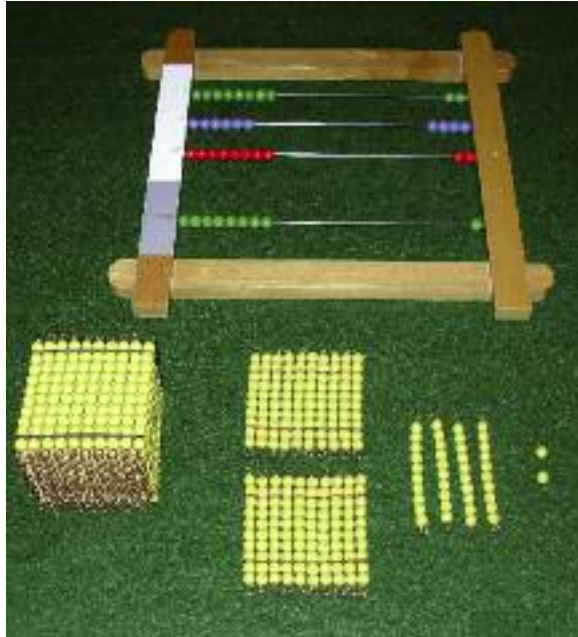


# ■ UNDERSTANDING THE HIERARCHY OF NUMBERS



Students are comfortable working with large numbers once they understand the hierarchy of numbers.

## Background Information

The students' introduction to the concept of The Hierarchy of Numbers material helps students explore place value and the power of ten in a sensorial way. Students manipulate the geometric representations to see and feel how units combine to create 10s, 10s combine to create 100s, and so on. They also develop an understanding of the relative size of quantities. For example, how big 1,000,000 is compared to 1,000.

### Note to teacher

When first being introduced to the Hierarchy of Numbers material, students may benefit from a review of the hierarchical terms using a three-period lesson.

Students explore place value with both the Geometric Hierarchical Material and the box of colored Number Symbol Cards. Place value is the value of a numeral's position within a number. For example, the number 3925 is really  $3,000 + 900 + 20 + 5$ , or  $3 \times 1,000 + 9 \times 100 + 2 \times 10 + 5 \times 1$ . If place value had not been created, numbers would always be written in the long form.

The Hierarchy of Numbers material also introduces students to the concept of classes of numbers: simple, 1,000s, and 1,000,000s. The material uses color to reinforce that each class is comprised of the same parts: units, 10s, and 100s. The following table reviews the terms used in the hierarchies and presents the classes and their colors.

| Class     | Value    | Numerals    | Color |
|-----------|----------|-------------|-------|
| simple    | units    | 1           | green |
|           | tens     | 10          | blue  |
|           | hundreds | 100         | red   |
| thousands | units    | 1,000       | green |
|           | tens     | 10,000      | blue  |
|           | hundreds | 100,000     | red   |
| millions  | units    | 1,000,000   | green |
|           | tens     | 10,000,000  | blue  |
|           | hundreds | 100,000,000 | red   |

## Resources

There are many excellent books and websites about place value. Here are some examples:

Burdett, Christopher A., Michael W. Davidson, and Matthew J. Parry-Hill. *"Molecular expressions." Secret Worlds: The Universe Within.* Florida State University.  
<http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/index.html>

Charity, Mitchell N. *How Big Are Things?*  
<http://www.vendian.org/howbig/>

Friedman, Aileen. *The King's Commissioners.* New York, NY: Scholastic, 1994.

Powers of 10. Eames Office.  
<http://powersof10.com/>

Schwartz, David M. *How Much Is a Million?* New York, NY: HarperCollins, 1985.

Sutherland, B. *Our Montessori. Montessori Games: Arithmetic.* <http://www.our-montessori.com/home.html>

## ACTIVITY 1

# Learning About Geometric Representation to 1,000,000

### Purpose

To recognize quantities up to 9,999,999 using the Hierarchy material.

### Material

Geometric Hierarchical Material (see Material List at the end of the manual).

Golden Beads Material (see Material List at the end of the manual).

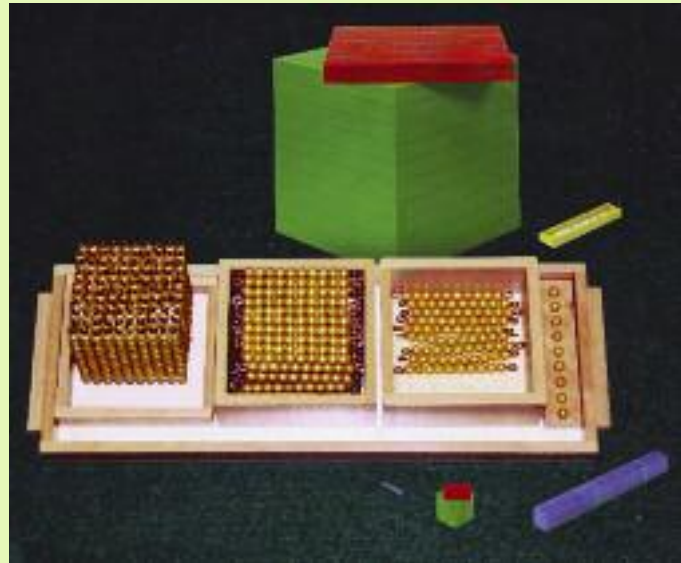
Math journals and pencils.

### Presentation

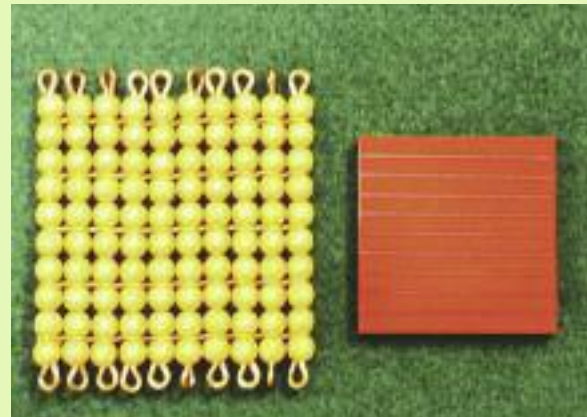
- Most Montessori teachers introduce this concept in Year 1 and present it in more detail in Year 2.
- Invite a student to the floor or mat set up with the required material.

### COMPARING MATERIAL WITH THE SAME VALUES

- With the student, compare a Golden Bead unit to a green unit cube. Ask the student questions about his/her observations.
- Next, compare a Golden Bead 10-bar with a blue 10-bar, asking the student questions about her/his observations.
- Continue in this manner comparing Golden Beads to Geometric Hierarchical Material of the same values. Each time, encourage the student to make observations.



*Two ways of representing quantities from units to 1,000,000*

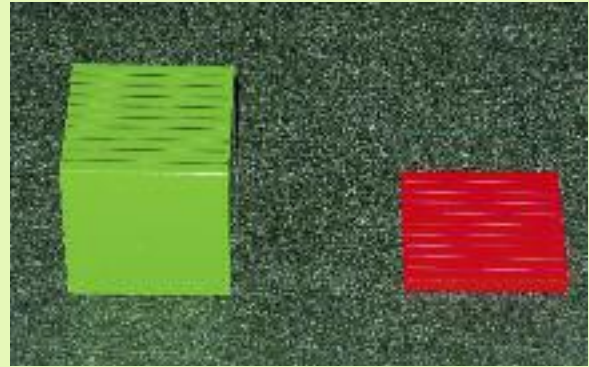


*How are the Golden Bead 100-square and the*

- Invite the student to record in his/her math journal her/his observations about one of the values of the Golden Beads and the corresponding Hierarchical Material.

## COMPARING DIFFERENT VALUES

- With the student, compare the green unit cube to the blue 10-bar.
- Invite the student to count the units in the 10-bar. While counting, follow along with the unit cube by placing it on top of each of the ten sections of the 10-bar.
- Next, compare the blue 10-bar to the red 100-square. With the student, count how many 10s make up the 100-square. Place the 10-bar along the top of each section of the 100-square, as the student counts.
- Repeat the step, comparing:
  - the red 100-square to the green 1,000-cube
  - the green 1,000-cube to the blue 10,000-bar
  - the blue 10,000-bar to the to the red 100,000-square
  - the red 100,000-square to the green 1,000,000-cube.



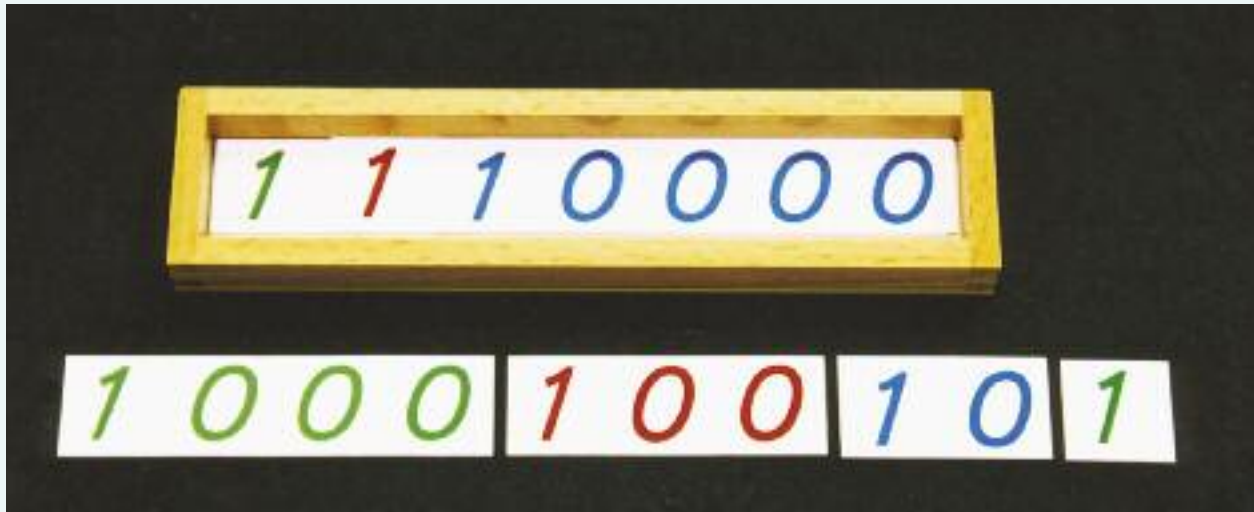
*Comparing the red 100-square to the green 1,000-cube. How are they different?*

## Extensions

- On the computer, look up the Molecular Expressions website at <http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/index.html>. Watch the interactive tutorial about the power of ten, called Secret Worlds: The Universe Within.
- Make a list of everyday or natural objects that are based on 10s. For example, hands are made up of ten fingers.
- Visit the Power of Ten exhibition at a local museum. Check exhibit dates and locations at <http://powersof10.com/>.
- Research and present a brief report about October 10, the Powers of Ten Day.

## ACTIVITY 2

# Learning About Numerals to 1,000,000



*The Number Symbol Cards*

### Purpose

To recognize quantities up to 1,000,000 using the Hierarchy material.

### Material

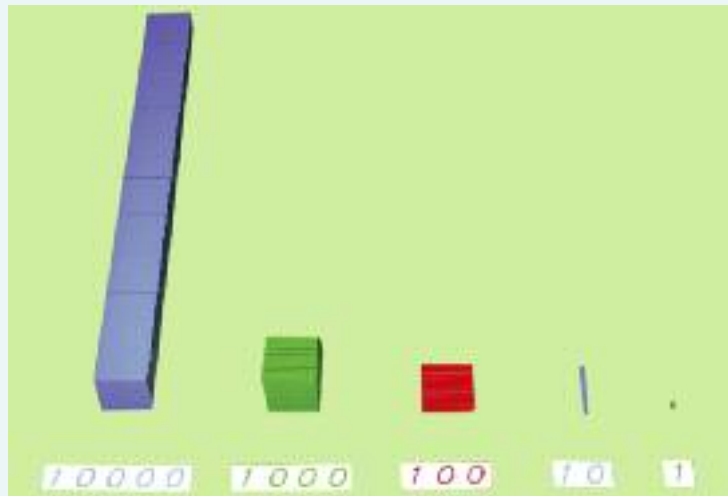
Number Symbol Cards.

Geometric Hierarchical Material (see Material List at the end of the manual).

Math journals and pencils.

### Presentation

- Most Montessori teachers introduce this concept in Year 1 and present it in more detail in Year 2.
- This activity centers on a three-period lesson and is carried out in three parts.



*Matching Number Symbols with Geometric Representations*

- Lay out the required material, then invite a student to learn something new about number symbols.

#### PART 1:

- Lay out the 1, 10, 100, and 1,000 cards.
- With the student, review the written representations of these hierarchies with a three-period lesson.

### **PART 2:**

- On another day, invite the student to learn more about hierarchies.
- This time, lay out the 10,000, 100,000, and 1,000,000 cards.
- Introduce the student to the written representations of these hierarchies with a three-period lesson.

### **PART 3:**

- After the student has completed the three-period lessons, invite him/her to work with the hierarchies again.
- Ask the student to order and lay out the geometric representations of the hierarchies.
- Then invite her/him to match the Number Symbol Cards with the geometric representations.

- When the student is finished, point to the matched cards and material, and ask the student to name the quantities. This can be done in any order.

### **Extensions**

- Invite the student to record some or all of the hierarchies in her/his journal. Suggest making three columns titled: Hierarchy, Numerals, and Example. Under Hierarchy, the student can write out the name of a hierarchy, for example 100s. Using the same example, the student would write 100 under the heading Numerals. He/she can then think of something in her/his environment to use as an Example. For 100, she/he could write, "pages in the novel Terry read."
- Invite the student to practice reading the hierarchies without the quantities. Then invite a second student to dictate numbers for the first student to record in his/her math journal.