At first students used the 5-D Process to solve problems. However, solving complicated problems with the 5-D Process can be time consuming and it may be difficult to find the correct solution if it is not an integer. The patterns developed in the 5-D Process can be generalized by using a variable to write an equation. Once you have an equation for the problem, it is often more efficient to solve the equation than to continue to use the 5-D Process. Most of the problems here will not be complex so that you can practice writing equations using the 5-D Process. The same example problems previously used are used here except they are now extended to writing and solving equations.

Example 1

A box of fruit has three times as many nectarines as grapefruit. Together there are 36 pieces of fruit. How many pieces of each type of fruit are there?

Describe: Number of nectarines is three times the number of grapefruit.
Number of nectarines plus number of grapefruit equals 36.

	Define		Do	Decide
	# of Grapefruit	# of Nectarines	Total Pieces of Fruit	36?
Trial 1:	11	33	44	too high
Trial 2:	10	30	40	too high

After several trials to establish a pattern in the problem, you can generalize it using a variable. Since we could try any number of grapefruit, use x to represent it. The pattern for the number of nectarines is three times the number of grapefruit, or $3x$. The total pieces of fruit is the sum of column one and column two, so our table becomes:

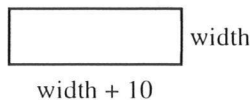| Define		Do	Decide
# of Grapefruit	# of Nectarines	Total Pieces of Fruit	36?
x	$3x$	$x + 3x$	$= 36$

Since we want the total to agree with the check, our equation is $x + 3x = 36$. Simplifying this yields $4x = 36$, so $x = 9$ (grapefruit) and then $3x = 27$ (nectarines).

Declare: There are 9 grapefruit and 27 nectarines.

Example 2

The perimeter of a rectangle is 120 feet. If the length of the rectangle is 10 feet more than the width, what are the dimensions (length and width) of the rectangle?

Describe/Draw:

```
┌──────────────┐
│              │  width
└──────────────┘
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width + 10

	Define		**Do**	**Decide**
	Width	Length	Perimeter	120?
Trial 1:	10	25	$(10 + 25) \cdot 2 = 70$	too low
Trial 2:	20	30	100	too low

Again, since we could guess any width, we labeled this column x. The pattern for the second column is that it is 10 more than the first: $x + 10$. The perimeter is found by multiplying the sum of the width and length by 2. Our table now becomes:

Define		**Do**	**Decide**
Width	Length	Perimeter	120?
x	$x + 10$	$(x + x + 10) \cdot 2$	$= 120$

Solving the equation:

$$(x + x + 10) \cdot 2 = 120$$
$$2x + 2x + 20 = 120$$
$$4x + 20 = 120$$
$$4x = 100 \qquad \text{So } x = 25 \text{ (width) and } x + 10 = 35 \text{ (length).}$$

Declare: The width is 25 feet and the length is 35 feet.

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Example 3

Jorge has some dimes and quarters. He has 10 more dimes than quarters and the collection of coins is worth $2.40. How many dimes and quarters does Jorge have?

Describe: The number of quarters plus 10 equals the number of dimes.
The total value of the coins is $2.40.

		Define		**Do**	**Decide**
	Quarters	Dimes	Value of Quarters	Value of Dimes	Total Value	$2.40?
Trial 1:	10	20	2.50	2.00	4.50	too high
Trial 2:	8	18	2.00	1.80	3.80	too high
	x	$x + 10$	$0.25x$	$0.10(x + 10)$	$0.25x + 0.10(x + 10)$	

Since you need to know both the number of coins and their value, the equation is more complicated. The number of quarters becomes x, but then in the table the Value of Quarters column is $0.25x$. Thus the number of dimes is $x + 10$, but the value of dimes is $0.10(x + 10)$. Finally, to find the numbers, the equation becomes $0.25x + 0.10(x + 10) = 2.40$.

Solving the equation:
$$0.25x + 0.10x + 1.00 = 2.40$$
$$0.35x + 1.00 = 2.40$$
$$0.35x = 1.40$$
$$x = 4.00$$

Declare: There are 4 quarters worth $1.00 and 14 dimes worth $1.40 for a total value of $2.40.

Problems

Start the problems using the 5-D Process. Then write an equation. Solve the equation.

1. A wood board 100 centimeters long is cut into two pieces. One piece is 26 centimeters longer than the other. What are the lengths of the two pieces?

2. Thu is five years older than her brother Tuan. The sum of their ages is 51. What are their ages?

3. Tomás is thinking of a number. If he triples his number and subtracts 13, the result is 305. Of what number is Tomás thinking?

4. Two consecutive numbers have a sum of 123. What are the two numbers?

5. Two consecutive even numbers have a sum of 246. What are the numbers?

6. Joe's age is three times Aaron's age and Aaron is six years older than Christina. If the sum of their ages is 149, what is Christina's age? Joe's age? Aaron's age?

7. Farmer Fran has 38 barnyard animals, consisting of only chickens and goats. If these animals have 116 legs, how many of each type of animal are there?

8. A wood board 156 centimeters long is cut into three parts. The two longer parts are the same length and are 15 centimeters longer than the shortest part. How long are the three parts?

9. Juan has 15 coins, all nickels and dimes. This collection of coins is worth 90¢. How many nickels and dimes are there? (Hint: Create separate column titles for, "Number of Nickels," "Value of Nickels," "Number of Dimes," and "Value of Dimes.")

10. Tickets to the school play are $5.00 for adults and $3.50 for students. If the total value of all the tickets sold was $2517.50 and 100 more students bought tickets than adults, how many adults and students bought tickets?

11. A wood board 250 centimeters long is cut into five pieces: three short ones of equal length and two that are both 15 centimeters longer than the shorter ones. What are the lengths of the boards?

12. Conrad has a collection of three types of coins: nickels, dimes, and quarters. There is an equal amount of nickels and quarters but three times as many dimes. If the entire collection is worth $9.60, how many nickels, dimes, and quarters are there?

Answers (Equations may vary.)

1. $x + (x + 26) = 100$
   The lengths of the boards are 37 cm and 63 cm.

2. $x + (x + 5) = 51$
   Thu is 28 years old and her brother is 23 years old.

3. $3x - 13 = 305$
   Tomás is thinking of the number 106.

4. $x + (x + 1) = 123$
   The two consecutive numbers are 61 and 62.

5. $x + (x + 2) = 246$
   The two consecutive even numbers are 142 and 144.

6. $x + (x + 6) + 3(x + 6) = 149$
   Christine is 25, Aaron is 31, and Joe is 93 years old.

7. $2x + 4(38 - x) = 116$
   Farmer Fran has 20 goats and 18 chickens.

8. $x + (x + 15) + (x + 15) = 156$
   The lengths of the boards are 42, 57, and 57 cm.

9. $0.05x + 0.10(15 - x) = 0.90$
   Juan has 12 nickels and 3 dimes.

10. $\$5x + \$3.50(x + 100) = 2517.50$
    There were 255 adult and 355 student tickets purchased for the play.

11. $3x + 2(x + 15) = 250$
    The lengths of the boards are 44 and 59 cm.

12. $0.05x + 0.25x + 0.10(3x) = 9.60$
    Conrad has 16 quarters, 16 nickels, and 48 dimes.

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