

## Photo Description



This photo shows a tall building with a large clock on its stone wall and an American flag flying above it. The clock has black hands pointing to different numbers, and there are decorative stone carvings around it. Behind the clock tower are modern glass and brick buildings reaching high into the sky.

## Scientific Phenomena

The anchoring phenomenon here is energy transfer through mechanical systems. The clock represents a complex machine that converts stored energy (either from springs, weights, or electrical power) into the controlled, regular movement of gears and hands. This mechanical energy transfer allows the clock to measure and display time consistently, demonstrating how humans engineer systems to harness and control energy for specific purposes.

## Core Science Concepts

1. Energy Transfer and Conversion - Clocks convert one form of energy (potential energy from springs/weights or electrical energy) into mechanical energy that moves the hands in precise, timed intervals.
2. Simple and Complex Machines - Clock mechanisms use gears (a type of wheel and axle) working together to create a complex machine that reduces the speed of energy transfer to match Earth's rotation.
3. Patterns in Motion - The clock hands move in predictable, repeating patterns that help humans track the passage of time based on Earth's rotation and orbit.
4. Human Engineering Solutions - Clocks represent how humans identify problems (needing to measure time) and design solutions using scientific principles about energy and motion.

### Pedagogical Tip:

Use analog clocks as concrete manipulatives during lessons. Have students physically move clock hands while discussing how energy makes the parts move, making the abstract concept of energy transfer more tangible.

### UDL Suggestions:

Provide multiple ways for students to explore clock mechanisms: visual diagrams, hands-on clock models, videos of gear movements, and kinesthetic activities where students act out gear rotations with their bodies.

## Zoom In / Zoom Out

1. Zoom In: Inside the clock mechanism, tiny metal gears with precisely cut teeth mesh together, transferring rotational energy from one gear to another. The gear ratios are carefully calculated so that energy moves at exactly the right speed to make the minute hand complete one rotation every hour.

2. Zoom Out: This clock is part of a larger human timekeeping system that connects to Earth's rotation, the atomic clocks that define official time, and global communication networks that help coordinate activities across different time zones around the world.

### Discussion Questions

1. What type of energy do you think makes the clock hands move, and how does that energy get transferred to the hands? (Bloom's: Analyze | DOK: 3)
2. If you could look inside this clock, what simple machines might you find working together? (Bloom's: Apply | DOK: 2)
3. How might this clock's energy source be different from the clock in your classroom? (Bloom's: Compare | DOK: 2)
4. What would happen to the clock's function if one of its gears broke, and why? (Bloom's: Evaluate | DOK: 3)

### Potential Student Misconceptions

1. Misconception: "Clocks make time happen" or "time comes from clocks"  
Clarification: Clocks measure time that already exists. Time continues even without clocks, just like distance exists even without rulers.
2. Misconception: "Clock hands move by themselves"  
Clarification: Clock hands need energy to move. This energy comes from batteries, springs, weights, or electrical power that gets transferred through gears and mechanisms.
3. Misconception: "All clocks work the same way"  
Clarification: Different clocks use different energy sources and mechanisms - some use springs, others use electricity, and some even use swinging pendulums.

### Cross-Curricular Ideas

1. Math - Time and Measurement: Have students practice telling time using analog clocks and explore how clock hands create angles. Students can measure angles between clock hands at different times and calculate elapsed time between events, connecting geometry and fractions to the clock's design.
2. ELA - Procedural Writing: Ask students to write step-by-step instructions explaining "How a Clock Works" or "How to Tell Time" using the vocabulary they've learned. This helps them practice organizing information sequentially and using technical language accurately.
3. Social Studies - Human Innovation and Culture: Explore how different cultures and time periods measured time before modern clocks (sundials, water clocks, hourglasses). Discuss why humans needed to measure time and how clocks changed society, connecting to human ingenuity and problem-solving across history.
4. Art - Design and Symmetry: Have students design their own decorative clock faces, incorporating symmetrical patterns and artistic elements like the stone carvings visible in this photo. They can explore how form (artistic design) and function (telling time) work together in engineering design.

### STEM Career Connection

1. Clockmaker or Horologist: A horologist is a person who makes and repairs clocks and watches. They understand how all the tiny gears, springs, and mechanisms work together to keep accurate time. Some horologists create fancy decorative clocks like the one in this photo, while others fix broken clocks. This job requires careful attention to detail and understanding of how machines work.

- Average Annual Salary: \$35,000 - \$50,000 USD

2. Mechanical Engineer: Mechanical engineers design and build machines and mechanical systems—including clocks! They use science and math to figure out how to make machines work better, faster, or more accurately. They might design the gears, springs, and other parts that make a clock tick.

- Average Annual Salary: \$88,000 - \$105,000 USD

3. Architect or Structural Engineer: The architects and engineers who designed this building had to plan where the clock would go and make sure the building could support it safely. These professionals combine science, math, and creativity to design buildings and structures that are both beautiful and functional, just like this clock tower.

- Average Annual Salary: \$80,000 - \$120,000 USD

### NGSS Connections

- Performance Expectation: 4-PS3-2: Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents
- Disciplinary Core Ideas: 4-PS3.A, 4-PS3.B, 3-5-ETS1.A
- Crosscutting Concepts: Energy and Matter, Systems and System Models

### Science Vocabulary

- \* Energy Transfer: The movement of energy from one object or place to another
- \* Mechanism: The working parts inside a machine that make it function
- \* Gear: A wheel with teeth that meshes with other gears to transfer motion
- \* Potential Energy: Stored energy that can be released to do work
- \* Kinetic Energy: The energy of motion or movement
- \* Complex Machine: A device made of two or more simple machines working together

### External Resources

Children's Books:

- The Clock Struck One: A Time-Telling Tale by Trudy Harris
- Clocks and More Clocks by Pat Hutchins
- What Makes a Clock Tick? by Franklin Branley