

QuantumVault Academy

CSTA K-12 Computer Science Standards Alignment

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This document maps QuantumVault Academy's curriculum to the CSTA K-12 Computer Science Standards (2017, updated 2022). It is intended to support school and district procurement decisions by demonstrating standards alignment across all three platform levels.

Platform	QuantumVault Academy
Focus Area	Post-Quantum Cryptography (NIST FIPS 203, 204, 205)
Grade Bands	K-5 (Level 1 Explorer), 6-8 (Level 2 Agent), 9-12 (Level 3 Specialist)
Standards Used	CSTA K-12 CS Standards 2017 (revised 2022)
NIST Alignment	FIPS 203 (ML-KEM), FIPS 204 (ML-DSA), FIPS 205 (SLH-DSA), FIPS 206 (FN-DSA)
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Alignment Key

Direct — The standard is a primary learning objective. Students demonstrate this standard through specific platform activities.

Supported — The standard is reinforced through platform activities but is not the primary focus of the lesson.

Introduced — The standard is introduced conceptually through narrative or game context without formal assessment.

1. Networks & the Internet (NI)

QuantumVault Academy addresses network security, cryptographic protocols, and internet infrastructure across all three grade bands. The post-quantum migration context provides real-world grounding for abstract networking concepts.

Standard	Description	Level	Platform Activities	Alignment
NI-K12.1	Network Communication Explain how computing devices work together in a network.	L1, L2, L3	Secure the Network game: students inspect network topologies (star, hub-spoke, mesh, hybrid), identify link types, and trace data flows across four real-world scenarios.	Direct
NI-K12.2	Network Security Explain how data is made secure when transmitted over networks.	L2, L3	Hash Lab: SHA-3 avalanche effect and tamper detection. Mission Control: TLS handshake scenarios, VPN encryption, secure messenger protocols. Secure Network Level 3: migration budget, justification for ML-KEM over RSA.	Direct
NI-K12.3	Cybersecurity Describe how encryption protects personal information and digital data.	L1, L2, L3	Lock Puzzle: 32 levels teaching hiding vs. proving, algorithm selection, key size. Quantum Derby: classical vs. quantum threat scenarios including RSA, ECC, AES, SHA-3. Story Time Level 3: Sarah's Hospital Migration — Harvest Now Decrypt Later threat model.	Direct
NI-K12.4	Secure Protocols Evaluate the capabilities of encryption and other security measures.	L3	PQC Mission Control: 6 scenarios requiring correct FIPS standard selection. Threat Modeler: hospital RSA-2048 threat assessment with migration priority. Code It Yourself: ML-KEM key exchange pseudocode with public/private classification.	Direct
NI-K12.5	Fault Tolerance Explain how distributed systems handle failure.	L3	Secure Network scenarios include redundant paths and the cascade effect when a CA root is compromised — students learn blast radius of single points of failure.	Supported

2. Data & Analysis (DA)

Cryptographic concepts are fundamentally mathematical data transformations. QuantumVault Academy teaches hashing, encoding, and data representation in context.

Standard	Description	Level	Platform Activities	Alignment
DA-K12.1	Data Collection Collect and use data to answer questions.	L2, L3	Hash Lab: students collect hash output data by modifying inputs and observing the avalanche effect. Quantum Derby: students collect win/loss data across 18 races to build intuition about quantum vs. classical performance.	Supported
DA-K12.2	Data Transformation Explain how binary sequences represent data including numbers, text, and images.	L1, L2	Logic Gate Lab: students wire AND/OR/XOR/NOT circuits and observe binary input/output. XOR reversibility demonstration shows how binary operations underlie encryption.	Direct
DA-K12.3	Data Analysis Use data to highlight relationships and support conclusions.	L2, L3	Key Size Lab: students compare public key sizes, security bits, and speed scores across RSA-2048, ECC-256, Kyber-512/768/1024, Dilithium-2, Falcon-512. Quantum Derby odds system: higher odds for counterintuitive results rewards analysis.	Direct
DA-K12.4	Data Inference Use data to model real-world situations and make inferences.	L3	Threat Modeler: students write a one-paragraph threat assessment for a hospital with RSA-2048 records dating to 2010, making concrete migration priority recommendations. Sarah's Hospital Migration: triage decisions based on data lifetime and exposure analysis.	Direct

3. Algorithms & Programming (AP)

Level 3 Specialist content includes real Python code using the liboqs library, pseudocode for ML-KEM key exchange, and fill-in-the-blank coding challenges. Lower levels build algorithmic thinking through game mechanics.

Standard	Description	Level	Platform Activities	Alignment
AP-K12.1	Algorithms Create and evaluate algorithms for a given task.	L2, L3	Quantum Circuit Composer: students build quantum circuits gate by gate, observing how algorithm structure affects qubit state and measurement probability. Logic Gate Lab: students design circuits from scratch to meet truth table requirements.	Direct
AP-K12.2	Variables Create and manipulate variables in programs.	L3	Mission Control code fill-in-the-blanks: students complete real Python using liboqs-python (ML-KEM, ML-DSA variables, key sizes, encapsulation parameters). VS Code expander shows runnable pip install snippet.	Direct

AP-K12.3	Control Flow Implement problem solutions using loops, conditionals, and functions.	L3	Code It Yourself: ML-KEM key exchange pseudocode requires correct sequencing of keypair generation, encapsulation, and decapsulation — conditional flow matters.	Supported
AP-K12.4	Decomposition Break problems into smaller parts to develop solutions.	L1, L2, L3	Lock Puzzle: students decompose the security problem (hide vs. prove vs. size) before selecting the correct algorithm. Secure Network Level 3: students triage 47 cryptographic assets into a prioritized 8-item migration plan.	Direct
AP-K12.5	Abstraction Use abstraction to manage complexity in programs.	L2, L3	Quantum Derby: quantum algorithms abstracted as race competitors with odds — students learn behavior without implementation detail. Mission Control: real FIPS API calls abstracted into fill-in-the-blank format.	Supported
AP-K12.6	Modeling Use models and simulations to formulate and refine hypotheses.	L2, L3	Quantum Circuit Composer: IBM-style drag-and-drop simulator with Bloch sphere visualization and probability bars. Students test hypotheses about gate combinations.	Direct

4. Impacts of Computing (IC)

The post-quantum migration context provides one of the most concrete real-world examples of computing's societal impact available in K-12 curriculum. Every lesson connects to why this matters beyond the classroom.

Standard	Description	Level	Platform Activities	Alignment
IC-K12.1	Culture Describe how computing impacts daily life and culture.	L1, L2, L3	Story Time NIST Timeline: 2016-2024 complete history of the PQC competition. Lock Puzzle: everyday vaults (toy box to hospital) ground abstract crypto in daily life. Quantum Derby: bank, medical, government scenarios show real stakes.	Direct
IC-K12.2	Social Interactions Explain how computing enables communication and collaboration.	L2, L3	Secure Network: students protect communication links across offices, hospitals, and school districts. Mission Control: secure messenger and VPN scenarios.	Supported
IC-K12.3	Safety Identify and describe how computing affects personal safety and privacy.	L1, L2, L3	All levels address data privacy: toy box to hospital records progression in Lock Puzzle. Harvest Now Decrypt Later in Story Time Level 3 explains why privacy threats are retroactive. HIPAA regulatory context in Threat Modeler L3-4.	Direct
IC-K12.4	Equity Describe tradeoffs in computing related to access and fairness.	L3	Sarah's Hospital Migration: budget constraint forces triage — students learn that not all systems can be migrated at once and must prioritize by risk. Government Contract story: compliance vs. security distinction.	Supported
IC-K12.5	Careers Describe career opportunities in computing.	L2, L3	Quiz Board Round 10: Future and Careers round covers cybersecurity career paths. Mission Control framing positions students as security engineers. Level 3 Specialist branding explicitly targets CTE cybersecurity majors.	Introduced
IC-K12.6	Collaboration Describe how collaboration affects the design and development of computing artifacts.	L2, L3	NIST Timeline: 6-year international collaboration of cryptographers. Students learn that FIPS 203/204/205 resulted from global peer review — the strongest argument for open standards over proprietary crypto.	Introduced

5. Computing Systems (CS)

Standard	Description	Level	Platform Activities	Alignment
CS-K12.1	Hardware Describe how hardware and software work together.	L1, L2	Lock Puzzle Level 7: smart watch scenario teaches that hardware constraints (tiny processor) affect algorithm selection (Falcon over SPHINCS+). Logic Gate Lab: hardware-level AND/OR/XOR gates underlie all computation.	Supported
CS-K12.2	Troubleshooting Systematically identify and fix problems in hardware and software.	L2, L3	Quantum Circuit Composer: students debug incorrect gate sequences by observing Bloch sphere state and probability output. Logic Gate Lab: circuit wiring errors produce visible incorrect outputs students must diagnose and fix.	Direct
CS-K12.3	Operating Systems Describe how operating systems manage computer resources.	L3	Mission Control VS Code expander: students see real terminal commands (pip install liboqs-python) and understand the software environment their code runs in. Indirect but genuine exposure.	Introduced

Standards Coverage Summary

At a glance: which CSTA strands QuantumVault Academy addresses by grade band.

CSTA Strand	Level 1 Explorer (K-5)	Level 2 Agent (6-8)	Level 3 Specialist (9-12)
Networks & Internet (NI)	✓ Direct	✓ Direct	✓ Direct
Data & Analysis (DA)	✓ Supported	✓ Direct	✓ Direct
Algorithms & Programming (AP)	✓ Introduced	✓ Supported	✓ Direct
Impacts of Computing (IC)	✓ Direct	✓ Direct	✓ Direct
Computing Systems (CS)	✓ Supported	✓ Direct	✓ Direct

NOTE ON CYBERSECURITY SPECIFICITY: CSTA standards provide the computer science framework. QuantumVault Academy also aligns to NICE Cybersecurity Workforce Framework (NCWF) work roles (Cyber Defense Analyst, Security Architect) and NSA GenCyber principles. A separate NICE/GenCyber alignment document is available on request.

FOR DISTRICT PROCUREMENT: This document confirms QuantumVault Academy addresses CSTA NI, DA, AP, IC, and CS standards across all three grade bands. The platform is purpose-built for CTE cybersecurity programs and dual-credit courses at the 9-12 level. Contact hello@quantumvaultacademy.com to request a pilot or additional documentation.

