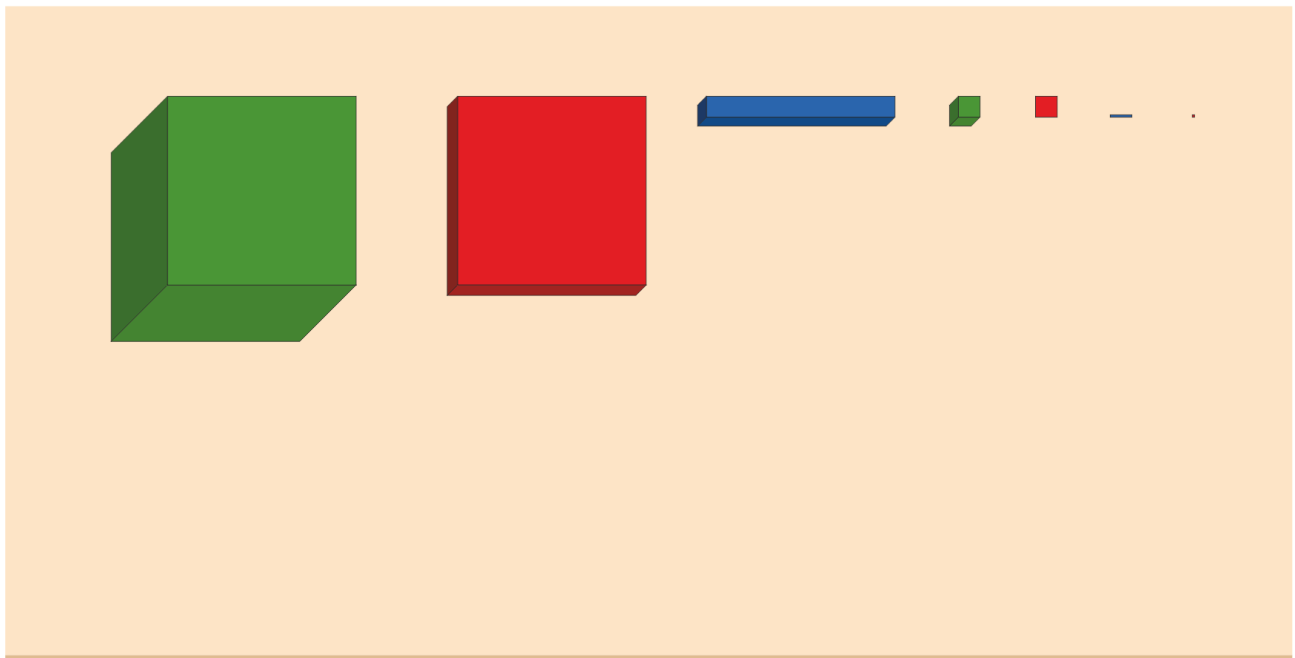
Presentation: Third Passage – Powers of Numbers with the Geometric Hierarchy of Number (Hierarchical material)**Materials:**

- Geometric Hierarchy of Number (Hierarchical material)
- labels
- black pen
- graph paper
- pencil, colored pencils

Aim: Present the child with sensorial representations of the powers of 10.

Presentation:

1. Set out the Hierarchical material (1 to 1 million).



5. Place the exponent labels below the second set of labels.

The image displays a series of geometric shapes and their corresponding numerical and exponential labels, arranged from largest to smallest. The shapes are: a large green cube, a red square, a blue rectangular prism, a small green cube, a small red square, a blue horizontal line, and a small red dot. Below each shape are three labels: a numerical value, a multiplication expression, and a power of 10.

1,000,000	100,000	10,000	1,000	100	10	1
$10 \times 10 \times 10 \times 10 \times 10 \times 10$	$10 \times 10 \times 10 \times 10 \times 10$	$10 \times 10 \times 10 \times 10$	$10 \times 10 \times 10$	10×10	10	1
10^6	10^5	10^4	10^3	10^2	10^1	10^0

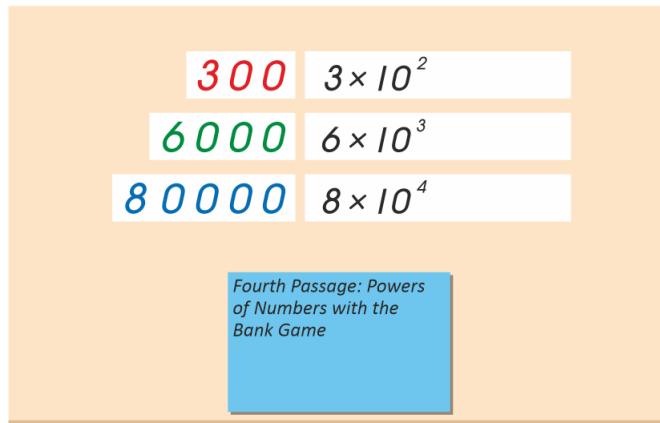
6. Ask, “What can we say about the exponent and the number of zeros?”

7. The child writes this in a note book and draws the figures (optional).

Presentation: Fourth Passage - Powers of Numbers with the Bank Game

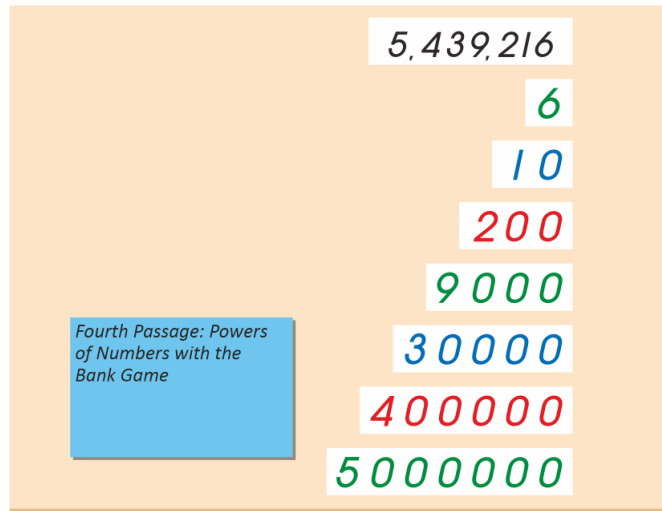
1. Select the Bank Game cards. Select one card from each hierarchy. Write the numerals as powers:

$$\begin{aligned} 300 &= 3 \times 10^2 \\ 6,000 &= 6 \times 10^3 \\ 80,000 &= 8 \times 10^4 \end{aligned}$$



2. Proceed with several examples.
3. Form a large numeral from the Bank Game cards such as: 5,439,216
4. Expand the cards. This is called expanded notation or expanded form. Write as powers of ten.

$$\begin{aligned} 6 &= 6 \times 10^0 \\ 10 &= 1 \times 10^1 \\ 200 &= 2 \times 10^2 \\ 9,000 &= 9 \times 10^3 \\ 30,000 &= 3 \times 10^4 \\ 400,000 &= 4 \times 10^5 \\ 5,000,000 &= 5 \times 10^6 \end{aligned}$$



5. Select the numeral cards 2,597,832 and 135,542,921. Expand the numeral cards. Write each numeral card as powers of ten.
6. The child composes a large number of at least 7 digits. Expand and write the numeral as powers of ten.
7. Compute and write the simple product of:

$$10^5 = 10 \times 10 \times 10 \times 10 \times 10 = 100,000$$

$$5^3 = 5 \times 5 \times 5 = 125$$

$$2^3 = 2 \times 2 \times 2 = 8$$

$$7^4 = 7 \times 7 \times 7 \times 7 = 2401$$

$$4^6 = 4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4096$$

$$11^2 = 11 \times 11 = 121$$

$$10^6 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 = 1,000,000$$