

Episode 4: Exploring Motion and Acceleration

High School Environmental Science

Summary

This lesson explores the intersection of science, engineering, and sustainability through e-bike technology. Students will investigate energy transformations, environmental benefits, and innovative engineering solutions highlighted by Paul Perkins, CEO of Orion Electronics Company. The session aligns with advanced environmental science standards by focusing on energy efficiency, conservation, and the environmental impact of renewable energy technologies.

Objective:

Students will analyze how e-bike technology applies principles of energy transformation, conservation, and sustainability to address environmental challenges and improve transportation accessibility.

Key Concepts:

1. Energy Transformations: Chemical to kinetic energy in e-bikes.
2. Gravitational Potential Energy: The impact of height on energy use and efficiency.
3. Environmental Impact: Evaluating e-bikes as a sustainable transportation solution.
4. Engineering Innovation: Lightweight design and battery advancements in e-bikes.
5. Friction and Resistance: The role of tires and aerodynamics in performance.

Key Vocabulary:

- **Energy Transformation:** The conversion of energy from one form to another (e.g., chemical to kinetic).
 - **Gravitational Potential Energy:** Energy stored due to an object's height and gravity's force.
 - **Sustainability:** Meeting current needs without compromising future resources.
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- **Lithium-Ion Battery:** A rechargeable battery type commonly used in e-bikes.
- **Friction:** The resistance force between surfaces in contact, affecting movement efficiency.

Pre-Video Discussion Questions:

1. **What challenges do people face with traditional transportation, and how might e-bikes address them?**

Discussion Point: Accessibility and affordability barriers can be mitigated by e-bikes.

2. **Why is sustainability important in transportation innovations?**

Discussion Point: Reducing carbon footprints helps combat climate change.

Activity: Design an Energy-Efficient E-Bike

Objective:

Students will apply knowledge of energy transformations, friction, and sustainability to design a concept for an energy-efficient e-bike while considering environmental and practical factors.

Materials Needed:

- Sketch paper or design templates
- Markers or pencils
- Calculators
- Access to online research resources (optional)

Procedure:

1. **Group Formation:**
 - Divide students into small groups (3-4 students per group).
2. **Introduction to the Task:**
 - Provide a brief overview of the principles of energy transformations (e.g., electrical energy to kinetic energy), the impact of friction, and the importance of sustainable materials in reducing environmental impact.
 - Share examples of current e-bike designs to inspire creative thinking.
3. **Design Challenge:**
 - Each group will sketch their e-bike design on paper.
 - Include specific design specifications, such as:
 - **Weight:** Estimate total weight based on frame materials.

- **Battery Type:** Decide on a battery type (e.g., lithium-ion) and explain its energy efficiency.
 - **Frame Materials:** Choose lightweight and sustainable materials (e.g., recycled aluminum, bamboo).
 - Groups should explain features that:
 - Optimize energy efficiency (e.g., aerodynamic design, regenerative braking).
 - Reduce friction (e.g., high-quality tires, efficient drivetrain).
 - Minimize environmental impact (e.g., renewable energy for charging, eco-friendly materials).
4. **Present Designs:**
- Groups will present their designs to the class.
 - Encourage peer feedback with specific prompts such as:
 - "What innovative features does this design include?"
 - "How could this design be further improved for sustainability?"

Analysis:

- Each student will write a one-paragraph reflection addressing the following:
 - How their design balances energy efficiency and environmental sustainability.
 - Examples of how technology and innovation (like e-bikes) can address environmental challenges.
 - Connections between their design and principles discussed in class.

Extension Activities:

1. **Research Alternative Energy Solutions:** Compare the environmental impacts of different renewable energy technologies used in transportation.
2. **Community Survey:** Investigate local attitudes toward e-bike adoption and propose ways to encourage usage.

Post-Video Discussion Questions:

1. **How do e-bikes demonstrate energy transformation in action?**

Answer: Chemical energy in the battery is converted into kinetic energy, powering the bike.

2. **What environmental benefits do e-bikes provide over traditional vehicles?**

Answer: E-bikes reduce carbon emissions and reliance on fossil fuels.



3. **Why is understanding forces like friction important for e-bike design?**

Answer: Minimizing friction increases efficiency and improves rider experience.

4. **What role does engineering innovation play in making e-bikes accessible?**

Answer: Innovations like lightweight frames and swappable batteries make e-bikes more user-friendly.

5. **How do e-bikes contribute to sustainable urban transportation?**

Answer: They promote eco-friendly commuting, reduce traffic congestion, and support active lifestyles.

