Grandmothers

K-6

Jenny is trying to figure out how many biological great grandmothers she has. Whenever she gets to Granny Rose, she loses count. Draw a picture to help Jenny out.

How

- Draw a picture to find out how many biological great-grandmothers Jenny has. If you like, you can use markers to represent each of the grandmothers.
  Hint: First figure out how many grandmothers she has.
- How many great-great-grandmothers does she have? Continue your picture to help figure it out.
- Discuss with your family how you worked on the problem and what you found out. What would your family tree look like?

Here's More

- Make a Fraction Kit, and try the Fraction Kit Games activities from the original *FAMILY MATH* book. How can these activities help you with Grandmothers?

This is about
counting, developing mathematical reasoning, and creating diagrams to explore exponential growth.

MATERIALS
scratch paper
pencils
markers

MATH CONNECTION
Discrete mathematics involves finding efficient ways to count separate things. In this activity the separate things are grandmothers, great-grandmothers, and great-great-grandmothers.

ACTIVIDADES DE LOS MATEOYCIENTINA

Paths and Ponds

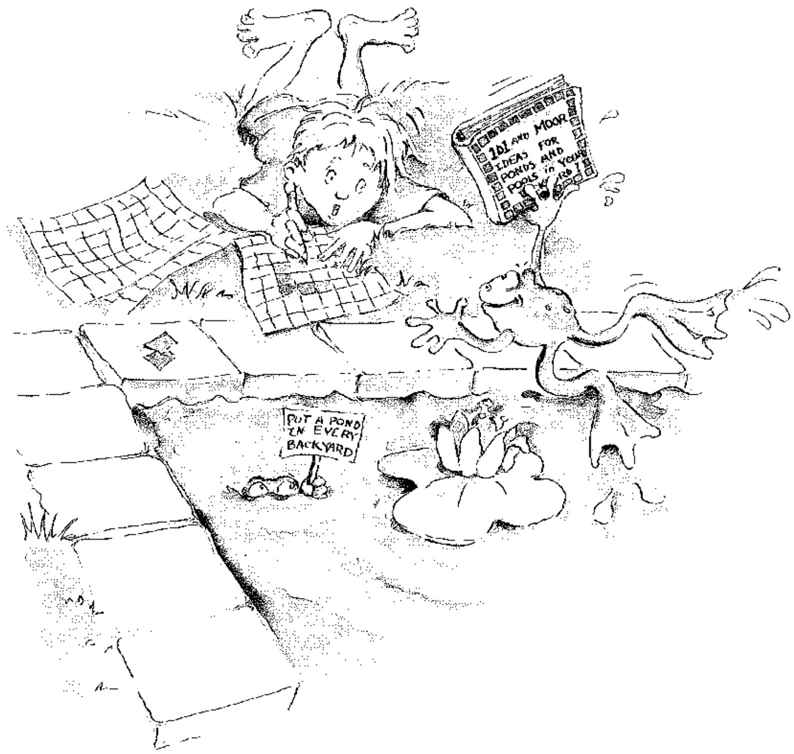
2–6

MATERIALS

50-60 cubes or construction paper squares of two colors
crayons
paper
pencils
grid paper, 1" or 2 cm, pages 178–179

REAL-WORLD CONNECTION

The Moors in Spain loved water. Their garden environment reflected this in the many ponds and pools in their homes and gardens. The Alhambra in Granada, Spain is a wonderful example of how water was used to create serene environments that also had practical applications. For example, the Moors' water-wheel technology was adapted for use as ancient air conditioning.



The sight and sound of murmuring water is considered a critical element in designing gardens today. Let's explore the designs for a series of ponds. The following are ideas for building square and rectangular ponds.

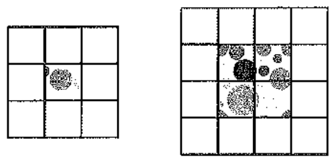
How

Square Ponds

- Let's begin with cubes (or 1" paper squares) that represent 1-foot-square tiles. Use them to figure out how many tiles you need to make a border or path around the edge of a pond. Try using one color for the pond and a different color for the border. Don't forget the corners.

This is about
connecting patterns and functions through the investigation of area and perimeter.

- Make some models for ponds that are 1´ by 1´, 2´ by 2´, 3´ by 3´, and 4´ by 4´.



1' BY 1' POND   2' BY 2' POND

- Figure out how many square tiles you will need for the border of each pond.

- To record your work, use the grid paper and color in the squares. Use one color for the pond and a different color for the border.

- Make a table. See if you can figure out a pattern that will tell you how many tiles you need for the border of any size square pond. Talk about how to use the table to figure out the border for your ponds.

LENGTH OF POND SIDE	POND SQUARE FEET	# OF BORDER TILES
1	1	8
2	4	12
3	?	?
.	.	.
.	.	.
.	.	.

- Before you move on to the rectangular ponds, ask your child what might happen next. Does your child see any patterns?

Paths and Ponds

How

Rectangular Ponds

- Ask your child to create some rectangular ponds in the following sizes: 1′ by 2′, 2′ by 2′, 3′ by 2′, 4′ by 2′... Add a border for each pond using your paper squares or cubes.

- See if your child confidently moves the tiles into the new shapes. If not, let your child keep exploring square ponds until she is ready to move on.

- Make a table to record your results similar to the one for square ponds. Show the length (let the changing number be the length), the width, the area, and the border for each pond.

- Make another table for the 1′ by 3′, 2′ by 3′, 3′ by 3′ family of ponds. Work out the pattern for the number of tiles in the borders for these ponds. What patterns does your child see?

- Next try the 1′ by 4′, 2′ by 4′, 3′ by 4′ family.

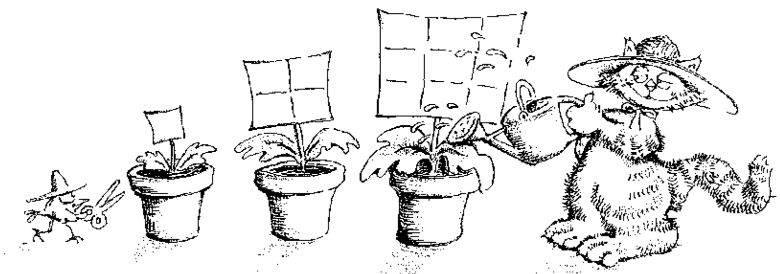
Here's More

- Ask your child what would happen if you had 24 tiles for the border. Using all 24 tiles, what size ponds could you enclose? Don't forget the corners.

- Create a table for these ponds.

Growing Squares

Algebraic reasoning



What do we mean when we say something is twice or three times as big as something else? This activity will help clarify the question as well as let us use precise mathematical language.

MATERIALS

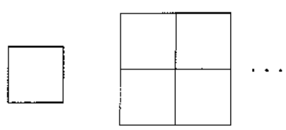
- 100 or more small squares of uniform size
- pencil and paper

WHAT'S THE MATH?

Area; ratios; recognizing and generalizing patterns.

How

• Lay out a sequence of squares as illustrated.



• Record the side length and area of each square in the sequence.

SIDE LENGTH IN UNITS	AREA IN SQUARE UNITS
1	1
2	4
3	.
.	.
.	.
.	

• The second square has sides that are twice as long as the first; the third square has sides that are three times as long as the first, and so on. What happens to the area of the squares as the sides increase in length?

• Study the results with your family and table group. Do they surprise you? Can you find a pattern?

• Discuss with your group what words or sketches you would use to explain to someone else what happens to the area of a square as the sides increase. Be ready to share your ideas with other groups. ■

Extension

- Graph side length versus area for the squares you have made.
- Compare the results from this activity to those of *Growing Cubes*.

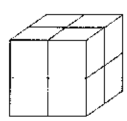
Discuss what you observe.

Algebraic reasoning

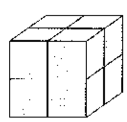
Growing Cubes

This activity explores 3-dimensional figures. What happens when you double the length of a cube? Does the volume double? What happens to the surface area?

Volume is the number of cubic units in a solid shape. The volume of the shape below is 8 cubic units.



Surface area is the number of square units it takes to cover the outside of a solid shape. The surface area of the shape is 24 square units.



Volume and surface area increase at different rates. Volume is proportional to weight, increases much more rapidly than area, and is proportional to strength.

This fact affects how large animals can be. The land-dwelling dinosaurs were at the upper limit of size for land-dwelling animals.

How

- Ask each person in your group to build a shape out of the cubes. Count the number of small cubes in each shape to determine its volume. Compare the volumes.

- Lay out a sequence of the cubes: the first with one unit on a side (just one of the small cubes); the second with two units on a side; the third with three units on a side; and so on.

- Record the side length, volume, and surface area of each cube-shape in the sequence.

SIDE LENGTH IN UNITS	VOLUME IN CUBIC UNITS	SURFACE AREA IN SQUARE UNITS
1	1	6
2	⋮	⋮
⋮		

- Look for patterns in your results. Do they surprise you? Discuss what you think is happening with a family member. Do you think the same thing will happen with other solid shapes like rectangular towers?

- Explore the last question by building a different shape to be first in the sequence. Continue the sequence. Build the second so that each side is double the length of the first; the third with sides three times the length of the first; and so on.

- Record the side length, volume, and surface area of each shape in the sequence.

- Discuss your observations with a partner. ■

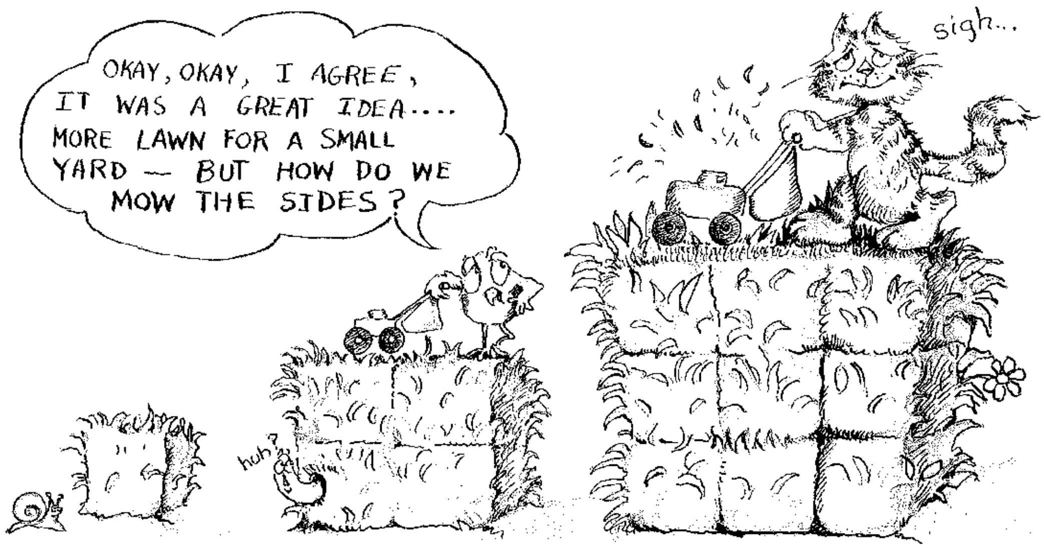
MATERIALS

200-400 inch or 2-cm cubes

paper and pencil

WHAT'S THE MATH?

Volume; surface area; ratios; generalizing patterns.

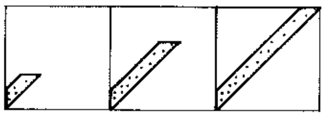


Extension

- Graph the length versus volume and length versus surface area for each sequence of cubes and other shapes you have made.

  How do the graphs help you understand what happens when the linear dimensions of a solid are increased?

Cover Patterns


Grade Level

TOOLS

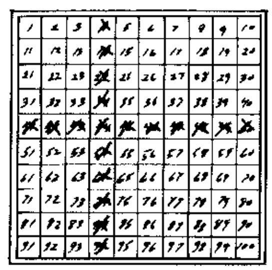
Hundred charts
Markers or beans

Why

To see visual patterns among the first hundred numbers

How

- Choose one of these rules, and cover all of the numbers on the chart that fit the rule. Usually it is better to take off the markers for one rule before starting another rule, but sometimes you may want to see how the rules overlap. Try these rules:
  - numbers with a 2 in them
  - numbers with a 4 in them

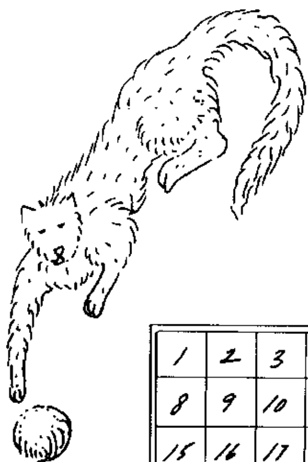


  - numbers with a 7 in them
  - numbers with a 0 in them
  - numbers with a 5 in the tens' place
  - numbers with both digits the same
  - numbers whose digits add to 9

    For example, in the number 45, the digits 4 and 5 add to 9; or in the number 81, the digits 8 and 1 add to 9.
  - numbers whose digits have a difference of 1

    For example, in the number 45, there is a difference of 1 between the 4 and the 5; and in a 54, there is also a difference of 1 between the 5 and the 4.
  - numbers that are multiples of 3
  - numbers that are multiples of 5
  - numbers that are evenly divisible by 6
  - numbers that have a circle
  - numbers that have a factor of 4
- Study the patterns that the different rules make. Mathematics **does** make sense when we see how it fits together.

□ Make some new cover pattern rules for your family to try.



1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49

1	2	3	4	5	6	7	8	9
10	11	12	13	14	15	16	17	18
19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36
37	38	39	40	41	42	43	44	45
46	47	48	49	50	51	52	53	54
55	56	57	58	59	60	61	62	63
64	65	66	67	68	69	70	71	72
73	74	75	76	77	78	79	80	81