

**2008
Winning Lesson Plan
from Louisville, Kentucky**

Energy Lesson Plan

by Troy Schuknecht
Shawnee High School

Subject: Integrated
Science

Grade Level: 9th Grade

Duration: Two 90-Minute
Class Periods

Overview and Purpose

Students will understand the law of conservation of energy and its relation to work.

Educational Standards Addressed

Kentucky Core Content

4.6.1 Students will give examples of conservation of energy.

4.6.2 Students will predict energy transfer.

4.6.7 Students will explain real world applications of energy using information/data.

Objectives

Students will apply the law of conservation of energy to a practical situation and determine energy lost to friction by performing a series of calculations including calculating work done, kinetic energy, and potential energy in a practical laboratory setting. Students will then conduct a laboratory investigation in a real world situation and write a formal report of their findings.

Materials

- One 1-meter long piece of molding with grooves
- Six books
- Three marbles (a metal marble, a plastic marble and a glass marble...ideally, these marbles will all have the same size and mass. However, I have not been able to locate these items. This provides for a quality discussion after the lab about keeping experiments controlled and the possible experimental error due to this extra manipulated variable.)
- Small milk carton with top cut off
- Ruler
- Triple-beam balance
- CPO science photogates and timer

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Procedures

Prior to Lesson

This lesson assumes that students have been exposed to the concepts for work, energy, the law of conservation of energy, and the calculation of physics problems dealing with work, kinetic energy and potential energy. Students should also know how to calculate the velocity of a marble at a single point along a ramp using CPO photogates and a timer.

Day 1

Independent Work

Sponge – Describe the transfer of energy throughout the following scenario. Show students the PowerPoint presentation (which illustrates the scenario to be analyzed) and allow them to answer the question. Also have students answer questions #1–3 in the pre-lab section on the Conservation of Energy Practice Sheet.

Expectations and Purpose

Today students will practice the laboratory and calculation skills they will need in order to solve the problem given them tomorrow by Frontline Ball Bearings (See page 9.).

Interactive Instruction

Provide procedural instructions for the Conservation of energy practice lab and demonstrate the laboratory technique. The PowerPoint slides also show the technique for students.

Authentic Engagement

Students conduct the lab, take data, and perform the data analysis section of the Conservation of Energy Practice Lab. (See lab sheet on page 4 for more details.)

Closure and Consolidation

Students answer the learning questions on the Conservation of Energy Practice Sheet. Any extra questions will be assigned as homework.

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Procedures (Cont'd)

Day 2

Independent Work

Sponge – Students answer the following question:

- “Look at your learning questions from yesterday’s lab. You should notice that the potential energy of the marble at the top of the ramp is greater than the kinetic energy of the marble at the bottom of the ramp. Is the law of conservation of energy wrong? Why or why not?”

Expectations and Purpose

Today students will use the same lab set up from yesterday to design and construct a new experiment that will enable them to answer the question posed by Frontline Ball Bearings. “Which material (metal, glass, or plastic) has the least amount of friction?” (See page 9.)

Interactive Instruction

Using the learning questions from yesterday, we will discuss why the potential energy at the top of the ramp and the kinetic energy at the bottom of the ramp are different. Through class discussion and oral questioning with Popsicle sticks (to randomly call on students), we will arrive at the conclusion that some energy was lost due to friction. Students will then see that the more energy that is lost, the greater the friction.

Authentic Engagement

Pass out the letter from Frontline Ball Bearings. Students read the letter, form a hypothesis, design an experiment, conduct the experiment, and then analyze their data.

Closure and Consolidation

Homework: Students will prepare and type a formal report to Frontline Ball Bearings describing their findings and recommending one type of material that has the least amount of friction for use in their bearings.

NAME:	DATE:	BLOCK:
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Conservation of Energy Practice

Pre-Lab

1) Know your formulas!

What is the formula for potential energy?

What is the formula for kinetic energy?

What is the formula for work?

2) Why is the unit for both energy and work the same?

3) What is the law of conservation of energy?

Problem Statement #1

What effect does changing the number of books have on the distance a milk carton moves?

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Conservation of Energy Practice (Cont'd)

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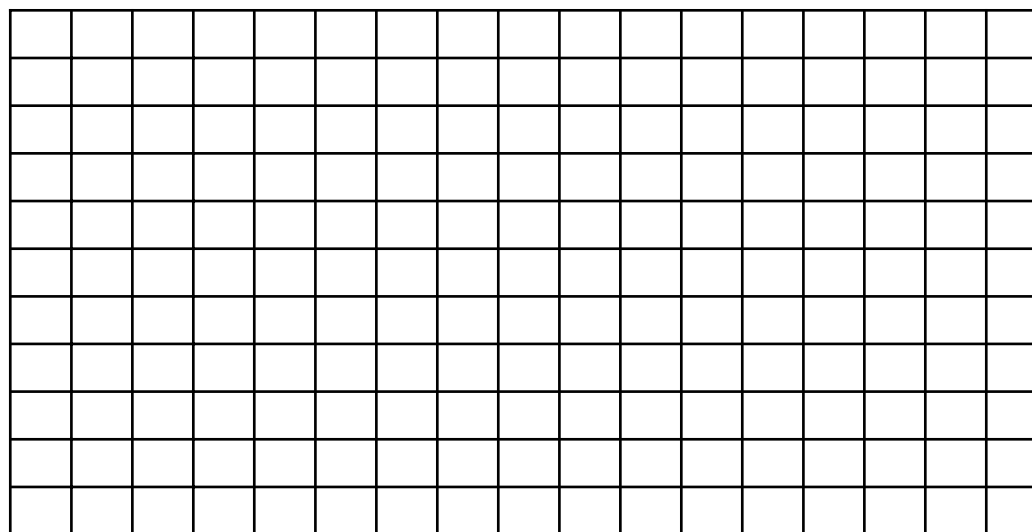
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Data Table #1

Mass of Marble (kg)	Weight of Marble (N)	Number of Books	Height of Ramp (meters)	Velocity of Marble at Bottom of Ramp (m/sec ²)	Distance Milk Carton Moved (meters)
Metal =		1			
Metal =		2			
Metal =		3			
Metal =		4			
Metal =		5			
Metal =		6			

Graph



NAME:	DATE:	BLOCK:
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Conservation of Energy Practice (Cont'd)

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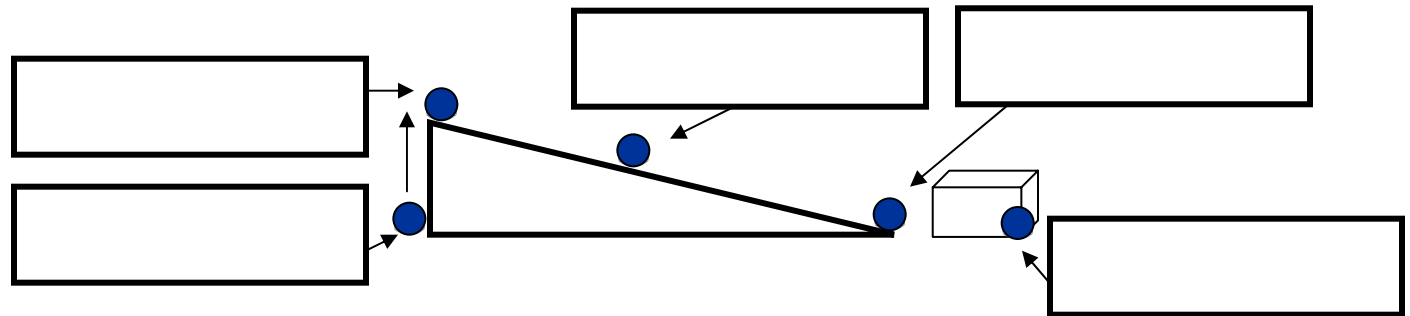
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Data Analysis

1) What is the answer to the problem statement? (Provide evidence please.)

Learning Questions (Use complete sentences.)

2) At each of the following locations describe what type of energy the marble has. (For our purposes, consider "doing work" a type of energy.)



3) The marble had no energy at the start, however, once at the top of the ramp it had energy...what did you do to give the marble this energy? (Be certain to use your science vocabulary in your response.)

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Conservation of Energy Practice (Cont'd)

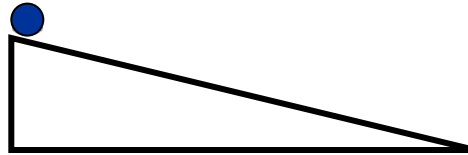
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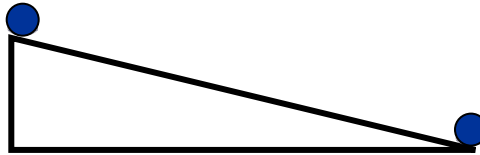
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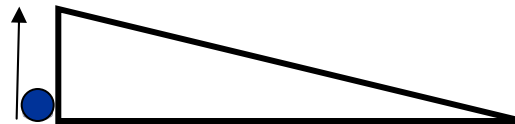
4) Calculate the **potential** energy of the metal marble at the top of the ramp when using 6 books. (show work)



5) Calculate the **kinetic** energy of the metal marble at the top of the ramp when using 6 books. (show work)



6) Calculate the work you did on the metal marble to place it on top of the ramp when using 6 books. (show work)



7) According to the law of conservation of energy, what type of energy does the marble have in the center of the ramp? Explain your answer.

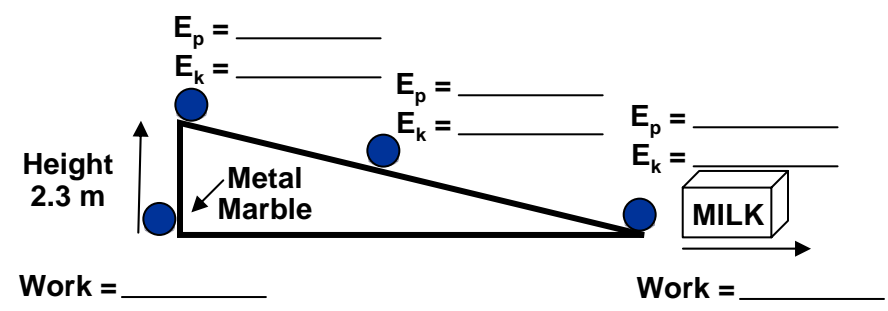
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Conservation of Energy Practice (Cont'd)

8) If there were no friction, the work done to lift the marble should be exactly equal to:

Diagram (Assume that there is no friction in this scenario.)

9) Fill in the blanks showing the potential energy, the kinetic energy, and the work.



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FRONTLINE[®]
Ball Bearings

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Frontline Ball Bearings
3486 Michigan Ave.
Louisville, KY 40237

January 13, 2008

Dear Researchers,

For years Frontline Ball Bearings has been the frontrunner for energy efficient bearings. Companies throughout the United States trust our bearings for use in roller skates, skateboards, rollerblades, scooters, and many other recreational type of wheels.

We are hoping to expand our operations and begin making bearings for larger clientele. No doubt you are aware of the energy crisis. The desperate need for alternate energy sources has created an opportunity for us to expand into the market of electric cars. We have recently built a multi-million dollar plant for the manufacture of ball bearings that can be used in electric engines. We have also produced a variety of materials that may be used as the bearings in these engines.

So far, electric engine manufacturers will not purchase our bearings. When our bearings are used in the engines, they overheat. As you know, a byproduct of friction is heat. It is clear that our bearings have too much friction for the high speeds in these engines. We have produced bearings out of three new materials and are hopeful that they will reduce the heat from the friction.

Along with this letter you will be receiving three ball bearings, one made from each of our manufactured materials. One is a metallic alloy (mixture of metals), another is a special polymer that can withstand high heat (looks much like plastic), and the final bearing is shaped from a naturally occurring glass (much like Obsidian). We need to know which of these bearings creates the least friction so that we can focus our efforts toward the manufacture of these bearings.

Please run tests on these bearings to determine which has the least friction and report your findings directly to us. Our company took a large risk in building this electric engine manufacturing plant and if we do not produce low friction electric engines soon, we may be forced to close our doors! The future of our company depends on you.

Sincerely,

James Francis

James Francis
CEO Frontline Ball Bearings