RIVER CROSSINGS
FESTIVAL GUIDE

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Materials and Setup

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

Per Table	Material Preparation	
5 sets of colored counters	Each set requires 10 each of yellow counters (goats/humans), blue counters (wolves/zombies), and green counters (cabbages).	
5 containers (boats) (optional)		
3 copies of Instructions	1-page sheet	p. 7
5 copies of Tasks	2-page sheet *can be printed double-sided*	p. 8-9
5 copies of River mat (optional)	1-page sheet	p. 10
1 copy of Table Sign	1-page sheet *print on cardstock for sturdiness*	p. 11

Per Table	Purchasing Materials		
150 counters in three colors	200 colored counters for $6.65		
5 containers (boats) (optional)	100 cardboard trays for $11.99		These are optional and used to carry the counters across an imaginary river. Children could slide the counters instead.
13 plastic sheet protectors	pack of 100 for $7.67	pack of 500 for $26.99	These are recommended in order to protect the documents that children will be handling.

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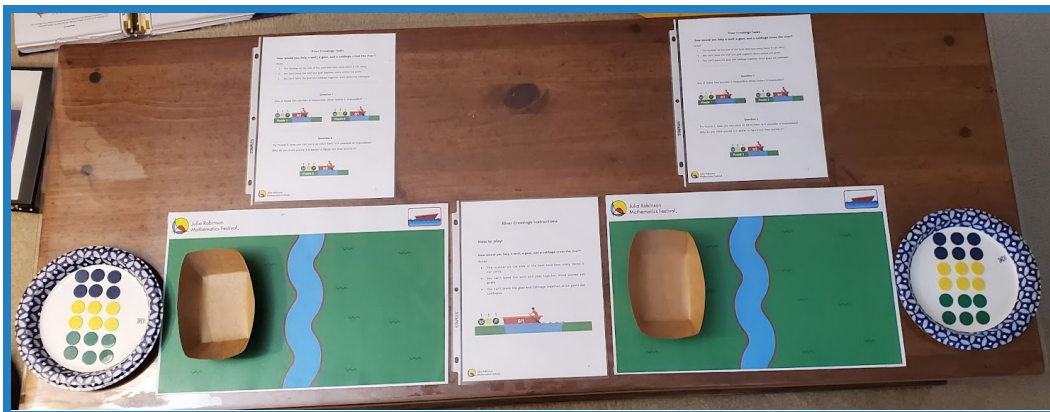
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Objective

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.

Materials

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) - optional.
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.

How to Play

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

Introduce the activity without overexplaining it and without telling what strategies children might want to use. As much as possible, avoid giving away answers. Children should be encouraged to explore, experiment, and learn from their mistakes.

1. Tell the child that River Crossings is one of the oldest, well-known puzzles in human history. It is over 1000 years old and has been found throughout the world: in Africa, Europe, Asia, and even in the Simpsons!
2. Use the counters to demonstrate the rules in Puzzle 1 by telling a story about wanting to help a wolf, goat, and a cabbage cross a river,
3. Ask the child to help guide you to finish Puzzle 1. A key understanding that needs to emerge here is that items can go back and forth across the river.
4. Have the child explore the next 6 puzzles, which allow for two items in the boat.

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

Asking Good Questions

1. Ask questions about confidence.
    a. When a student asks you "Is this right?", instead of saying "yes" or "no" right away, ask them how confident they are in their answer. Here are some examples:
        i. "Maybe. What do you think? How confident are you?"
        ii. "On a scale of 1-5, how confident are you in your answer?"
    b. If a student is not confident in their answer, follow up by asking "What would help you feel more confident in your answer?" or "Why do you not feel confident?" This helps you determine how best to help the student through their explorations.

2. Ask students about choices.
    a. When a student is stuck or shows you a wrong answer, instead of jumping in and showing the student the correct answer, start by asking about the choices that the student made along the way. Here are some suggested steps to follow:
        i. Start from the beginning.
        ii. Ask students to show you what they've tried so far.
        iii. When the student gets to a point where they have different choices, ask the student "What other choices can you make here?"
        iv. Have the student make a different choice and try to solve the puzzle. This helps the student see that they have the power to make different choices during an activity, and they'll start to do this on their own in the future.
        v. If you're familiar with the puzzle or a particular solution, stop the student only when a different choice will help them get to the solution. This will help them feel successful faster without you giving away too much of the answer.

3. Ask students about strategies.
    a. If a student is getting into the activity and has been doing it for a while, ask the student if there are any strategies they've come up with to help them solve the puzzle or win the game.
    b. Follow up by asking if they think their strategies will work for all puzzles and/or larger puzzles, more complex puzzles, etc. Have the student explore more complex puzzles to test out their strategies.
    c. This is a great way to encourage a student to dive deeper into an activity and to start looking for patterns, structure, and proofs.

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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.

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. 2 wolves, 2 goats, and 2 cabbages and 2 items?
        - Solvable in 7 moves.
    b. 1 wolf, 4 goats, and 1 cabbage and 2 items?
        - Solvable in 7 moves.
    c. 1 wolf, 1 goat, and 4 cabbages and 2 items?
        - Solvable in 7 moves.
    d. 1 wolf, 2 goats, and 3 cabbages and 2 items?
        - Solvable in 7 moves.
    e. 1 wolf, 3 goats, and 2 cabbages and 2 items?
        - Unsolvable.
    f. 2 wolves, 1 goat, and 3 cabbages and 2 items?
        - Solvable in 7 moves.

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

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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?

1 1 1

Puzzle 1 — 0/1

2. What if your boat can hold two items? Try the next six puzzles.

a.

2 2 2

Puzzle 2 — 0/2

b.

1 4 1

Puzzle 3 — 0/2

c.

1 1 4

Puzzle 4 — 0/2

d.

1 2 3

Puzzle 5 — 0/2

e.

1 3 2

Puzzle 6 — 0/2

f.

2 1 3

Puzzle 7 — 0/2
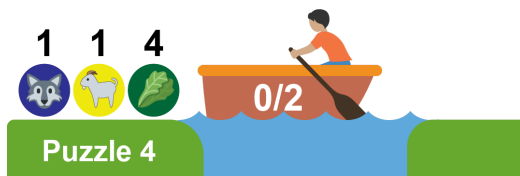
3. Find another set of six items that you can cross with and a set of six that you cannot cross with.

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?
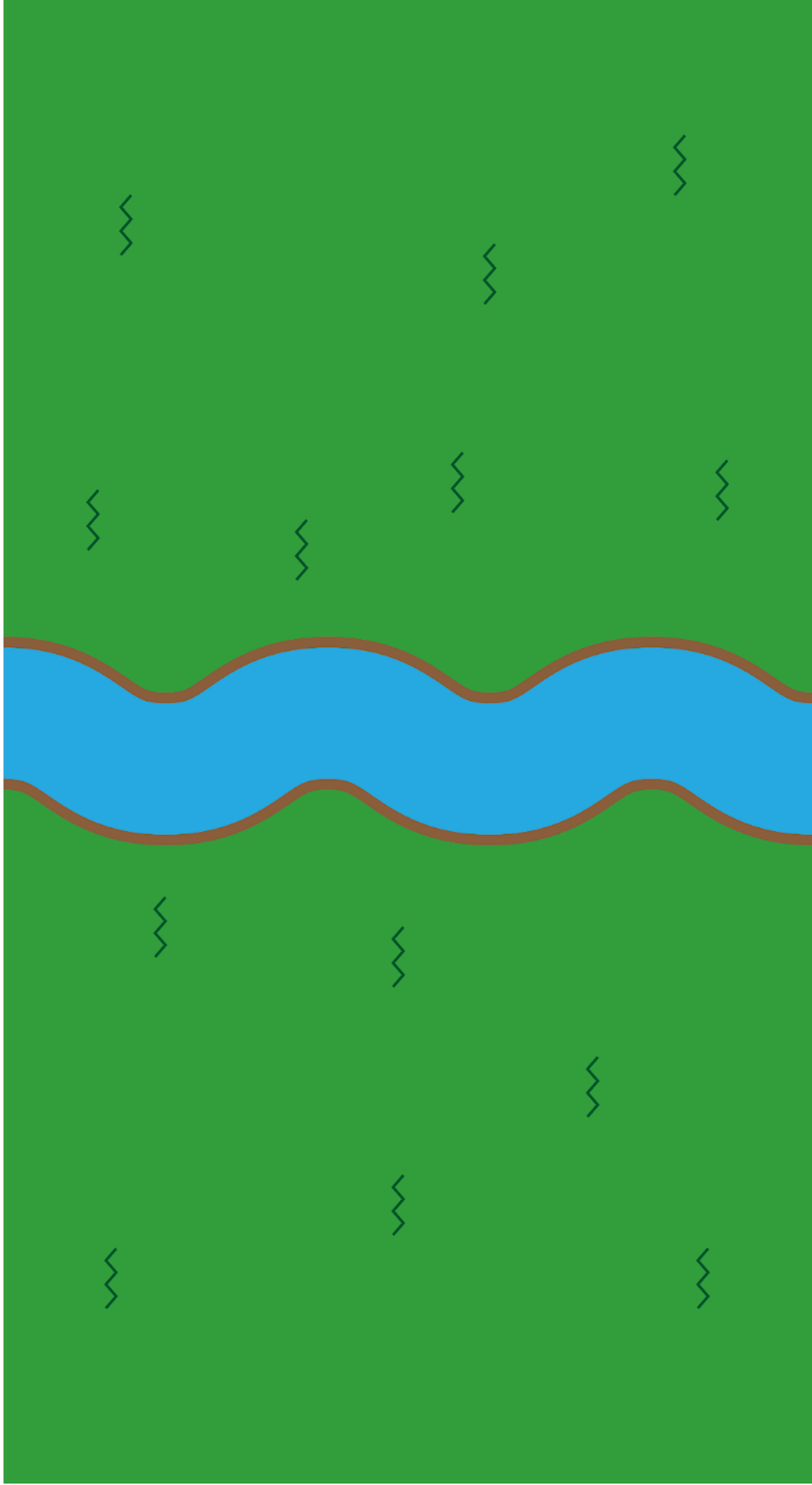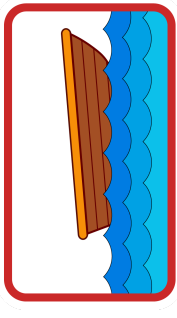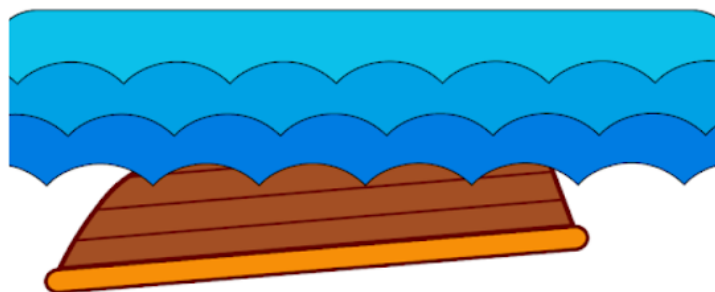
a.
3   **3**
0/2
Puzzle 1

b.
4   **4**
0/2
Puzzle 2

c.
5   **4**
0/2
Puzzle 3

d.
5   **5**
0/2
Puzzle 4

e.
6   **5**
0/2
Puzzle 5

f.
6   **6**
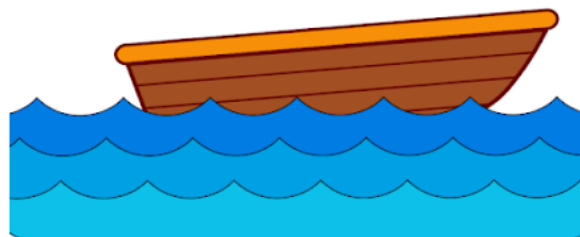0/2
Puzzle 6

RIVER CROSSINGS

RIVER CROSSINGS

Play for free at
jrmf.org/puzzle/river-crossings