Mining in the context of Bitcoin involves solving complex mathematical problems to validate and add new transactions to the blockchain. This process is known as Proof of Work (PoW). Here’s a detailed explanation of how a miner mines a block:

**Steps in the Mining Process**

1. **Transaction Collection**:
   * Miners collect valid transactions from the mempool (a pool of unconfirmed transactions) and assemble them into a candidate block.
2. **Block Header Preparation**:
   * The miner prepares a block header, which includes the following components:
     + **Previous Block Hash**: A 256-bit (32-byte) string of numbers and letters. The hash of the previous block in the blockchain.
     + **Merkle Root**: A hash that represents all the transactions in the block. It is derived from the transaction hashes using the Merkle tree structure.
     + **Timestamp**: The current time when the block is created. Information of date and time up to milliseconds.
     + **Difficulty Target**: A 256-bit number. The current difficulty level of the network, which determines how hard it is to find a valid hash.
     + **Nonce**: A 32-bit number that miners vary to find a valid hash.
3. **Hashing the Block Header**:
   * Miners repeatedly hash the block header by varying the nonce value. The goal is to find a hash that is lower than or equal to the current difficulty target. This process involves a lot of trial and error and requires significant computational power.
4. **Proof of Work**:
   * The Proof of Work is the process of finding a valid hash. It ensures that miners have invested computational effort into solving the puzzle. The difficulty target is adjusted approximately every two weeks (every 2016 blocks) to ensure that blocks are mined approximately every 10 minutes.
5. **Broadcasting the New Block**:
   * Once a miner finds a valid hash, they broadcast the new block to the network. This includes the block header (with the nonce and the hash) and the transactions in the block
6. **Validation by Nodes:**
   * Other nodes in the network validate the new block to ensure it meets all the protocol requirements. This includes verifying the hash, the transactions, and the block structure. If the block is valid, it is added to the blockchain.
7. **Reward**:
   * The miner who successfully mines the block is rewarded with newly generated bitcoins (the block reward) and the transaction fees from the transactions included in the block. The block reward is currently 6.25 BTC (as of the last halving in May 2020) and is halved approximately every four years.

**Technical Details**

1. **Hash Function:**
   * Bitcoin uses the SHA-256 (Secure Hash Algorithm 256-bit) hash function. This function takes an input and produces a fixed-size 256-bit hash. The hash is a one-way function, meaning it is computationally infeasible to reverse-engineer the input from the hash.
2. **Difficulty Adjustment:**

* The difficulty of the mining puzzle is adjusted every 2016 blocks (approximately every two weeks) to ensure that blocks are mined at a consistent rate of roughly one block every 10 minutes. If blocks are being mined too quickly, the difficulty increases; if they are being mined too slowly, the difficulty decreases.

1. **Nonce:**

* The nonce is a 32-bit number [0 - 4,294,967,295] that miners vary to find a valid hash. If the nonce range is exhausted without finding a valid hash, miners can modify other parts of the block header, such as the timestamp or the Merkle root, to continue their search

**Example of the Mining Process**

1. **Collect Transactions**:
   * A miner collects transactions from the mempool and creates a candidate block.
2. **Prepare Block Header**:
   * The miner prepares the block header with the previous block hash, the Merkle root, the timestamp, the difficulty target, and an initial nonce.
3. **Hashing**:
   * The miner hashes the block header using SHA-256. If the resulting hash is not less than or equal to the difficulty target, the miner increments the nonce and hashes again. This process is repeated until a valid hash is found.
4. **Broadcast and Validation**:
   * Once a valid hash is found, the miner broadcasts the new block to the network. Other nodes validate the block and its transactions. If valid, the block is added to the blockchain.
5. **Receive Reward**:
   * The miner receives the block reward and the transaction fees from the transactions included in the block.

**Summary**

* **Mining**: The process of validating and adding new transactions to the blockchain by solving a complex mathematical puzzle.
* **Proof of Work**: The consensus mechanism that requires miners to find a hash that meets the network's difficulty target.
* **Block Header**: Contains the previous block hash, Merkle root, timestamp, difficulty target, and nonce.
* **Hash Function**: Bitcoin uses SHA-256 to hash the block header.
* **Difficulty Adjustment**: Ensures blocks are mined approximately every 10 minutes by adjusting the difficulty level every 2016 blocks.
* **Reward**: Miners receive newly generated bitcoins and transaction fees as a reward for mining a block.

Mining is a crucial component of the Bitcoin network, ensuring the security and integrity of the blockchain by requiring miners to invest computational effort into validating transactions and adding new blocks.