RIVER CROSSINGS
FESTIVAL GUIDE

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# Materials and Setup

Per table (assuming ~5 children per table), you will need:

<table>
<thead>
<tr>
<th>Per Table</th>
<th>Material Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 sets of colored counters</td>
<td>Each set requires 10 each of yellow counters (goats/humans), blue counters (wolves/zombies), and green counters (cabbages).</td>
</tr>
<tr>
<td>5 containers (boats) (optional)</td>
<td></td>
</tr>
<tr>
<td>5 copies of Instructions</td>
<td>1-page sheet</td>
</tr>
<tr>
<td>5 copies of Tasks</td>
<td>2-page sheet \textit{can be printed double-sided}</td>
</tr>
<tr>
<td>5 copies of River mat (optional)</td>
<td>1-page sheet</td>
</tr>
<tr>
<td>1 copy of Foldable Table Sign</td>
<td>1-page sheet \textit{print on cardstock for sturdiness}</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Per Table</th>
<th>Purchasing Materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>150 counters in three colors</td>
<td>\textbf{200 colored counters for $6.65}</td>
</tr>
<tr>
<td>5 containers (boats) (optional)</td>
<td>\textbf{100 cardboard trays for $11.99}</td>
</tr>
<tr>
<td>15 plastic sheet protectors</td>
<td>\textbf{pack of 100 for $7.67} \textbf{pack of 500 for $26.99}</td>
</tr>
</tbody>
</table>

These are optional and used to carry the counters across an imaginary river. Children could slide the counters instead.

These are optional and used to protect the table documents that children will be handling. You may prefer just to have several extra copies of the Instructions and Tasks available.
How to safely carry wolves, goats, and cabbages across a river by boat.

- The number of wolves, goats, and cabbages being transported will vary from puzzle to puzzle, as will the number of items the boat can carry.

Rules:
1. Wolves and goats can’t be left together - a wolf will eat a goat.
2. Cabbages and goats can’t be left together - a goat will eat a cabbage.

Each River Crossings table should be prepped for 5 stations.
Each station needs:
1. 10 each of green, yellow, and blue counters.
2. Small container (boat).
3. River mat or (blank sheet of paper with a line (river) dividing it).
4. River Crossings instructions.
5. River Crossings tasks.
6. Paper and pencils.

We strongly encourage you to explore the activity yourself ahead of time.
You can try our digital version here: jrmf.org/puzzle/river-crossings

The goal here is to introduce the activity without overexplaining it and without telling all the strategies they might use. Normalize making mistakes and avoid giving the answer, as well. When possible, have pairs of children work together.

1. Tell the child that they will be doing one of the oldest, well-known puzzles in human history. This puzzle is over 1000 years old and has been found throughout the world: in Africa, Europe, Asia, and even in the Simpsons!
2. Using the counters introduce Puzzle 1 by telling a story about wanting to help a wolf, goat, and a cabbage cross a river.
3. Explain that you can only take one item at a time in the boat with you and that all the items are safe when you are nearby.
4. Demonstrate the rules for Puzzle 1 by pretending to take the cabbage across first - the wolf then eats the goat!
5. Try again, this time taking the wolf - the goat then eats the cabbage!
6. Ask the child what else they could try (goat) and demonstrate taking the goat safely across.
7. Ask the child to help guide you to finish Puzzle 1. A key understanding that
Have the child explore the next 6 puzzles, which allow for two items in the boat.

Check in with the child and ask questions to encourage deeper thinking. Ask the questions on the task instructions or try some of these examples:

a. What if you had one more [insert wolf, goat, or cabbage here]? How would that have changed the puzzle?

b. Which puzzle did you find the hardest so far? The easiest? Why?

c. Have you found a strategy that works for all or many of the puzzles?

d. When a child is stuck, ask:
   i. Are there times where you had to choose between options?
   ii. What do you know so far?
   iii. What didn’t work?
   iv. What are you thinking about trying?

e. To support pattern recognition, ask:
   i. What if you track your moves?
   ii. What do you think will happen?
   iii. Is there a way to organize what we know to understand it better?

f. “Tell me more.” is a great basic prompt for getting a child to explain their thinking.

When the child finishes the Wolves/Goats/Cabbages puzzles, check in with them and ask if they would like to try the Humans/Zombies puzzles. For these puzzles, humans are blue counters and zombies are green counters.

**Standards**

1. Make sense of problems and persevere in solving them.  
   [CCSS.MP1]

2. Construct viable arguments and critique the reasoning of others.  
   [CCSS.MP3]

3. Model with mathematics.  
   [CCSS.MP4]

4. Look for and make use of structure.  
   [CCSS.MP7]

**Answers:**

These answers are to give you confidence while doing the activity. However, the real answers are in the way that children solve the puzzles and explain their thinking. If a child asks if their solution is correct, ask them to first show you how they solved it.

**General Answers:**

For wolves, goats, and cabbages, if you have a boat that can carry 2 items:
• You can have 1 goat and any number of other non-goats.
• You can have 2 goats and take a maximum of 4 non-goats.
• You can have 4 goats and take a maximum of 2 non-goats.

For humans and zombies:
• If the boat can hold 2 individuals, then 3 of each can cross.
• If the boat can hold 3 individuals, then 4 of each can cross.
• If the boat can hold 4 individuals, any same number of each can cross.

Possible Student Answers to Questions 1 to 3:

1. Can you help one wolf, one goat, and one cabbage cross the river if your boat can only hold one item?
   • Puzzle 1 is solvable in 7 moves.

2. What if your boat can hold two items? Try the next six puzzles.
   a. Can you help 2 wolves, 2 goats, and 2 cabbages cross the river if your boat can hold 2 items?
      i. Solvable in 7 moves.
   b. Can you help 1 wolf, 4 goats, and 1 cabbage cross the river if your boat can hold 2 items?
      i. Solvable in 7 moves.
   c. Can you help 1 wolf, 1 goat, and 4 cabbages cross the river if your boat can hold 2 items?
      i. Solvable in 7 moves.
   d. Can you help 1 wolf, 2 goats, and 3 cabbages cross the river if your boat can hold 2 items?
      i. Solvable in 7 moves.
   e. Can you help 1 wolf, 3 goats, and 2 cabbages cross the river if your boat can hold 2 items?
      i. Unsolvable.
   f. Can you help 2 wolves, 1 goat, and 3 cabbages cross the river if your boat can hold 2 items?
      i. Solvable in 7 moves.

3. What if humans and zombies were crossing the river?
   a. Can 3 humans and 3 zombies cross the river if the boat can hold 2 items?
      i. This can be solved in 11 crossings.
   b. Can 4 humans and 4 zombies cross the river if the boat can hold 2 items?
      i. Unsolvable. Need a minimum of 3 seats in the boat.
   c. Can 5 humans and 4 zombies cross the river if the boat can hold 2 items?
      i. Unsolvable. Need a minimum of 3 seats in the boat.
   d. Can 5 humans and 5 zombies cross the river if the boat can hold 2 items?
      i. Unsolvable. Need a minimum of 4 seats in the boat.
   e. Can 6 humans and 5 zombies cross the river if the boat can hold 2 items?
      i. Unsolvable. Need a minimum of 4 seats in the boat.
   f. Can 6 humans and 6 zombies cross the river if the boat can hold 2 items?
      i. Unsolvable. Need a minimum of 4 seats in the boat.
River Crossings Instructions

How would you help a wolf, a goat, and a cabbage cross the river?

Rules:

- The number on the side of the boat tells how many items it can carry.
- You can’t leave the wolf and goat together, since wolves eat goats.
- You can’t leave the goat and cabbage together, since goats eat cabbages.
River Crossings Puzzles

1. Can you help one wolf, one goat, and one cabbage cross the river if your boat can only hold one item?

2. What if your boat can hold two items? Try the next six puzzles.
   a. Can you help 2 wolves, 2 goats, and 2 cabbages cross the river if your boat can hold 2 items?
   b. Can you help 1 wolf, 4 goats, and 1 cabbage cross the river if your boat can hold 2 items?
   c. Can you help 1 wolf, 1 goat, and 4 cabbages cross the river if your boat can hold 2 items?
   d. Can you help 1 wolf, 2 goats, and 3 cabbages cross the river if your boat can hold 2 items?
   e. Can you help 1 wolf, 3 goats, and 2 cabbages cross the river if your boat can hold 2 items?
   f. Can you help 2 wolves, 1 goat, and 3 cabbages cross the river if your boat can hold 2 items?

3. Find another set of six items that you can cross with and a set of six that you cannot cross with.
River Crossings Puzzles

What if humans and zombies were crossing the river?

- At least one human or zombie needs to be in the boat to row from one side to the other.
- If there are ever more zombies than humans on one side of the river (on the shore and in the boat), then the zombies will eat the humans.

4. Which of these zombie and human puzzles can be solved with a boat that can hold 2 items? For those that can't be solved, what's the smallest boat you need?

a. Can 3 humans and 3 zombies cross the river if the boat can hold 2 items?

```
3  3
Puzzle 1
```

b. Can 4 humans and 4 zombies cross the river if the boat can hold 2 items?

```
4  4
Puzzle 2
```

c. Can 5 humans and 4 zombies cross the river if the boat can hold 2 items?

```
5  4
Puzzle 3
```

d. Can 5 humans and 5 zombies cross the river if the boat can hold 2 items?

```
5  5
Puzzle 4
```

e. Can 6 humans and 5 zombies cross the river if the boat can hold 2 items?

```
6  5
Puzzle 5
```

f. Can 6 humans and 6 zombies cross the river if your boat holds 2 items?

```
6  6
Puzzle 6
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