

## Lesson Plan

Assessment	AFL, AOL
Cross-curricular	

### Big Ideas

- Energy can be transformed from one type to another.
- Systems that involve energy transformations are never 100% efficient.

### Learning Goals

- I know and can use the terms work, energy, gravitational potential energy, kinetic energy, chemical energy, and energy transformations.
- I can describe energy transformations and explain the energy transformations in a system.
- I can use the law of conservation of energy to solve problems.
- I can design and construct a device that integrates energy transformations and analyse its operation.

### Specific Expectations:

E2. investigate energy transformations and the law of conservation of energy, and solve related problems;

E2.1 use appropriate terminology related to energy and energy transformations, including, but not limited to: work, gravitational potential energy, kinetic energy, chemical energy, energy transformations, and efficiency [C]

E2.2 use the law of conservation of energy to solve problems involving gravitational potential energy, kinetic energy, and thermal energy [AI]

E2.4 design and construct a complex device that integrates energy transformations (e.g., a mousetrap vehicle, an “egg-drop” container, a wind turbine), and analyse its operation in qualitative and quantitative terms [IP, PR, AI]

E3. demonstrate an understanding of diverse forms of energy, energy transformations, and efficiency.

E3.1 describe and compare various types of energy and energy transformations (e.g., transformations related to kinetic, sound, electric, chemical, potential, mechanical, nuclear, and thermal energy)

E3.2 explain the energy transformations in a system (e.g., a toy, an amusement park ride, a skydiver suspended from a parachute), using principles related to kinetic energy, gravitational potential energy, conservation of energy, and efficiency

### Description:

In this lesson students will build a device that has at least 4 energy transformations. Prior to this lesson, students should have already learned about work, energy, power, and efficiency, and done calculations involving work, efficiency, potential energy, and kinetic energy. **This lesson is intended for the college level.**

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**Materials**

Work, Energy, and Power video  
Energy Transformation Visuals and Information  
Constructing a Complex Energy Transformation  
Device (Student)  
Complex Energy Transformation Device Rubric  
Materials for device:

- Various Household items

**Safety Notes**

Be careful when using electrical devices and power tools.

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**Introduction**

What is energy? With a partner, students think about how they can tell if an object possesses energy. Students then share an example with the class. Show the video “Work, Energy, and Power” to review concepts of work, energy, and power.

<http://science360.gov/obj/video/c5be5456-2e39-49a7-8118-218868df89eb/work-energy-power>

Science 360

National Science Foundation & NBC Learn

Retrieved February 12, 2016

Next, students learn about Energy Transformations using the Conservation of Energy visuals (See Link).

Note: The Transformation of Energy visuals should take place prior to introducing the Energy Transformations activity.

Students should be given class time (approximately 20 minutes) to design their devices together and plan to scavenge any building materials they may require. The Transformation of Energy visuals should take place on the planning day, and the activity, during another class day.

An Energy Transformation Device Rubric for the activity is attached (See Link).

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**Action**

In groups of 3-4, design and construct a multi-step device (such as a small vehicle, wind turbine, Rube Goldberg...) that integrates energy transformations.

**Group Materials**

Household items

**Instructions**

1. Design the device you will build. Ensure that there are at least 4 energy transformations involved in its operation.

2. Develop labeled drawings.
3. Collect necessary materials.
4. Take a video or photographs of your device in motion.

### **Analysis**

- A. Write a summary of what device you created and the task it performs.
- B. Give a list of the materials you used.
- C. On your labeled drawings, identify at least four stages at which energy is transferred from one form to another. Identify what transformation has occurred (i.e. gravitational to kinetic etc.). If possible, identify these stages on the video or in photographs.
- D. Construct an energy transformation equation that takes into account all of the energy transformations that occur.
- E. Give a quantitative analysis of the energy transformations. You may need to estimate some quantities.
- F. Analyze the efficiency of the device qualitatively. Which stages were the most/least efficient and why?

Activity adapted from

<https://rdsb.elearningontario.ca/d21/le/content/6766984/viewContent/66637229/View>.

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### **Consolidation/Extension**

The teacher may assign additional Conservation of Energy questions from a textbook.