# Counting Cubes

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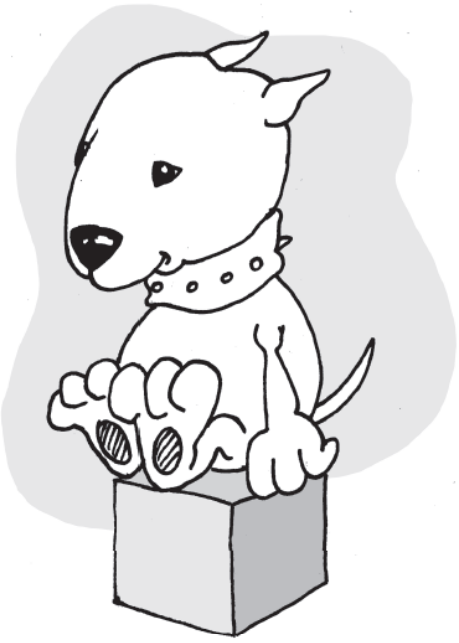


## An Introduction to Manipulatives

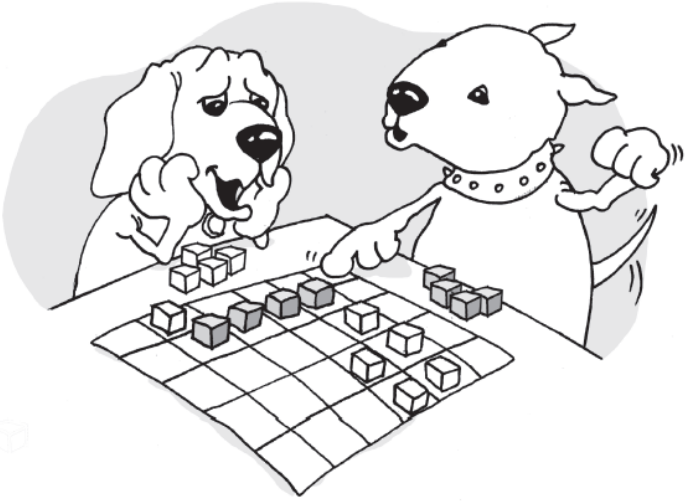
A manipulative is any object that aids children in visualising mathematical processes. Our range of manipulatives includes Tangrams, Geoboards, Fraction Pieces, Fraction Circles, Fraction Bars, Linking Cubes, Pentominoes and Pattern Blocks. However a manipulative can be as simple as a piece of string or a tin can.

Manipulatives are invaluable in the classroom because, as modern research tells us, children retain information gained from hands-on experiences better than information they gain from memorisation. They learn in a physical way - with their hands as well as their minds. As a physical learning aid, manipulatives encourage this natural learning process by adding a concrete element to ordinarily abstract concepts.

Above all else, children enjoy working with concrete materials - in the hands of young children manipulatives will excite their natural curiosity and motivate them to take responsibility for their own learning. Children will become flexible thinkers with a knowledge of mathematics that can be applied to a wide variety of situations - instead of being taught seemingly unrelated rules, they will learn to be problem solvers.

## Introductory Activities

- First, allow the children to engage in free play with the cubes. Gradually introduce various fun activities. Familiarity with the tiles will help activities go smoother and reduce the fear of numbers that sometimes develops with traditional maths classes.
- Start a colour-square pattern on the overhead projector and have a student guess what colour comes next. Have students use their own squares to copy and continue the pattern at their desks. After two or three patterns have been demonstrated, have the students work individually.
- Distribute a set of cubes to each student. Ask the students to describe different ways that a rectangle could be made using 12 squares. As the students use the cubes and respond, draw a picture on the board to illustrate each rectangle.
- Prepare a grid 5 x 6 beforehand. Children form pairs and then select 20 cubes each of one particular colour. Each child takes turns placing a cube on the grid with the aim of being the first to get four in a row either vertically, horizontally or diagonally. If the grid is filled without a row being completed, remove the cubes and continue.



## Addition & Subtraction

- Hold up one cube, add two or three and ask the children to count the cubes in order to find the total. The process can be reversed for subtraction.
- This exercise can be made much more exciting if the teacher comes up with little stories to represent the addition or subtraction and the children use the cubes to act out the stories. For example "3 children were swimming in the pool and 2 more jumped. How many children were in the pool?"
- Part of a well-developed concept of, say, the number 6 is the fact that "2+4=6" and "3+3=6". These facts can be illustrated with the cubes by forming 6 different towers made up of 2 colours - for example 6 red (6+0=6), 5 red and 1 blue (5+1=6), 4 red

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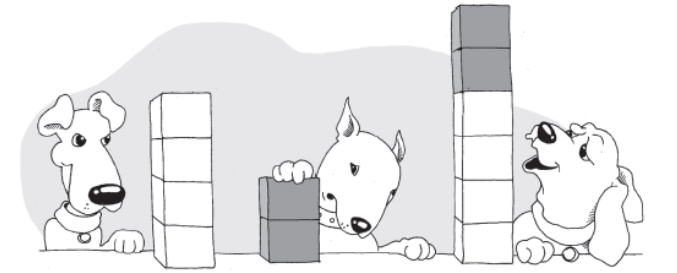
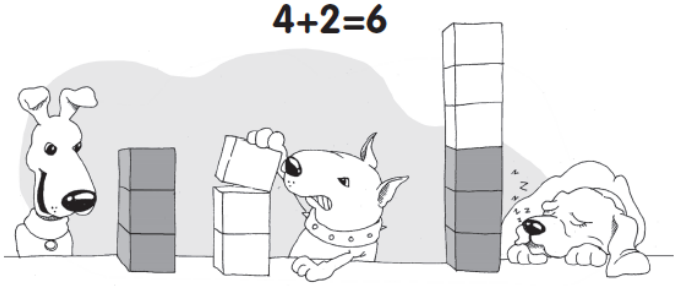


4+2=6



3+3=6

and 2 blue (4+2=6) right through to 6 blue (0+6=6). Ask the children to make up cubes in this way. The patterns formed by the cubes will help children learn the various attributes of the number 6. Encourage the children to use sentences to describe the towers in front of them. Perhaps the word "equals" could be substituted by "is the same as the number" in the early stages. Similarly, substituting "4 and 2" for "4+2" could be helpful. This exercise can be extended to point out the commutative nature of addition - "5+1=6" is the same as "1+5=6". It can also be used for fractions - "3 out of the 6 cubes are blue".

## Multiplication & Division

- When approaching multiplication for the first time, children are required to think of two numbers that represent two different things - the number of groups (or sets) and the number of members in each group. This concept can be made more concrete using cubes as groups. Set out some simple multiplications and encourage children to count how many groups and how many cubes in each group before counting all of the cubes to arrive at the answer. Thus 2 groups of 3 cubes is the same as the number 6. And 4 groups of 2 cubes is the same as the number 8.
- Take the above exercise one step further by asking the children to set cubes out in front of them as you call out various simple multiplications. Perhaps at this stage more specific terminology such as "4 multiplied by 2 is?" can be used. Eventually "equals" can be substituted for "is". To make the exercise more interesting and challenging, use a story or everyday problem that can be represented by the cubes.
- To introduce the concept of division a sharing game can be used. A pair of children can be handed 6 cubes and asked to

6÷2=?

6÷2=3 each

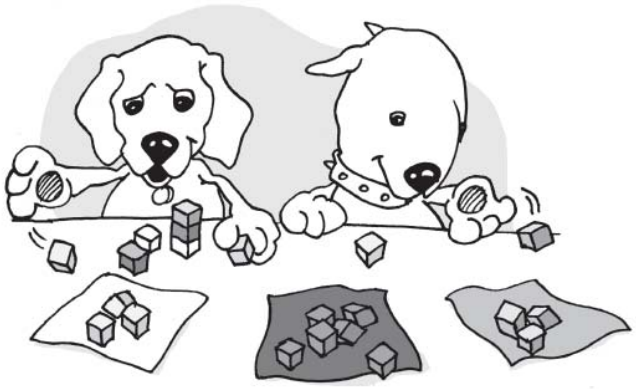
share them equally amongst themselves. Thus 6 cubes shared out equally between 2 children means they get 3 each - 6 divided by 2 equals 3. Repeat the exercise this time asking the children to form groups of 3. This will lead to the realisation that 6 cubes between 3 children means 2 cubes each - 6 divided by 3 equals 2. Teachers can then extend the exercise, using a number of cubes that is easily divisible before moving on to remainders.

## Sorting Fun

This activity aims to teach children about cooperation and achieving group goals as well as sorting skills.

1. Place 4 pieces of coloured paper onto a table.
2. Put one container on each piece of paper.
3. Give each participating child a random pile of cubes. Each student should have between 5 and 20 cubes.
4. On the count of "1,2,3 Go!" the teacher starts timing and the children try to put each of their cubes into the container representing the corresponding colour.
5. If someone places the wrong colour in a container they must get it out before they continue.
6. If one student finishes first, he or she should help one of the other students place the last of their cubes into the containers.
7. The timer is stopped when the last cube is placed in its container.
8. Be sure to explain to the children that there is no winner in this game - the goal is for the whole group to complete the activity in the shortest time. Cooperation and communication are the keys to achieving group goals.

## Sorting Fun



Groups should try to improve their times by investigating different methods for completing the activity. Maybe the children should swap the piles around before the activity starts so that the person nearest to the red container, for example, has the most red cubes.

## Graphing

As an introduction to graphing, cubes can be used to make simple, two column, bar graphs. Ask the children to come to the front of the class and select a red cube if they eat cereal for breakfast or a blue cube if they don't. The first child to eat or not eat cereal should simply place their cube in a designated place. All the following children should join their cubes to form two towers representing those that do and don't eat cereal.

More complex graphs can be introduced by collecting data each day of the week - perhaps graphing how many children are away each day or the temperature at a particular time.

## Area, Perimeter & Volume

- The difference between length, perimeter, area and volume can be simply demonstrated using cubes. A small sheet of paper can be used as an example. Ask the children to predict how many cubes can be laid end-to-end along one of the long sides of the sheet. Then asked them to try it, recording their results. The perimeter can be demonstrated in a similar way.
- Area can be determined by covering the sheet with cubes. In this way simple area calculations for squares and rectangles can be made using "number of cubes" as a unit of measurement. It can be pointed out that the number of cubes along the length of the sheet multiplied by the number along the width will equal the total number of cubes. The students should verify this fact themselves by counting the cubes as well as trying the same exercise with different squares and rectangles.
- Use a similar exercise to explain volume. Build a cube that measures 3 by 3 by 3 cubes. Point out that the volume in cubes can be determined by multiplying 3 x 3 x 3 = 27 cubes. Again the children can verify this by pulling the cube apart and counting the cubes. Ask them to build other cubes and rectangular prisms and work out their volumes.
- One way to define the volume of a solid is "the amount of space it occupies". The concept of displacement can illustrate this. Fill a see-through container half full with water. A tall and relatively skinny container works best. Add some cordial or other dye to aid visibility. In front of the class, drop a cube into the water and point out that the water has risen. The cube is taking up space within the water. Mark the new level of the water and repeat the exercise until about 10 marks have been made on the container. Remove the cubes and start building various solids with them. Ask the class to determine the volume of each solid before you drop it into the container and point out what mark the water comes to.

## Probability

1. Put 15 cubes into a cloth or plastic bag that is not see through. Use 5 cubes of 1 colour and 10 of another. Mix them up thoroughly. Don't let the children see you put the cubes into the bag but tell them that you put 5 of 1 colour and 10 of another. Don't tell them which colour is more common.
2. Pull 3 cubes out one at a time and show the class.
3. Tell the children that there are 12 cubes left and ask them to predict how many are one colour and how many are the other. Remind them that if they add their predictions together they must equal 12. Ask them to record their predictions.
4. Pull out another 3 cubes. Count how many of the 6 are one colour, and how many are the other. Tell them that there are now 9 cubes left and, again, ask them to record how many they think are left of each colour.
5. Continue this pattern until all the cubes have been taken out of the bag.
6. Point out that the laws of probability tell us that the cubes we pull out of the bag give an indication of what colours remain in. As we pull out more cubes, our predictions should get better and better.
7. Try the exercise again to see if the children have gained an appreciation of probability. Introduce fractions as a convenient notation for probability.

Repeat the exercise without telling the children the initial ratios.