

Cross-the-River Puzzle Answer Key

One Optimal Solution (7 crossings)

Notation: "→" means Left→Right, "←" means Right→Left.

State shown as (Left | Right).

Start: (F, W, G, C | —)

1. **F takes G** → → (W, C | F, G) — safe (wolf + cabbage together is fine)
2. **F returns alone** ← → (F, W, C | G)
3. **F takes W** → → (C | F, W, G) — **not safe** to leave G with C, so...
4. **F brings G back** ← → (F, G, C | W)
5. **F takes C** → → (G | F, C, W) — safe (wolf + cabbage + farmer together)
6. **F returns alone** ← → (F, G | C, W)
7. **F takes G** → → (— | F, G, C, W) **Done!**

Why it works:

- The goat (the "vulnerable middle") is moved first to avoid being alone with either the wolf or cabbage.
- Whenever the wolf or cabbage is moved over, the farmer temporarily returns the goat to the original side to prevent a "snack situation."

Minimum Moves: 7. (Any safe solution can be mapped to this structure.)

Common Pitfalls (useful for feedback)

- Taking **W** first: leaves **G with C** (goat eats cabbage).
- Taking **C** first: leaves **W with G** (wolf eats goat).
- Forgetting that **F must return** the boat.

How an AI might solve it (step-by-step logic):

- Represent each state (who's on each bank).
- Apply legal moves (F + one passenger, no forbidden pairs left together).
- Use **systematic search** (like breadth-first search) to find the **shortest** sequence to the goal.
- Strength: Consistent, complete, proves minimality (7 moves).
- Weakness: May feel mechanical; needs precise rules and state tracking.

How humans often solve it (trial, error, intuition):

- Notice the goat is the "dangerous middle," so move **G first**.
- Use **pattern/analogy** ("I remember this puzzle—take G, then juggle it back").
- Try a few moves, mentally simulate, backtrack when a rule breaks.
- Strength: Quick insights, flexible thinking, pattern recognition.
- Weakness: Can miss edge cases or forget constraints without a written plan.

Teacher Tips

- Have students **verbalize** why each interim state is safe.
- Encourage different solution styles: some students prefer drawing banks and arrows; others like the **Move Log** table.
- Fast finishers: Ask them to **prove** no 6-move solution exists (hint: parity/transport counting), or redesign the puzzle with a boat capacity of two.