

L07: Decentralized Finance (DeFi)

Extended Slides – BSc Blockchain Course

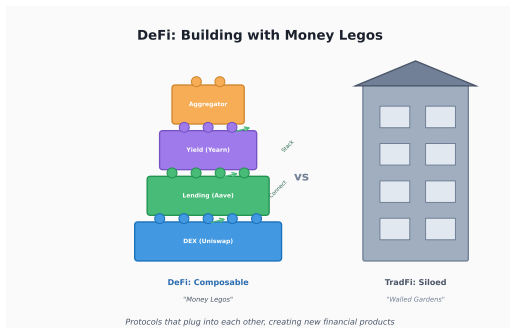
Digital Finance

2026

By the end of this lesson, you will be able to:

- 1 Explain automated market maker (AMM) mechanics
- 2 Understand liquidity provision and impermanent loss
- 3 Describe lending protocols and liquidation mechanics
- 4 Analyze yield farming strategies and risks
- 5 Evaluate the DeFi ecosystem and composability

Prerequisites: L05 Ethereum, L06 Solidity.



Purpose: DeFi recreates financial services (lending, trading, derivatives) using smart contracts. It offers permissionless access but introduces new risks.

Over \$100B locked in protocols that run without human intervention.

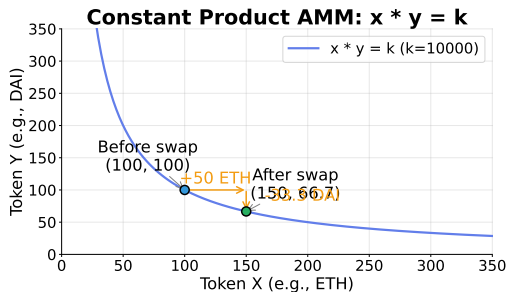
Definition:

- Financial services on public blockchains
- Permissionless, non-custodial
- Smart contracts replace intermediaries
- 24/7 operation, global access

Key Principles:

- Self-custody of assets
- Transparent, auditable code
- Composability (“money legos”)

DeFi peaked at ~\$175B TVL in late 2021.



Price = dy/dx along the curve. Larger trades = more slippage.

Uniswap V2 Formula:

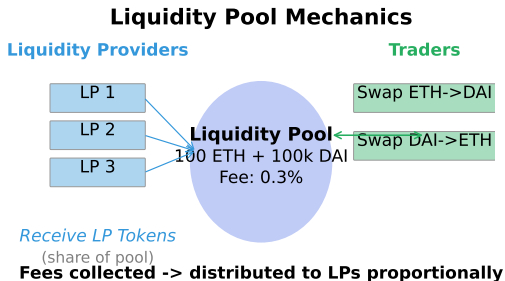
$$x \cdot y = k$$

- x = reserve of token A
- y = reserve of token B
- k = constant (changes only on add/remove liquidity)

Price Determination:

$$\text{Price of A in B} = \frac{y}{x}$$

Curve uses different formula optimized for stablecoins.



LP tokens represent share of pool; burnable to withdraw.

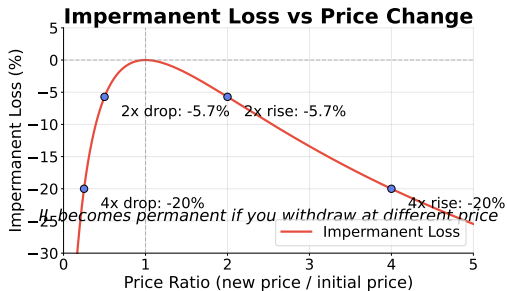
Process:

- 1 Deposit equal value of both tokens
- 2 Receive LP tokens proportional to pool share
- 3 LP tokens accrue fees over time
- 4 Burn LP tokens to withdraw + fees

Fee Distribution:

- Uniswap V2: 0.3% per swap
- Fees added to pool reserves
- LPs earn proportionally

Uniswap V3 adds concentrated liquidity for capital efficiency.



IL formula: $2\sqrt{r}/(1+r) - 1$ (negative value = loss vs holding).

Why It Happens:

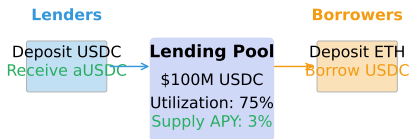
- AMM rebalances as prices change
- You end up with more of depreciating asset
- Less of appreciating asset

Key Points:

- “Impermanent” if prices return to original
- Becomes permanent on withdrawal
- Fees may compensate for IL

Stablecoin pairs have minimal IL due to correlated prices.

DeFi Lending Protocol Mechanics



Key Parameters:

- Collateral Factor: 80% (can borrow 80% of collateral value)
- Health Factor < 1 triggers liquidation
- Borrow APY: 5% (paid by borrower)

Aave, Compound dominate DeFi lending.

Over-collateralization:

- Must deposit more than you borrow
- Collateral factor: 50-85% typically
- Protects lenders from default

Health Factor:

$$HF = \frac{\text{Collateral} \times \text{Liquidation Threshold}}{\text{Debt}}$$

- $HF < 1$ triggers liquidation
- Liquidators repay debt, get collateral + bonus

Monitor positions to avoid liquidation losses.

DeFi Yield Strategies Comparison

Strategy	APY	Risk
Staking ETH	3.05%	Low
Lending Agave	2.4%	Low
LP Fees Uniswap	5.2%	Medium
Yield Tokens	10.1-10.5%	High
Leveraged Recursion	20.5%	High

Higher APY = Higher Risk (smart contract, IL, liquidation, token devaluation)

Yield aggregators like Yearn automate strategies.

Token Incentives:

- Protocols distribute governance tokens
- Rewards for providing liquidity
- Early users get highest yields

Risks:

- Token price volatility
- Smart contract exploits
- Impermanent loss
- Rug pulls

"DeFi Summer" 2020 saw explosive yield farming growth.

Flash Loan: Uncollateralized Atomic Borrowing

All within ONE transaction (atomic)



Borrow Arbitrage Profit Repay Keep Profit



\$10M USD Borrow from Aave
Buy cheap on DEX A
Sell high on DEX B
\$10M + fee back to Aave
Net gain (atomic!)

No collateral needed - if repayment fails, entire tx reverts
Used for: arbitrage, collateral swaps, self-liquidation, attacks

Aave pioneered flash loans; now standard DeFi primitive.

Legitimate Uses:

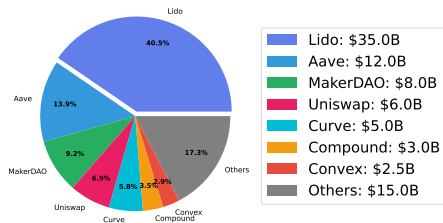
- Arbitrage between exchanges
- Collateral swaps (refinancing)
- Self-liquidation
- One-transaction leverage

Attack Vector:

- Oracle manipulation
- Governance attacks
- Price manipulation

Flash loan attacks: millions lost to exploits.

DeFi TVL Distribution (~\$86B Total)



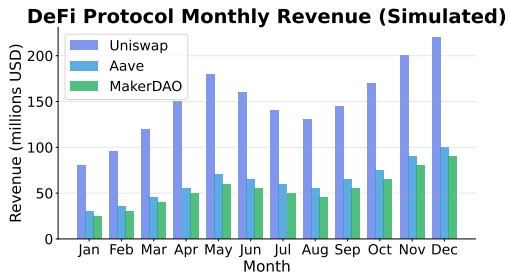
Lido dominates due to ETH liquid staking.

DEX vs CEX Comparison

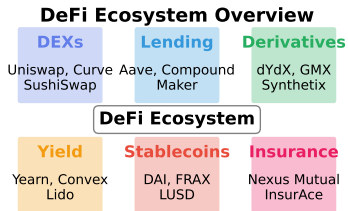
Feature	DEX (Uniswap)	CEX (Binance)
Custody	Self-custody	Exchange holds
KYC	None	Required
Speed	Slower (on-chain)	Faster (off-chain)
Liquidity	Growing	High
Fees	0.3% swap	Maker/taker
Security	Smart contracts	Counterparty risk

DEX: "Not your keys, not your coins" | CEX: Better UX, more features

After FTX collapse, DEX volumes increased significantly.



Fee revenue indicates real usage and sustainability.



Composability: "Money Legos" - protocols can be combined

Composability enables complex financial products.

Technical Risks:

- Smart contract bugs and exploits
- Oracle manipulation
- Flash loan attacks

Economic Risks:

- Impermanent loss
- Liquidation cascades
- Token devaluation

Regulatory Risks:

- Unclear legal status
- Potential enforcement

Never invest more than you can afford to lose.

Remember These Points

- 1 AMMs enable permissionless trading via $x*y=k$
- 2 LPs earn fees but face impermanent loss
- 3 Lending requires over-collateralization
- 4 Flash loans: uncollateralized but atomic
- 5 Higher yield = higher risk (always)
- 6 Composability is DeFi's superpower and risk

Next Lesson: NFTs and Token Standards.