Kinetic Energy

Physical Science | Lesson Guide

5th Grade

Photo Description

This image shows a skateboarder launching into the air at a concrete skate park, with their skateboard flying beneath them. The skateboarder is wearing safety gear—a white helmet—and is captured mid-jump above the ground. The concrete park features various ramps and curved surfaces that help riders build and use speed.

Scientific Phenomena

Anchoring Phenomenon: Motion and Energy Transfer in Skateboarding

This image captures a skateboarder demonstrating kinetic energy—the energy of motion. Here's what's happening scientifically: As the skateboarder rides down the curved ramp, gravity pulls them downward, converting potential energy (stored energy from height) into kinetic energy (energy of movement). The faster they move, the more kinetic energy they have. When they reach the bottom and push upward, they launch into the air. At the peak of their jump, some of their kinetic energy has been converted back to potential energy (height), and their skateboard continues moving forward due to inertia—the tendency of objects to keep moving unless a force stops them. This visible, dramatic moment makes abstract physics concepts concrete and observable for young learners.

Core Science Concepts

- Kinetic Energy: Energy that objects have when they are moving. The faster an object moves or the heavier it is, the more kinetic energy it has.

- Potential Energy: Stored energy based on an object's position or height. Objects at the top of a ramp have more potential energy than objects at the bottom.

- Energy Transformation: Energy can change from one form to another (potential to kinetic, kinetic to potential) but is never lost—only transferred.

- Inertia and Newton's First Law of Motion: Objects in motion tend to stay in motion, and objects at rest tend to stay at rest, unless acted upon by an outside force (like gravity, friction, or air resistance).

Pedagogical Tip:

Students often struggle to "see" energy because it's invisible. This skateboarding image is powerful because students can observe the effects of kinetic and potential energy—the motion, the height, the speed. Encourage students to slow down the action mentally: "What happens at the bottom of the ramp? What happens at the top?" This helps them track energy transformations across time.

UDL Suggestions:

For Multiple Means of Representation: Provide both visual (the skateboarding image) and kinesthetic learning by having students physically model the ramp using their bodies (crouching low = potential energy; jumping high = kinetic energy conversion). For students who need additional scaffolding, create a labeled diagram showing energy at three points: top of ramp, bottom of ramp, and mid-air.

For Multiple Means of Engagement: Connect skateboarding to students' interests (sports, extreme activities, YouTube culture). Allow choice in how students demonstrate understanding—some might create animations, others might build a small ramp and measure distances, and others might write explanations.

Zoom In / Zoom Out

Zoom In: The Atomic Level

When the skateboarder's wheels roll across the concrete, what looks smooth to our eyes is actually bumpy and rough at the atomic level. The wheels and concrete are made of tiny atoms and molecules. As they rub together, friction happens because these microscopic surfaces catch and drag against each other, creating heat energy. Some of the skateboarder's kinetic energy is actually being converted into heat at the atomic scale—which is why wheels can get warm after a long ride! This invisible atomic interaction is what slows the skateboarder down and is why they can't roll forever without pushing again.

Zoom Out: The Earth System

The skate park exists within larger natural and human systems. The concrete was made from materials mined from Earth's crust (limestone, sand, gravel). The water used to cure the concrete came from Earth's water cycle. The trees visible in the background are part of local ecosystems that provide oxygen and absorb carbon dioxide. When the skateboarder jumps, they're using energy from food they ate—energy that originally came from the Sun and was captured by plants through photosynthesis. Even this single moment of skateboarding connects to planetary cycles of energy and matter, showing that nothing happens in isolation on Earth.

Discussion Questions

1. What forces are acting on the skateboarder when they are in the air? (Bloom's: Understand | DOK: 1)

2. Why does the skateboarder move faster at the bottom of the ramp than at the top? Use the words "potential energy" and "kinetic energy" in your answer. (Bloom's: Explain | DOK: 2)

3. If the skateboarder were heavier, how might that change how high they could jump or how far they could travel? Why? (Bloom's: Analyze | DOK: 2)

4. How could friction (like from the wheels on the concrete) and air resistance affect the skateboarder's motion? What would happen if there were no friction at all? (Bloom's: Evaluate | DOK: 3)

Potential Student Misconceptions

Misconception 1: "Energy disappears when things slow down."

Students often think that when the skateboarder lands and stops, the energy just vanishes. Scientific clarification: Energy never disappears—it transforms. When the skateboarder lands, their kinetic energy is converted into other forms: heat (warming the ground and their shoes), sound (the impact noise), and work done by muscles pushing back against gravity. The energy is still there; it just changed form.

Misconception 2: "Heavier objects fall faster, so a heavier skateboarder will always jump higher."

Students may think that weight directly determines jumping height or speed. Scientific clarification: While a heavier object does have more gravitational force pulling it down, weight alone doesn't determine jumping ability. A heavier skateboarder also has more mass to accelerate down the ramp, but the relationship between mass, force, and acceleration is more complex (Newton's Second Law: $F = ma$). The skateboarder's muscle power and the ramp's curve matter just as much as their weight. A lighter skateboarder with strong muscles might jump just as high as a heavier one.

Misconception 3: "The skateboard falls because it's not attached to the skateboarder."

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Students may believe the skateboard falls separate from the skateboarder by accident. Scientific clarification: Both the skateboarder and skateboard are falling due to gravity—they're both affected by the same gravitational force pulling them downward at the same rate. The skateboard stays roughly under the skateboarder during the jump because both started with the same upward velocity and both are falling at the same speed. This is why the skateboarder can land back on it!

Extension Activities

1. Build a Marble Ramp Experiment: Students construct ramps from foam tubes, cardboard, or PVC pipe at different angles. They release marbles from the same height on each ramp and measure how far the marble travels after leaving the ramp. This directly models the energy transformations in the skateboarding image and allows quantitative data collection.

2. Energy Transformation Carousel Walk: Create four stations around the classroom, each showing a different scenario (a ball rolling down a hill, a pendulum swinging, water flowing downhill, a person jumping). At each station, students identify where potential energy is highest, where kinetic energy is highest, and draw arrows showing energy transformation. This builds conceptual understanding across multiple contexts.

3. Design a Safer Skate Park: Challenge students to analyze the skateboard park image and propose design changes to make it safer while still allowing skateboarders to convert potential energy into kinetic energy effectively. Students might discuss curve angles, padding placement, and size of ramps—integrating physics with engineering design thinking.

Cross-Curricular Ideas

Math Connection: Measuring and Graphing Jump Heights
Have students measure how high different skateboarders jump (or simulate with a ball rolling down ramps of different heights). Create a bar graph or line graph showing the relationship between ramp height and jump height. Students can calculate averages, ranges, and make predictions: "If a ramp is 2 meters tall, how high do we predict the jump will be?" This integrates measurement, data collection, and algebraic thinking.

ELA Connection: Write a "Day in the Life" Narrative
Students write a first-person narrative from the perspective of the skateboard or the skateboarder, describing the energy transformations they experience throughout a day at the skate park. Example: "I started the day at rest against the fence (potential energy = 0). Then my rider picked me up and climbed the ramp..." This creative writing activity helps students internalize scientific concepts through storytelling and perspective-taking.

Social Studies Connection: The History of Skateboarding and Innovation
Research how skateboarding evolved and how skate parks became part of communities. Students can explore why cities build skate parks, how they're designed for safety, and what role skateboarding plays in youth culture. This connects to civic engagement, community planning, and the idea that understanding physics helps us design better spaces for people.

Art Connection: Energy Visualization Posters
Students create colorful posters or digital artwork that visually represents energy transformations during skateboarding. They might use arrows, color gradients (blue for potential, red for kinetic), or abstract designs to show how energy changes form. Display these around the classroom as visual references for the abstract concept of energy transformation—making the invisible visible through artistic interpretation.

STEM Career Connection

Mechanical Engineer

Mechanical engineers design and improve skateboards, ramps, wheels, and safety equipment. They use physics—just like in this lesson—to figure out the best materials, shapes, and angles to make skateboards faster, more durable, and safer. A mechanical engineer might test different wheel materials to understand friction, or design ramps that help skateboarders jump higher. Average annual salary: $88,000 USD

Sports Scientist / Biomechanist
Sports scientists study how human bodies move during athletic activities like skateboarding. They analyze video of jumps, measure forces on bones and muscles, and help athletes improve their performance while staying healthy. They use the same energy and motion concepts from this lesson to understand why some people jump higher or land more safely than others. Average annual salary: $52,000 USD

Civil/Structural Engineer
These engineers design and build public skate parks, making sure the concrete structures are safe, properly angled, and built to last. They must understand forces, gravity, and how materials respond to repeated impacts from skateboarders. They also plan drainage so water doesn't damage the park, and consider how to make parks accessible to all community members. Average annual salary: $89,000 USD

NGSS Connections

Performance Expectation:
5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.

Disciplinary Core Ideas:
- 5-PS2.A: Forces and Motion
- 5-PS2.B: Types of Interactions

Crosscutting Concepts:
- Energy and Matter
- Systems and System Models
- Cause and Effect

Science and Engineering Practices:
- Developing and Using Models
- Analyzing and Interpreting Data
- Constructing Explanations

Science Vocabulary

- Kinetic Energy: The energy of motion—energy that something has because it is moving.
- Potential Energy: Stored energy that an object has because of its position or height above the ground.
- Inertia: The tendency of an object to keep doing what it is already doing (keep moving or stay still) unless a force changes it.
- Force: A push or pull that can change how an object moves, stops, or changes direction.
- Gravity: The force that pulls objects toward Earth, always pulling downward.

External Resources

Children's Books:

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- Energy by Susan Minden (National Geographic Little Kids First Big Book of Science) — A foundational, highly illustrated introduction to energy in everyday contexts.
- Forces and Motion by DK Findout — Clear photographs and diagrams showing energy and motion in sports and play.
- The Skateboard Mom and Other Parenting Disasters by Catherine Clark (for older fifth graders) — A fun narrative connecting sports and physics.

Implementation Note: This lesson works best as a 2-3 day unit, with Day 1 focused on observation and phenomena, Day 2 on hands-on exploration (ramp experiments), and Day 3 on deep analysis and transfer of learning. Safety is paramount—ensure students understand that skateboarding requires protection and skill, and that this is a lesson about the physics, not an invitation to attempt tricks.

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