

## THE LAKE PROBLEM

- Some adults and children need to cross a lake on their hike.
- They have a small kayak that can't hold everyone.
- Determine the number of one-way trips needed to get everyone across the lake.
- What do you need to know in order to solve the problem of getting everyone to the other side?

Adapted from *MathLinks: Grade 8*

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# SOLVING THE LAKE PROBLEM

Use the information to answer the questions and to determine how many one-way trips are needed to get everyone across the lake.

- Six adults and two children need to cross a lake to get from the hiking trail back to their tents.
- They have a canoe that can hold **one child alone**, OR **two children together**, OR **one adult alone**.
- Everyone is able to paddle the canoe. The only way to get across the lake is to use the canoe.

1. Who must get across the lake?
2. How many children can fit in the canoe at any one time?
3. How many adults can fit in the boat at any one time?
4. Does the trip from the hiking trail to the tents count as one trip?
5. Does the trip from the tents back to the hiking trail count as one trip?
6. What is the question we are trying to answer?
7. Draw very simple pictures/sketches that you could use to represent the three possibilities for people in a canoe at one time.
8. Record your diagram for solving the lake problem with any symbols or notations that are helpful.
9. Look closely at your diagram. Do you see any patterns? Does anything seem to be happening regularly, over and over again? Circle a repeating pattern if you see one. Write your observations below.
10. Use your diagram as needed to determine the number of one-way trips necessary to take each combination of people across the lake. 4 adults and 2 children, 2 adults and 2 children, 0 adults and 2 children, 20 adults and 2 children, 100 adults and 2 children, and  $a$  adults and 2 children.
11. If there were some adults and 2 children and it took a minimum of 201 one-way trips to get everyone across the lake, how many adults must have been in the group?

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# THE LAKE PROBLEM NOTES AND A DIAGRAM

Give students this sequence:

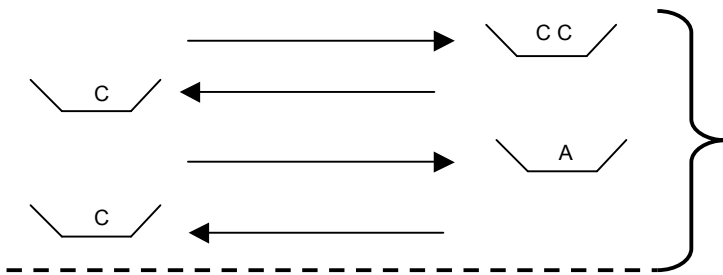
Prompt	Notes
(1) 6 adults, 2 children	a sample picture is provided on the next page, which leads to $6(4) + 1$
(2) 4 adults, 2 children	some students may completely re-create their picture; using the structure and repeated reasoning leads to $4(4) + 1$
(3) 0 adults, 2 children	$0(4) + 1$ ; we can later connect this to the meaning of the vertical intercept, if graphed.
(1) 20 adults, 2 children	this is probably the step that will require thinking about generalizing a procedure, unless students are willing to persevere through this cumbersome drawing; $20(4) + 1$
(2) 100 adults, 2 children	generalizing is necessary; $100(4) + 1$
(5) $x$ adults, 2 children	formalizing the generalization with symbolic / algebraic notation; $x(4) + 1$ or $4x + 1$
(6) If there are 2 children and 201 one-way trips, how many adults must there have been?	This is what Driscoll refers to as “undoing,” since students have to think in an inverse direction as compared to the “doing” in the other parts of the problem. The CCSS 7 <sup>th</sup> grade standards call for solving “2-step” equations, and this is a good motivator for that skill.

See next page for diagram.

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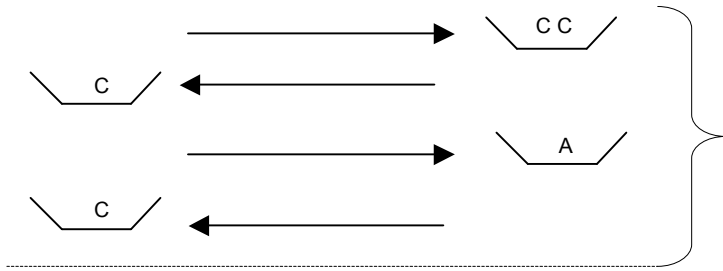
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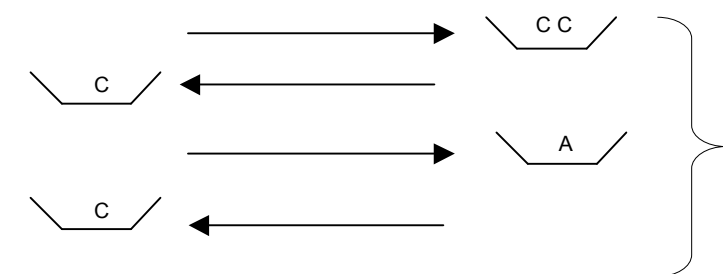


**First cycle**

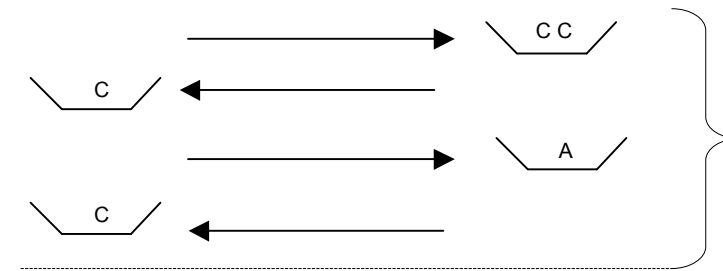
Gets 1 adult over and the 2 children are back to the “starting point”



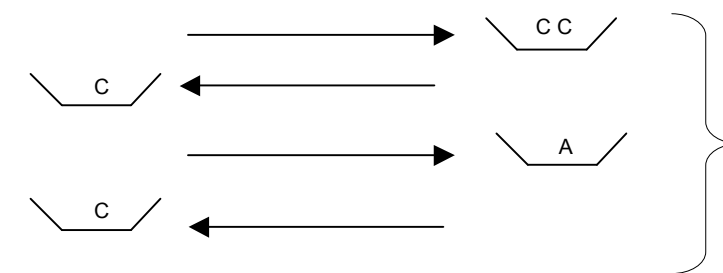
**2<sup>nd</sup> cycle**



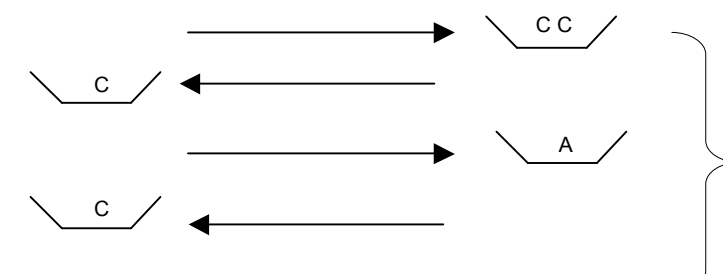
**3<sup>rd</sup> cycle**



**4<sup>th</sup> cycle**



**5<sup>th</sup> cycle**



**6<sup>th</sup> cycle**

**Finish up with last trip**

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