

Phenomenon-Based Quantum Fundamentals



A phenomenon-based crash course in quantum information. Students walk through a series of hands-on experiments and are asked to record their results. They are then asked to come up with their own theory of quantum which matches their observations. It concludes with a discussion of the limitations of entanglement.

DURATION

2h 45m

WITH BREAK

2h 55m

FORMAT

Fully hands-on

AUDIENCE

Grades 9 to 12+

GROUP SIZE

2 per Qubi pair

PREP

None required

0:00

PART 1 Single qubits

75 min

- 0:00 ○ Framing: what are we trying to predict?
- 0:08 ● Exercise 1 · Measure a random qubit
- 0:18 ● Exercise 2 · Measure twice, no rotation
- 0:28 ● Exercise 3 · Flip it upside down
- 0:40 ● Exercise 4 · Rotate 90 degrees
- 0:53 ● Exercise 5 · Rotate less than 90 degrees
- 1:07 ○ Students derive the Born rule

Break · 10 minutes

1:25

PART 2 Quantum entanglement

60 min

- 1:25 ○ The mystery procedure
- 1:33 ● Exercises 1 to 3 · Measure the entangled pair
- 1:48 ● Hypothesis: glove theory
- 1:56 ● Exercise 4 · Rotate one, then measure
- 2:08 ● Exercise 5 · Rotate both 90 degrees
- 2:20 ○ The reveal: the Singlet state

2:25

PART 3 Create your own entanglement

30 min

- 2:25 ○ Can we use this to communicate?
- 2:40 ○ Why it cannot signal

WHAT PARTICIPANTS LEAVE WITH

Quantum is about measurement

Predicting outcomes, nothing more mystical than that.

Born rule and Bloch sphere

An introduction to physical modeling of experimental results.

Entanglement

A deep understanding of what quantum entanglement means.

Gates, if time allows

Single-qubit gates and CX, combined to build new states.