

Overview leaflet

Quanto ©

a simple and engaging

card game

with qubits and quantum gates



	Age: 14+ full game / 10+ beginner level	
	Difficulty level: <input type="checkbox"/> Easy <input checked="" type="checkbox"/> Medium <input type="checkbox"/> Difficult	
	Keywords: card game, physics, quantum mechanics, quantum technologies, non-formal learning settings	
	Summary of the activity: <p>Quanto is a card game designed to introduce some of the fundamental aspects of quantum mechanics. The game mechanism, in principle extremely simple, consists of matching and discarding cards that represent quantum states. The matching occurs through appropriate operations on the states, a non-trivial step that requires concentration and skill. The game is made compelling by its short-term strategy which, enriched by elements of tactics and interaction, guarantees gratification to the players at every turn. The materials are accessible even to the youngest and the least experienced, thanks to clear and comprehensive graphics.</p> <p>Quanto brings together these characteristics in an essential and compact game, suitable for both educational experiences and free time, able of gradually revealing the most astonishing phenomena of quantum mechanics and of proposing increasingly complex challenges.</p> <p>The activity based on Quanto consists in training moments alternating with game sessions, in which on the one hand the concepts necessary to face the games are introduced and on the other the game acts as a stimulus and vehicle for the advancement of knowledge in a non-formal learning environment.</p>	
	Learning objectives: The main characters of Quanto are qubits, the elementary constituents of quantum computers. Unlike classical bits that can only be turned on or off, quantum bits are described by a 'state', whose extraordinary properties manifest in an exemplary manner the fundamental principles of quantum mechanics. Furthermore, qubits are perfect playmates because their state can be transformed using quantum gates that perform logical operations, can be subjected to measurement processes, can be disturbed by the surrounding environment that	

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acts in the form of noise, but can also be protected from noise with special error correction protocols.

Starting from the behavior of two qubits in these various situations, with QUANTO one discovers what quantum states, the superposition principle, measurement processes and entanglement are and how they work, one verifies their deepest implications and appreciates the power of imagination in understanding physics.

The game can be used as the starting point to introduce in-depth modules related to further aspects of quantum mechanics.



Interdisciplinary connections:

1. Mathematics: elements of linear algebra
2. Computer sciences: solution of simple quantum circuits and hints on the experimental realizations of quantum computers
3. Sciences: chemistry, hints on quantum biology
4. Philosophy: ontology and representation of reality



Prerequisites:

The level of the game and the learning path associated with it, understood as the set of previous knowledge and competences that one wants to achieve, can be calibrated and modulated based on the age and level of the participants. In this sense, no prerequisites are required.



Required time:

2 hours for the basic level game + 2 hours for the complete game + 2 hours for the physics in-depth module + 2 hours for each interdisciplinary module

Required materials:

decks of QUANTO cards (ideally one deck is required for every 3-4 players, i.e. groups of 6-8 people playing in pairs)



Learning and teaching support material

1. Informative flashcards (part of the deck of cards)
2. Interactive presentation/tutorial
3. Experience and acquisition of knowledge evaluation questionnaire
4. Teacher's guide



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(* in progress)

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