BRIDGES®
BREAKOUT

The Number Rack

Problem Types

The MATH LEARNING CENTER

Number Rack Problem Situations

Solving a contextualized problem is about more than just computation. Students must understand what is going on in the situation to choose a solution strategy. They need to identify the known and missing information, make a plan to find the missing information, and then carry out the computation. Sometimes students find problem situations challenging because they don't fully understand the context. In life, there are a variety of contexts that may be solved using addition and subtraction. Math researchers have found these situations fall into three groups, each with a distinct mathematical structure. In order to build confident mathematical thinkers, students need to experience problem situations aligned with these various contexts.

There are four lessons in this guide that look at the underlying structure of problem situations: Lessons 9, 12, 16, and 22. Lessons 9 and 12 focus primarily on Join and Separate contexts. Lesson 16 looks at both Join and Separate contexts as well as Part-Part-Whole contexts. Lesson 22 provides opportunities for students to solve problems within a Compare context.

Join and Separate Contexts

Join and Separate contexts are generally thought of as the most straightforward problems to solve. This is because they have a story structure—beginning, middle, and end. The beginning of the story has an amount of something. Then something happens in the story that involves an action (the change) that is easily associated with addition or subtraction—giving and receiving, finding and losing, coming and going, and so on. This action either increases (adds to) or decreases (takes from) that quantity leaving a new amount (the result).

Since the missing information (the unknown) can be in different parts of the problem, and the change can involve either adding to or taking from the starting amount, there are six subtypes within this problem group, as shown in the table below.

	Result unknown	**Change unknown**	**Start unknown**
Join	There are 9 penguins on the ice. Then 8 penguins climbed out of the water to join them. How many are on the ice? 9 + 8 = _____	There are 7 penguins in the water. Some more penguins dove into the water. Now there are 17 penguins in the water. How many penguins dove into the water? 7 + _____ = 17	There are some penguins on the ice. Then 4 more penguins climbed out of the water to join them. Now there are 12 penguins on the ice. _____ + 4 = 12
Separate	There are 15 penguins on the ice. Then 9 penguins dove into the water. How many penguins are still on the ice? 15 – 9 = _____	There are 12 fish in the bucket. The hungry mother penguin eats some of them. Now there are 4 fish in the bucket. How many fish did the mother penguin eat? 12 – _____ = 4	There were some penguins in the water. Then 5 penguins climb out onto the ice. Now there are 10 penguins in the water. How many penguins were in the water at the start? _____ – 5 = 10

Part-Part-Whole Contexts

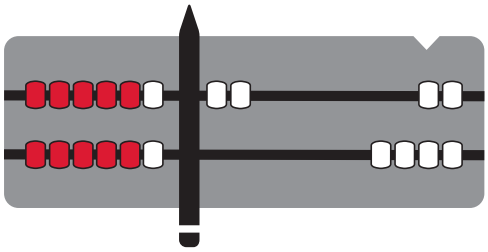
Part-Part-Whole contexts involve two (or more) quantities that have a static relationship, meaning these problem situations do not have an action to suggest the operation of addition or subtraction like Join and Separate contexts. Solving the problem involves either finding the whole (total) or one or both of the parts (addends). To find the total, the parts are added together. To find the unknown part, students use the operation that makes sense to them since either addition or subtraction work. Seeing it both ways reinforces the relationship between the two operations.

	Whole Unknown	**Part Unknown**	**Both Parts Unknown**
Part-Part-Whole	There are 8 adult penguins and 4 baby penguins standing on an iceberg. How many penguins are standing on the iceberg? 8 + 4 = _____	There are 7 penguins on the ice and some more penguins in the water. There are 16 penguins in all. How many penguins are in the water? 7 + _____ = 16 or 16 – 7 = _____	There are 8 penguins. Some are adult penguins and some are baby penguins. How many of each could there be? 8 = _____ + _____

Compare Contexts

Compare contexts involve comparing two quantities to find the difference between them. The missing information or unknown in a comparison situation may be the smaller quantity, the larger quantity, or the difference between quantities.

The number rack is a particularly useful model for representing Compare situations within 10, as both quantities can easily be aligned and a pencil used to highlight the part of each quantity that is equal and the remaining beads that represent the difference in the two quantities.



You can see that 8 is 2 more than 6 when you put your pencil up to where they're both the same.

Compare situations are often regarded as the most challenging of the three problem types because students are asked to think about a quantity that is not physically present (the number that is more or less than a number given in the problem only describes a relationship between two quantities). The words used in Compare situations—greater, fewer, lesser, difference—can also add to their difficulty. For this reason, Compare contexts are usually introduced in Grade 1 and further developed in Grade 2.

	Difference Unknown	**Quantity Unknown**	**Referent**
Compare	There are 6 gentoo penguins and 14 rockhopper penguins. How many more rockhopper penguins are there than gentoo penguins? 6 + _____ = 14 or 14 – 6 = _____	The chinstrap penguin weighs 9 pounds. The gentoo penguin weighs 4 more pounds than the chinstrap penguin. How much does the gentoo penguin weigh? 9 + 4 = _____	Sage and Sam were looking for feathers. Sage found 4 more feathers than Sam. Sage found 9 feathers. How many feathers did Sam find? 9 – 4 = _____ or 4 + _____ = 9