21 Keys to Ethereum Basics

Master the essentials of Ethereum.

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Beacon Chain

The proof-of-stake consensus layer of Ethereum, coordinating validators since December 2020.

The Beacon Chain is Ethereum's proof-of-stake (PoS) blockchain, launched on December 1, 2020, to manage the PoS consensus mechanism. It operates as the coordination layer for validators who stake ETH to secure the network, propose blocks, and attest to their validity.

Fully integrated with Ethereum's execution layer during The Merge in 2022, the Beacon Chain replaced proof-of-work mining, enabling faster and more energy-efficient transaction processing. It is critical for Ethereum's security and scalability, supporting validator duties and finality.

dApp (Decentralized Application)

A software application that runs on a decentralized network like Ethereum, leveraging smart contracts for backend logic.

A decentralized application (dApp) is a software application that operates on a blockchain, such as Ethereum, rather than centralized servers. Its backend code runs on a decentralized peer-to-peer network, typically using smart contracts to execute logic automatically and transparently. dApps are designed to be open-source, trustless, and resistant to censorship, with data stored on the blockchain to ensure immutability and security. Examples include decentralized finance (DeFi) platforms like Uniswap and NFT marketplaces like OpenSea, which rely on Ethereum's infrastructure for transactions and operations.

ERC-20

A standard for fungible tokens on Ethereum, enabling interoperability across dApps.

ERC-20 (Ethereum Request for Comment 20) is a technical standard for fungible tokens on the Ethereum blockchain, introduced in 2015. It defines a set of rules and functions (e.g., `transfer`, `balanceOf`, `approve`) that ensure tokens are interchangeable and compatible with dApps, wallets, and exchanges. Widely used for cryptocurrencies, stablecoins (e.g., USDT, USDC), and utility tokens, ERC-20 tokens power decentralized finance (DeFi) and other applications. Its standardization simplifies integration, making it a cornerstone of Ethereum's token ecosystem.

ERC-721

A standard for non-fungible tokens (NFTs) on Ethereum, representing unique digital assets.

ERC-721 is an Ethereum standard for non-fungible tokens (NFTs), introduced in 2018, where each token is unique and indivisible. Unlike ERC-20 tokens, ERC-721 tokens represent distinct assets, such as digital art, collectibles, or in-game items, with metadata stored on-chain or via IPFS. Key functions include `ownerOf` and `transferFrom`, enabling ownership tracking and transfers. Popularized by projects like CryptoPunks and Bored Ape Yacht Club, ERC-721 underpins the NFT market, ensuring interoperability across Ethereum-based platforms.

ETH ETF

An exchange-traded fund providing investors with exposure to the price of Ether, Ethereum's native digital asset, without direct ownership.

Spot ETH ETFs hold actual Ether as their underlying asset, allowing investors to track the real-time price of ETH through a regulated security traded on stock exchanges like the NYSE or Nasdaq. Approved by the U.S. Securities and Exchange Commission (SEC) on May 23, 2024, these ETFs launched in late July 2024.

Eight spot ETH ETFs are currently available, including iShares Ethereum Trust (ETHA) with a 0.25% expense ratio and Franklin Ethereum ETF (EZET), enabling traditional brokerage access for retirement accounts and institutional portfolios.

As of 2025, ETH ETFs have attracted significant institutional inflows, with $646 million recorded in the week ending September 13, 2025, driven by Ethereum's role in decentralized finance and smart contracts. Total assets under management (AUM) across ETH ETFs exceed $10 billion, bolstered by staking integrations and network upgrades.

ETH ETFs differ from futures-based predecessors by offering direct spot exposure. However, they exclude staking rewards unlike direct ETH holding.

ETH

ETH is the native digital asset of the Ethereum blockchain, used for transaction fees, staking, and as a medium of exchange in decentralized applications.

ETH is the foundational digital asset powering the Ethereum network, serving as the fuel for executing smart contracts, processing transactions, and securing the blockchain through proof-of-stake validation. As of September 16, 2025, ETH trades at $4,535 USD, with a market capitalization of $547 billion based on a circulating supply of 120,704,430 ETH.

Unlike Bitcoin's fixed 21 million cap, Ethereum has no maximum supply, but mechanisms like EIP-1559 burn portions of transaction fees to potentially make ETH deflationary during high network activity.

ETH's value derives from its utility in the world's leading smart contract platform. Institutional accumulation such as BitMine's $204 million ETH purchase, pushing exchange balances to a nine-year low of 15.72 million ETH. The all-time high for ETH stands at $4,953.73, achieved on August 24, 2025, amid broader market recovery and Ethereum's post-Merge efficiency gains.

ETH is the second-largest digital asset by market cap, often serving as a benchmark for altcoin performance and a store of value in decentralized finance protocols.

Ether (ETH)

Ether(ETH) is the native digital asset of the Ethereum blockchain, used to pay for transaction fees and computational services.

Ether (ETH) is the native coin of the Ethereum network, serving as both a cryptocurrency and a utility token. It is used to compensate validators for processing transactions and executing smart contracts on the Ethereum blockchain.

Users pay transaction fees, known as "gas," in ETH to interact with dApps or transfer assets.

Ether's supply is not capped, and its issuance is governed by Ethereum's proof-of-stake consensus mechanism, with additional dynamics introduced by EIP-1559, which burns a portion of transaction fees to manage inflation.

Ethereum (ETH)

A decentralized blockchain platform that pioneered smart contracts, enabling programmable money and decentralized applications.

Ethereum is a blockchain network, launched in 2015 by Vitalik Buterin and co-founders, that pioneered the smart contract platform. With Ether (ETH) as its native cryptocurrency, Ethereum serves as the world's settlement layer, acting as critical financial infrastructure akin to Google's role in information technology. It powers decentralized applications (dApps), decentralized finance (DeFi), non-fungible tokens (NFTs), decentralized autonomous organizations (DAOs), as well as real-world assets(RWAs). As the second-largest digital asset by market cap, ETH facilitates transactions, staking, and yield generation. Its consensus algorithm was transformed from PoW to PoS in 2022 to enhance scalability, energy efficiency, and throughput.

Over $165 billion in stablecoins is currently on the Ethereum network underscoring its role in liquidity and DeFi ecosystems.

Ethereum Contract Account

A blockchain account containing smart contract code, controlled by its programmed logic rather than a private key.

A Contract Account is an Ethereum account that contains smart contract code and is controlled by its programmed logic, not a private key.

Created when a smart contract is deployed to the blockchain, it has a unique address and can hold Ether or tokens. Contract accounts execute their code automatically when triggered by a transaction from an EOA or another contract, enabling functionalities like automated token transfers or complex dApp logic. They are fundamental to Ethereum's programmable ecosystem.

Ethereum EOA Account

An externally owned account on Ethereum, controlled by a private key and used to initiate transactions.

An Externally Owned Account (EOA) is one of the two types of accounts on the Ethereum blockchain, controlled by a user via a private key. EOAs are associated with a public address and can hold Ether (ETH) or tokens, as well as initiate transactions, such as sending ETH or interacting with smart contracts.

Unlike contract accounts, EOAs do not contain executable code and rely on user-initiated actions. Wallets like MetaMask typically manage EOAs, allowing users to sign transactions securely.

Ethereum Wallet

A software or hardware tool that manages Ethereum accounts, enabling users to store, send, and receive ETH or tokens.

An Ethereum wallet is a tool that allows users to interact with the Ethereum blockchain by managing their externally owned accounts (EOAs) and private keys. It enables users to store, send, and receive Ether (ETH) or other tokens, as well as interact with decentralized applications (dApps) and smart contracts. Wallets come in various forms, including software wallets (e.g., MetaMask, OKX Web3 Wallet) and hardware wallets (e.g., Ledger, Trezor) for enhanced security. They do not store assets directly but provide access to funds and assets recorded on the blockchain.

EVM (Ethereum Virtual Machine)

A decentralized computation engine that executes smart contracts on the Ethereum blockchain.

The Ethereum Virtual Machine (EVM) is a Turing-complete virtual machine embedded in every Ethereum node, responsible for executing smart contract code.

It provides a sandboxed environment where smart contracts, written in languages like Solidity, are compiled into bytecode and run deterministically across the network. The EVM ensures that all nodes reach the same state after executing a contract, enabling trustless and decentralized computation. Gas fees, paid in ETH, limit the computational resources used by the EVM to prevent abuse and ensure network efficiency.

Gas (Ethereum)

A unit measuring the computational effort required to execute transactions or smart contracts on Ethereum.

Gas is a unit that quantifies the computational work needed to process transactions or execute smart contracts on the Ethereum blockchain. Each operation in the Ethereum Virtual Machine (EVM), such as transferring ETH or running a smart contract, consumes a specific amount of gas. Users pay for gas in Ether (ETH), with the total cost determined by the gas limit (the maximum gas a transaction can use) and the gas price (the amount of ETH per gas unit). Gas ensures network resources are allocated efficiently and prevents spam or infinite loops.

Gas Price

The amount of Ether (ETH) a user is willing to pay per unit of gas for a transaction on Ethereum.

Gas price is the cost per unit of gas, denominated in Gwei (1 Gwei = 10^-9 ETH), that a user sets when submitting a transaction to the Ethereum network. It determines the priority of the transaction, as validators typically prioritize transactions with higher gas prices. After EIP-1559 (implemented in August 2021), the gas price consists of a base fee (burned by the network) and an optional priority fee (paid to validators). Users can adjust gas prices in wallets like MetaMask to balance speed and cost.

Smart Contract

Self-executing code on the Ethereum blockchain that automatically enforces agreement terms when conditions are met.

A smart contract is a self-executing program stored on the Ethereum blockchain, written in languages like Solidity. It automatically executes predefined actions when specific conditions are met, without intermediaries. Smart contracts power decentralized applications (dApps), enabling functions like token issuance (e.g., ERC-20), NFT creation (e.g., ERC-721), or automated financial agreements in DeFi. They are immutable once deployed, ensuring trustless and transparent execution, with all interactions recorded on the blockchain and requiring gas fees for computation.

Solidity

A high-level programming language for writing smart contracts on Ethereum.

Solidity is a statically typed, contract-oriented programming language designed for developing smart contracts on the Ethereum blockchain. It resembles JavaScript and is compiled into bytecode for execution on the Ethereum Virtual Machine (EVM). Solidity supports complex logic, including loops, conditionals, and inheritance, making it ideal for creating decentralized applications (dApps) and tokens (e.g., ERC-20, ERC-721). Its widespread adoption stems from Ethereum's dominance, with tools like Remix and Hardhat facilitating development, testing, and deployment.

The Merge

Ethereum's transition from proof-of-work to proof-of-stake consensus, completed on September 15, 2022.

The Merge was a major upgrade to Ethereum, finalized on September 15, 2022, marking the shift from energy-intensive proof-of-work (PoW) to proof-of-stake (PoS) consensus. It integrated Ethereum's original execution layer with the Beacon Chain, a PoS-based consensus layer introduced in December 2020. The Merge reduced Ethereum's energy consumption by ~99.95%, improved scalability potential, and set the stage for future upgrades like sharding. It did not directly lower transaction fees but enabled mechanisms like EIP-1559 to optimize fee dynamics.

Token

Digital units of value built on existing blockchains, representing assets, utilities, or stakes in decentralized ecosystems.

A token is a digital unit of value built on a blockchain, representing assets, utilities, or stakes, distinct from native coins like BTC or ETH. Tokens enable fundraising, decentralized finance (DeFi), and real-world asset representations(RWAs). They leverage underlying networks for security and interoperability, powering decentralized applications (dApps) and ecosystems.

People sometimes refer to all digital assets as tokens, though technically tokens are built on existing blockchains while native coin have their own blockchain networks.

Turing Complete (Ethereum)

The ability of Ethereum's programming environment to compute any function given sufficient resources.

Ethereum is considered Turing complete because its Ethereum Virtual Machine (EVM) and programming languages like Solidity can theoretically compute any function or algorithm, provided enough computational resources (gas) are available. This property allows developers to create complex smart contracts and decentralized applications with diverse functionalities, such as loops and conditional logic. However, gas limits prevent infinite computations, ensuring network efficiency. Turing completeness distinguishes Ethereum from more limited blockchains, enabling its robust ecosystem of dApps and programmable finance.

Validator of PoS

Network participants staking tokens to propose and attest blocks in proof-of-stake consensus.

In PoS, validators stake 32 ETH ($130,000 at $4,000/ETH) to run nodes, proposing blocks every 12 seconds and attesting via committees—Ethereum's 1 million validators secure $400 billion. Selection is pseudorandom, weighted by stake, slashing 1-100% for downtime/malice.

Solana validators (2,000+) stake SOL for 1,500 TPS, earning 6% APY minus 8% commission, requiring 128 GB RAM setups. Cardano's Ouroboros selects via stake pools, processing 250 TPS.

Energy-efficient (99% less than PoW), PoS validators earn $10 billion yearly rewards, but centralization risks (top 1% control 33% stake) prompt delegation tools.

Vitalik Buterin

Vitalik Buterin, co-founder of Ethereum, is a programmer, thinker and a leading figure in blockchain and decentralization technology, driving innovations in smart contracts and scalable decentralized systems.

Vitalik Buterin, born January 31, 1994, is widely recognized as a pioneering leader in blockchain and decentralization technology. As the co-founder of Ethereum, launched in 2015, Buterin introduced a Turing-complete blockchain platform that revolutionized digital asset ecosystems by enabling smart contracts and decentralized applications (dApps).

Buterin's technical leadership extends beyond Ethereum's creation. He has been instrumental in its major upgrades, including the 2022 Merge, which transitioned Ethereum to proof-of-stake and the ongoing roadmap for danksharding and rollups.

His concept of the “blockchain trilemma” (balancing decentralization, security, and scalability) has shaped industry discourse, influencing solutions like Optimistic and ZK-Rollups. Buterin actively contributes to Ethereum's research, publishing on topics like account abstraction for user-friendly wallets and enshrined proposer-builder separation to enhance decentralization.

ETH

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