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Free Lesson Plan — Teacher Edition

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9-12 Quantum Computing Intro — Weekly Lesson Plan

GRADE LEVEL	SUBJECT	WEEK OF
9-12	Quantum Computing Intro	_____

Unit Overview

A five-session conceptual intro to quantum computing without calculus. Students build intuition with coin and card analogies, see superposition and entanglement on the IBM Quantum Composer, learn what kinds of problems quantum is actually expected to crack (and which it isn't), and finish able to talk about qubits without the popular-science fairy tales.

Standards Alignment

AP Physics-aligned conceptual extension; CSTA 3B-AP-15; QED-C high-school framework

Global Standards Mapping

United States:
AP Physics-aligned conceptual extension; CSTA 3B-AP-15; QED-C high-school framework

United Kingdom:
Key Stage 4–5 (Years 10–13, GCSE / A-Level)

Australia / NZ:
Years 9–12 (AC v9.0) · NCEA Levels 1–3

IB Programme:
MYP Years 4–5 + DP / Career-Related Programme

Canada (Ontario):
Ontario Senior Division (Grades 9–12)

Singapore / India:
MOE Secondary 3–5 / JC · CBSE Classes 9–12

EU/EEA note: EU/EEA: GDPR-compliant — no student PII collected; teacher use only

Companion Student Handout — ready to photocopy

Each lesson plan ships with a separate "Student Edition" PDF — daily I-can goals, vocabulary blanks, work space, and exit-ticket boxes. No teacher prep. Print and hand out.

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Session 1

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Learning Objective

Students will be able to explain how a classical bit differs from a qubit using a coin analogy and identify what 'superposition' actually means.

Standards Alignment

QED-C HS framework §1.1; CSTA 3B-AP-15

Materials Needed

- A coin per student
- Whiteboard
- Anchor chart paper

Lesson Flow

Opening / Hook (5-10 min):

"Flip a coin. While it's spinning in the air — what is it?" Discuss: heads, tails, both, neither?

Direct Instruction (15-20 min):

Classical bit = coin lying on the table (0 or 1). Qubit = coin in the air (a probability mix of 0 and 1) until measurement. Build the anchor chart.

Guided Practice (10-15 min):

Triads use 4 coins to model 'measurement collapses superposition' and 'two qubits = 4 possible outcomes'.

Independent Practice (10-15 min):

Half-page: 'Why "a qubit is both 0 and 1 at once" is misleading — and what's more accurate.'

Closing / Exit Ticket (5 min):

Sentence stem: "A qubit isn't both — it's a ___ until ___."

Differentiation

For struggling learners:

Provide a partially-completed organizer with the first row modeled and 2-3 sentence stems specific to quantum.

For advanced learners:

Add a transfer prompt: apply today's idea to a context outside quantum and defend the move in 3 sentences.

For ELL students:

Pre-teach 4 key terms with a visual glossary; offer the sentence frame "I notice that ___, which suggests ___ because ___."

For IEP students:

Reduce the response set by half; offer choice between a written, oral (recorded on Flip), or sketch response — same rubric.

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Session 2

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Learning Objective

Students will be able to use the IBM Quantum Composer to set up a 1-qubit experiment and interpret the histogram result.

Standards Alignment

QED-C HS framework §2.1; CSTA 3B-AP-15

Materials Needed

- Chromebooks/laptops
- IBM Quantum Composer (free, browser-based)
- Step-by-step demo handout

Lesson Flow

Opening / Hook (5-10 min):

"Today you write your first quantum program. It'll be 1 line."

Direct Instruction (15-20 min):

Demo: drag a Hadamard gate onto qubit 0, add a measurement, run on the simulator. Walk through the resulting 50/50 histogram.

Guided Practice (10-15 min):

Pairs replicate the demo; modify by stacking two Hadamards and predicting + checking the result.

Independent Practice (10-15 min):

Each pair sets up one experiment of their own choice (within taught gates) and explains the histogram in 2 sentences.

Closing / Exit Ticket (5 min):

Whip-around: one prediction that matched, one that surprised you.

Differentiation

For struggling learners:

Provide a partially-completed organizer with the first row modeled and 2-3 sentence stems specific to quantum.

For advanced learners:

Add a transfer prompt: apply today's idea to a context outside quantum and defend the move in 3 sentences.

For ELL students:

Pre-teach 4 key terms with a visual glossary; offer the sentence frame "I notice that ___, which suggests ___ because ___."

For IEP students:

Reduce the response set by half; offer choice between a written, oral (recorded on Flip), or sketch response — same rubric.

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Session 3

9-12 Quantum Computing Intro — Weekly Lesson Plan

Learning Objective

Students will be able to explain entanglement as 'measuring one tells you about the other' using a 2-qubit Bell state demo.

Standards Alignment

QED-C HS framework §3.2

Materials Needed

- IBM Quantum Composer
- Two-coin manipulative
- Anchor chart

Lesson Flow

Opening / Hook (5-10 min):

"Here are two coins that always land showing the same face — even if they're across the room. Spooky?"

Direct Instruction (15-20 min):

Build the Bell state on the Composer (Hadamard on qubit 0, then CNOT to qubit 1). Run; show 00 + 11 only, never 01 or 10. Define entanglement = correlated measurement, not faster-than-light communication.

Guided Practice (10-15 min):

Pairs build the Bell state, then try to break the correlation by inserting a gate; debrief.

Independent Practice (10-15 min):

One paragraph: 'What entanglement is and what science writers usually get wrong about it.'

Closing / Exit Ticket (5 min):

Add 'entanglement' to anchor chart with student-friendly definition.

Differentiation

For struggling learners:

Provide a partially-completed organizer with the first row modeled and 2-3 sentence stems specific to quantum.

For advanced learners:

Add a transfer prompt: apply today's idea to a context outside quantum and defend the move in 3 sentences.

For ELL students:

Pre-teach 4 key terms with a visual glossary; offer the sentence frame "I notice that ___, which suggests ___ because ___."

For IEP students:

Reduce the response set by half; offer choice between a written, oral (recorded on Flip), or sketch response — same rubric.

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Session 4

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Learning Objective

Students will be able to identify two problems quantum is well-suited for and two problems where classical wins.

Standards Alignment

QED-C HS framework §4; CSTA 3A-IC-29

Materials Needed

- Problem-card set: factoring, drug discovery, simulating molecules, video streaming, sorting a list, route optimization
- Sorting mat

Lesson Flow

Opening / Hook (5-10 min):

"Quantum will not make Netflix faster. Why not?"

Direct Instruction (15-20 min):

Quantum strengths: problems with exponential structure (factoring, simulating quantum systems, certain optimization). Quantum weaknesses: linear data tasks, classical I/O, anything bandwidth-bound.

Guided Practice (10-15 min):

Triads sort the problem cards and defend each placement.

Independent Practice (10-15 min):

Pick one card and write a 3-sentence explanation of why quantum will or won't help.

Closing / Exit Ticket (5 min):

Class consensus on the two trickiest cards.

Differentiation

For struggling learners:

Provide a partially-completed organizer with the first row modeled and 2-3 sentence stems specific to quantum.

For advanced learners:

Add a transfer prompt: apply today's idea to a context outside quantum and defend the move in 3 sentences.

For ELL students:

Pre-teach 4 key terms with a visual glossary; offer the sentence frame "I notice that ___, which suggests ___ because ___."

For IEP students:

Reduce the response set by half; offer choice between a written, oral (recorded on Flip), or sketch response — same rubric.

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Session 5

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Learning Objective

Students will be able to explain quantum computing in 60 seconds at a level a smart adult who hasn't studied it can follow.

Standards Alignment

CCSS SL.9-10.4

Materials Needed

- 60-second pitch template
- Phones for recording
- Class rubric (correct, concrete, no fairy-tale phrasing)

Lesson Flow

Opening / Hook (5-10 min):

Watch a 60-second pop-science explanation that contains 2 errors. Class spots them.

Direct Instruction (15-20 min):

Pitch structure: what it is (15s), one thing it can do (20s), one thing it can't (15s), why it matters now (10s).

Guided Practice (10-15 min):

Pairs draft + critique with two rules: no fairy-tale phrasing ('infinite parallel universes'), every claim grounded in something we did this week.

Independent Practice (10-15 min):

Record (phone or Flip).

Closing / Exit Ticket (5 min):

Two volunteers play their pitch; class scores against rubric.

Differentiation

For struggling learners:

Provide a partially-completed organizer with the first row modeled and 2-3 sentence stems specific to quantum.

For advanced learners:

Add a transfer prompt: apply today's idea to a context outside quantum and defend the move in 3 sentences.

For ELL students:

Pre-teach 4 key terms with a visual glossary; offer the sentence frame "I notice that ___, which suggests ___ because ___."

For IEP students:

Reduce the response set by half; offer choice between a written, oral (recorded on Flip), or sketch response — same rubric.

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