

<b>Title</b>	Rope
<b>Subject(s)</b>	Mathematics
<b>Learning goal(s)</b>	<ul style="list-style-type: none"> <li>• Understand how variables refer to varying unknowns;</li> <li>• Construct and use expressions with variables to solve problems.</li> </ul>
<b>Time</b>	One lesson (circa 30 minutes)
<b>IBL</b>	<p>The activity asks for IBL:</p> <p>The task doesn't prescribe a solution procedure and invites students to reason geometrically or algebraically for finding unknowns and to critically reflect on the generalizability of their solution strategies.</p> <p>As a teacher you will need to decide how organize the collaborative work, and how to share/communicate the various strategies and whether to offer more structure, guidance and help.</p>
<b>Achievement</b>	Collaborating on an open task allows for diversity in chosen strategy as well as in the level of achievement. Students can discuss and support each other. Classroom discussion of strategies is needed to share strategies and to provide focus to generalizing (based on students' contributions).
<b>Context</b>	The context is rather artificial, but very concrete and allows all students to start reasoning about the problem.
<b>Culture</b>	Encourage students to find their own solution strategies. Appreciate and acknowledge diverse solutions and take that opportunity to discuss characteristics of the solutions to afford whole class progress.
<b>Fundamental Values</b>	Collaborative work, valuing each other's reasoning in group work, feel part of an inquiring community (belonging).
<b>SSI/RRI</b>	NA

## Lesson outline

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### *Orientation*

- Introduce the context, show a rope and a pair of scissors. Present the problem (and form small groups).

### *Working in groups and whole class discussion*

- Have students work for about 5 minutes on the first activity.
- Discuss questions and strategies briefly with the whole class to make sure every one or all groups can continue.
- Plan a whole class moment to share results and provide focus to generalizing. Let students give arguments to the presented strategies from that perspective.

### *Own constructions*

Give all students time (circa 5 minutes) to design their own problem (and solve it). Evaluate these problems before the next lesson. They can be used for decisions on further instruction (if needed), or a follow up with for example an ordering task, or a student-assignment.

## Rope puzzles

### Activity 1 – Rope puzzle

A rope of 30 meter is divided in 5 short and 3 long parts. A short and a long part together are 9 meter. How long is a short part?

### Activity 2 – Four children

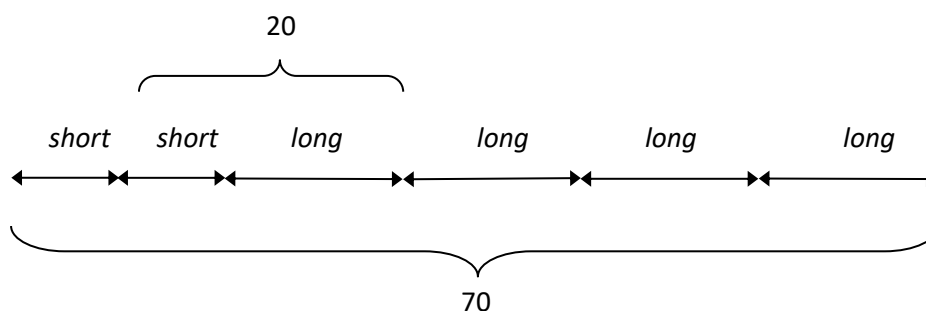
Four children are sitting in a row. Each child is three years older than the previous one. When you add all four ages together, the result is 50. What is the age of the youngest child?

### Activity 3 – More rope puzzles

a) Design a rope for this puzzle and solve the puzzle.

$$\begin{aligned} 2 \text{ long} + \text{short} + 5 &= 28 \\ \text{long} + \text{short} &= 12 \end{aligned}$$

b) What problem could be phrased for the situation below? Solve the problem.

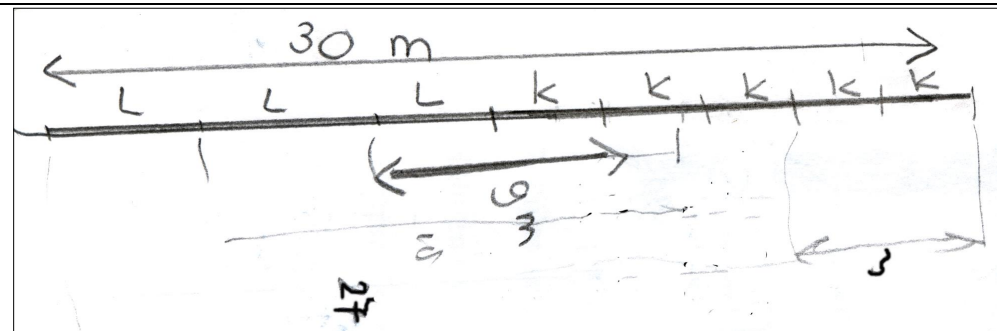


### Activity 4 – Design your own rope puzzle

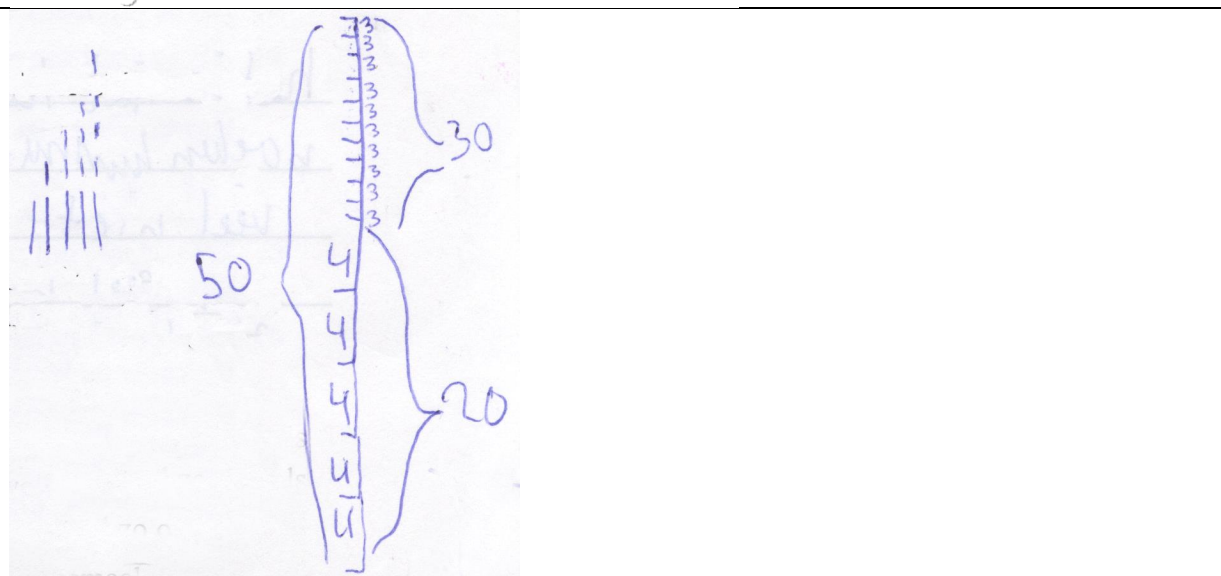
Design a rope puzzle (and provide an answer for your teacher).

### Example student answers

The following answers to different kinds of puzzles show the possible various strategies. By presenting two or more different kinds of strategies in front of the class, these strategies can be compared (what is the purpose of variables and mathematical expressions like  $4z + 18$  where do they refer to) and justified (which strategy is easier to generalize).



$z$	$4 \cdot z + 18$
$z + 3$	$4 \cdot z = 50 - 18 = 32$
$z + 6$	
$z + 9$	$z = 8 \quad (32 : 4)$



er zijn 2 lange stukken, één korte stuk en een stuk van 5 cm.  
 lange stuk + korte stuk samen zijn  $n = 12$  cm totaal is 't 28 cm  
 antw:  $28 - 5 = 23$   $23 - 12 = 11$  lange stuk = 11 cm korte stuk  
 is 1 cm