GHOST GUARD · Facilitator Guide

Keep a ghost's secret safe from noise · Grades 6–8

Players	groups of 3: Guardian, Gremlin, Keeper (or 1–2 players on the computer)
Time	about 45 minutes
Big idea	You can find and fix mistakes in a qubit without looking at it.

Your job as the facilitator

You are the game guide. You do not need to be a quantum expert. Your job is to keep the game moving, read the rules out loud, and ask good questions. It is fine to say "Let's find out together."

What the game is about

A ghost is hiding in a box. It is stored in three coins, in **two rows at once**: a row of HEADS and a row of TAILS, each with its own chips. That is the secret. The **Gremlin** is noise. It tries to flip coins. The **Guardian** protects the ghost. The **Keeper** runs the box.

The big rule: the Guardian may **never look** at a coin. Looking would make the ghost pick one row, and the secret would be lost. Instead, the Guardian asks "Do these two coins match?" That tells where a mistake is, but not what the secret is.

What you need (per group of 3)

- The Ghost Guard printables: Ghost Box mat, cards, secret cards, night tracker
- 6 coins, about 8 green and 8 red chips (Ghost Coin chips work), one 10-sided die, and a folder to hide the mat
- Optional: a computer with GhostGuard_Offline.html

Get ready

1. The Keeper draws a secret card without showing anyone.
2. Behind the folder, the Keeper builds the ghost: 3 HEADS coins with that row's chips, and 3 TAILS coins with that row's chips.
3. Guardian takes 3 **Check** + 4 **Rest** cards. Gremlin takes 2 **Flip** + 5 **Calm** cards.

Run the game, step by step (7 nights)

> **Say:** “The Gremlin wants to mess up the ghost. The Guardian wants to keep it safe. But the Guardian is not allowed to look!”

1. Guardian and Gremlin each lay one card face-down at the same time.
2. The Gremlin hands its card to the Keeper only. **Calm**: nothing happens. **Flip**: the Gremlin names a coin (1, 2 or 3), and the Keeper turns that coin over **in both rows**.
3. The Guardian shows its card. **Rest**: the night ends. **Check**: the Keeper says only "Coins 1 and 2 match or don't match. Coins 2 and 3 match or don't match."
4. The Guardian uses the check table to pick a coin to turn over (in both rows).
5. After night 7, there is one free final Check. Then the Keeper opens the box.
6. Same chips, same colors, same rows as the secret card? **Guardian wins.** If not, **Gremlin wins**. Swap roles every game.

Coins 1 & 2	Coins 2 & 3	Turn over
match	match	nothing
don't match	match	coin 1
don't match	don't match	coin 2
match	don't match	coin 3

Peeking: the Guardian may peek at a coin, but the Keeper then rolls the die to pick one row and removes the other. The secret is gone, and the Gremlin wins.

Levels

- **Level 0 (warm-up):** one row, no chips. Peeking is fine for ordinary bits.
- **Level 2:** swap one Calm card for a **Sign** card (it changes chip colors in rows with TAILS on that coin). Checks never see it, so the Gremlin always wins. That is the lesson!

Watch for these mistakes

- The Keeper flips a coin in only one row. Flips always happen in **both** rows.
- The Keeper says too much. Only "match" or "don't match".

Questions to ask

- Did a check ever tell you what the secret chips were? Why not?
- The Gremlin flipped two different coins before one check. What happened?
- Why is the Guardian never allowed to look?

Answer key

- Two flips before a check: the table points at the wrong coin, the rows swap their chips, and the Gremlin wins.
- With best play by both sides, each side wins half the games. To make it easier for the Guardian, give 4 Check cards.

The quantum words

In the game	In a quantum computer
Ghost in two rows	One qubit spread over three qubits (a code)
Flip card	Bit-flip error
Sign card	Phase error
"Match?" checks	Parity checks: find the error without looking at the data
Peeking	Measurement, which collapses the qubit

Wrap up (say this)

> **Say:** “Real quantum computers do exactly this. In 2024, Google used checks like ours to make a qubit last longer by using more qubits. You just did quantum error correction!”