

Week 1 — Student Worksheet

Qubits & Measurement (Grades 6–8)

Name: _____ Date: _____ Class: _____

Partner Roles: Driver ☐ Navigator ☐ (switch for Part B)

Quick Compass Reminder

- **X (flip):** arrow **North** ↔ **South** (deterministic).
 - **H (mix):** turn arrow **90° to East** (from $|0\rangle$) → N/S checks **~50% / 50%**.
 - **Measurement:** repeated checks on N/S give counts of **0** and **1**.
 - **Shots:** how many times we repeat the same circuit.
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Part 0 — Do Now (2 min)

1. Draw an arrow for **North**, **South**, and **East** on a mini compass:
N ↑ S ↓ E →
 2. Which direction do we use for **50/50 on N/S checks**? _____
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Part A — Scene 1: Flip Test (X)

Goal: Show a guaranteed outcome.

Composer steps:


1. New circuit → on **q0** place **X** → add **Measure** to **c0**.
2. Set **shots = 100** → **Run**.

A1. Record your counts (100 shots):

- Count(0) = _____
- Count(1) = _____

A2. Why is this “classical” or deterministic?

A3. (Sketch) Draw a tiny histogram for your result:

0:  | 1:  (shade to match your counts)

Part B — Scene 2: Equal Mix (H)

Goal: See ~50/50 on N/S checks.

Composer steps:

1. Remove **X** → place **H** on **q0** → keep **Measure**.
2. Set **shots = 1000** → **Run**.

B1. Record your counts (1000 shots):



- Count(0) = _____
- Count(1) = _____

B2. Convert to probabilities (round to 2 decimals):

- $P(0)=P(0)=P(0)= \text{Count}(0) \div 1000 = \underline{\hspace{2cm}}$
- $P(1)=P(1)=P(1)= \text{Count}(1) \div 1000 = \underline{\hspace{2cm}}$

B3. In compass words, what did H do and why does that make ~50/50 on N/S?

B4. (Sketch) Draw a tiny histogram for H:

0:  | 1:  (should be about the same height)

Part C — Scene 3: The Wobble (Noise)

Goal: Notice small shifts; not every run is exactly the same.

Task: Run **H + Measure** three times at **1000 shots**. Fill the table.

Run	Count(0)	Count(1)	P(0)	P(1)
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1				
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2				
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3				
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C1. Did you ever see exactly 500/500? ☐ Yes ☐ No

C2. Explain using the compass idea (wobble):

Exit Ticket (2–3 sentences)

Where did we see **bit** behavior (deterministic) and where **qubit** behavior (probabilistic)? Explain using the **compass** idea.

(Optional) Challenge

Predict before you run: What happens if you put **H then H** on q0 and measure?

- Prediction: _____
- Try it (100 shots). Counts: 0 = _____, 1 = _____ → Did the result match your prediction?
☐ Yes ☐ No

Mini-Glossary (use as needed)

- **bit:** 0 or 1, like off/on.
- **qubit:** quantum bit; can behave like a blend until we check.
- **gate:** instruction that changes a qubit.
- **X:** flip $0 \leftrightarrow 1$ (compass $N \leftrightarrow S$).
- **H:** turn 90° to **East** from $|0\rangle$ (mix \rightarrow $\sim 50/50$ on N/S checks).
- **measurement:** checking to see 0 or 1.
- **shots:** number of repeats.
- **histogram:** bar chart of how many 0s and 1s.
- **probability:** likelihood; counts \div shots.
- **noise:** tiny, unwanted wobble that nudges results.