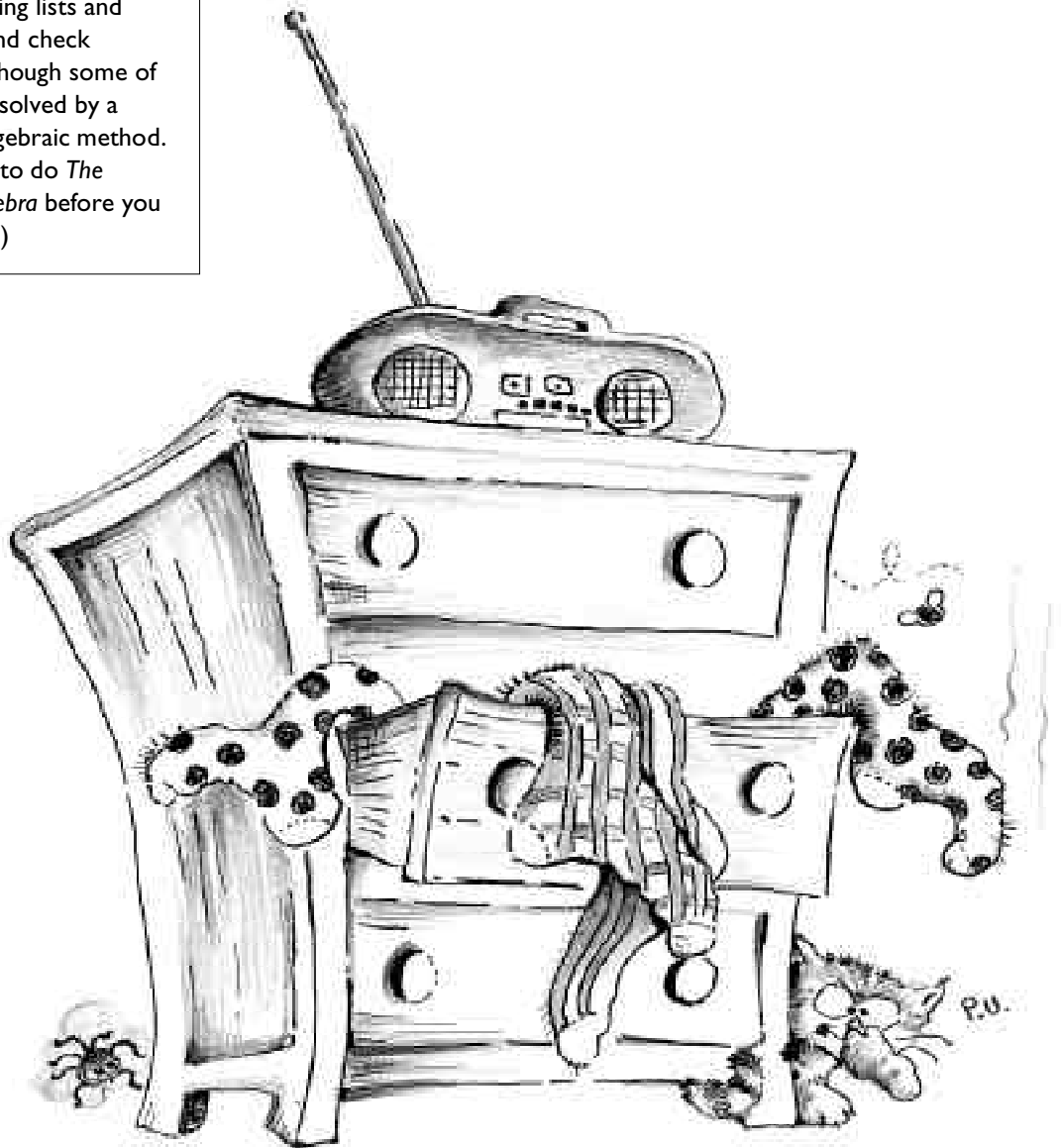## Algebraic reasoning

Four-Sock Drawers

Working with pairs of socks should add fun to this activity. You can find the answers to the puzzles by making lists and using a guess and check method, even though some of them could be solved by a more formal algebraic method. (You may want to do *The Language of Algebra* before you try this activity.)

MATERIALS

Four-Sock Drawer puzzles

pencil and paper

calculators

colored markers

WHAT'S THE MATH?
 Algebraic language; proportional reasoning; simultaneous equations; logical thinking.

How

• Each drawer contains black, red, blue, and white socks. Each sock is only a single color. Work with your family to find how many socks of each color there are in each drawer.

•You may want to try a combination of guess and check and algebra methods for Drawer 7.

• When you have solved the puzzles, make up sock drawer puzzles to share with others.

❧ Drawer 1 ❧
This drawer contains:
• Three times as many blue socks as black
• Two more blue socks than red
• One fourth as many black socks as white
• 20 socks in all

❧ Drawer 2 ❧
This drawer contains:
• Three blue socks
• A total of seven white or black socks
• In alphabetical order, one more of each color of sock than the color before

❧ Drawer 3 ❧
This drawer contains:
• Three more white than blue socks
• Twice as many red as blue socks
• Four more black than red socks
• A sock that could not possibly have a mate of the same color

❧ Drawer 4 ❧
This drawer contains:
• Twelve socks that are red or white
• Six socks that are black or blue
• Twice as many white as blue socks
• Half as many black as red socks
• One and a half pairs of blue socks

❧ Drawer 5 ❧
This drawer contains:
• 13 black socks
• Red and blue socks together that equal black socks alone (more blue than red socks)
• Less than half as many blue socks as white
• A list of sock numbers that is part of the *Fibonacci* series
• The *Fibonacci* series goes 1, 1, 2, 3, 5, 8, and so on

❧ Drawer 6 ❧
This drawer contains:
• Socks of all colors that do not have mates
• An equal number of blue and white socks
• 20 blue or black socks
• 22 black or red socks
• 16 red or white socks

❧ Drawer 7 ❧
This drawer contains:
• 482 socks
• 202 black or red socks
• 240 black or white socks
• 280 white or blue socks
• 242 red or white socks

❧ Drawer 8 ❧
• One more pair of black socks than red
• One more than twice as many white socks as black
• One more blue pairs than black pairs
• 12 red socks

Four-Sock Drawers

The guess and check method is very helpful in finding the solutions for the *Four-Sock Drawer* puzzles. Some of the puzzles can be easily solved using algebra alone. Look at the Drawer 2 puzzle.

Let b represent the number of blue socks, k represent the number of black socks, r represent the number of red socks, and w represent the number of white socks.

The first clue tells us that there are three blue socks. So b = 3.

The second clue tells us there is a total of seven white or black socks. Thus, we know that w + k = 7.

The last clue tells us that in alphabetical order, there is one more of each color sock than the color before. The alphabetical order of the colors is black, blue, red, white.

Therefore we know that
$$b = k + 1,$$
$$r = b + 1,$$
and
$$w = r + 1.$$

Since we also know that b = 3, we have 3 = k + 1.

Therefore, the number of black socks, k, is 2.

Since r = b + 1, we have r = 3 + 1 or 4 red socks.

And since w = r + 1, we have w = 4 + 1 or 5 white socks. ■