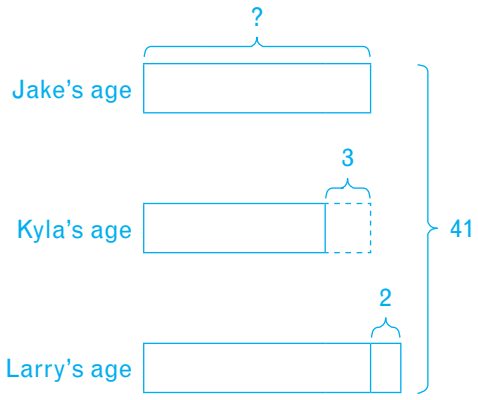
The Model Method and Algebraic Word Problems

The model method lays the foundation for learning formal algebra. In the **Age Problem** below, rectangular bars are used to represent an unknown quantity.

Age Problem	Jake is 3 years older than Kyla and 2 years younger than Larry. The total of their ages is 41 years. Find Jake's age.

Solution



3 units = 41 + 3 – 2 = 42

1 unit = 14

Jake is 14 years old.

In using the model method with algebraic word problems, we can see three distinct advantages:

- It helps students derive algebraic expressions.
- It helps students construct algebraic equations.
- It helps students simplify algebraic equations.

Jake is 3 years older than Kyla, so the bar that represents Kyla's age is shorter than the bar that represents Jake's age.

Jake is 2 years younger than Larry, so the bar that represents Larry's age is longer than the bar that represents Jake's age.

Comparison Models: An Introduction

In situations involving comparison models, a quantity is compared to another. Let us look at two examples of such situations.

Seashells Problem	Juan has 3 more seashells than Kim. Juan and Kim have 15 seashells altogether. Find the number of seashells that Juan has.

This problem involves discrete quantities.

Money Problem	Lanny has 3 times as much money as Ming. Lanny and Ming have $120 altogether. Find the amount of money Lanny has.

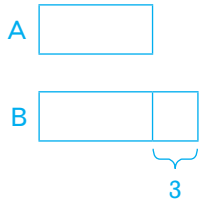
This problem involves continuous quantities.

In the **Seashells Problem**, the number of seashells Juan has is compared to the number of seashells that Kim has.

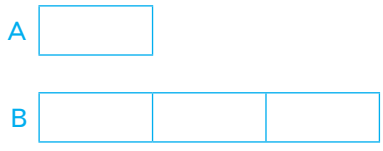
In the **Money Problem**, the amount of money Lanny has is compared to the amount of money Ming has.

Here, we see that the first problem is an example of additive comparison while the second problem is an example of multiplicative comparison.

In additive comparison, one quantity is a certain amount **more or less** than another quantity.
The model on the right shows a situation where B is 3 more than A.



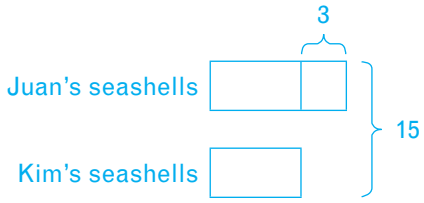
In multiplicative comparison, one quantity is a certain **number of times** another quantity.
The model on the right shows a situation where B is 3 times as much as A.



A common mistake that students make is misinterpreting 'B is 3 more than A' and 'B is 3 times as much as A'. The model method helps students avoid these problems.

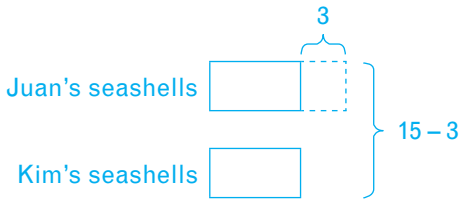
Now, let us solve the **Seashells Problem** and the **Money Problem** using comparison models.

This is the basic comparison model for the **Seashells Problem** (p. 33).



Here are two ways to use this model to find the number of seashells that Juan has.

Method 1

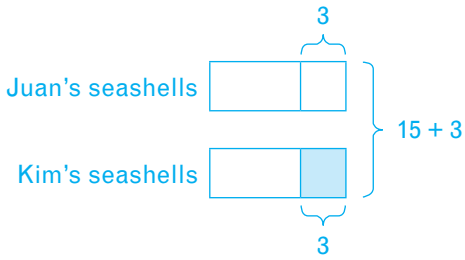


2 units = 15 – 3
2 units = 12
1 unit = 12 ÷ 2 = 6

Kim has 6 seashells.
So, Juan has 9 seashells.

Here, ☐ is a unit.

Method 2



2 units = 15 + 3
2 units = 18
1 unit = 18 ÷ 2 = 9

Juan has 9 seashells.

Here, ☐ (3) is a unit.

LEARNING FROM THEORY

Why are problems that involve change situations difficult to solve?

In Newman's procedure (1983) to analyze errors when students solve word problems, there are six potential areas of difficulty.

1. Students may have difficulty in reading the text.
2. Students may have difficulty in comprehending the text.

   The dynamic nature of change situations, which involve an initial state, a change and a final state, makes word problems that involve change situations harder to comprehend.
3. Students may lack suitable strategies to handle the problem.

   Students may not have appropriate strategies to keep track of the changes in word problems with change situations.

   In the model method, students are taught the use of dotted lines and shading to keep track of changes in word problems.
4. Students may not be able to transform the information in the text into mathematical forms.

   Change situations are dynamic. However, models that students draw are static. Students may find it difficult to represent dynamic situations using static representations.

   In the next chapter, we will deal with advanced skills such as 'cutting up' units and 'shifting' units in the model method. Such skills allow students to represent dynamic information on static diagrams.
5. Students may lack computational skills.
6. Students may not be able to use computation results to solve the problems.

   As change situations are dynamic, students may not recall the changes made to a model and may not be able to trace the original situation.

Reference:

Newman, A. (1983). The Newman Language of Mathematics Kit — Strategies for Diagnosis and Remediation. Sydney, Australia: Harcourt Brace Jovanovich Group.