

## Lesson Plan

**Subject:** Grade 7 Science

**Lesson:** Knock Out!

**Standards Addressed:**

- Understand forms of energy, energy transfer and transformation and conservation in mechanical systems. (7.P.2)

**Objectives:**

- Explain how kinetic and potential energy contribute to the mechanical energy of an object.
- Explain how energy can be transformed from one form to another.
- Recognize that energy can be transferred from one system to another when two objects push or pull on each other over a distance.

**Materials Needed:**

- Device for showing “Knock Out!” video
- “Investigating Mechanical Energy” activity
- Marbles of varying sizes (standard size marbles and the larger “shooters”)
- Ruler
- Paper towel tubes
- Textbooks or other items that can be stacked to raise and lower track made from paper towel tubes

**Outline:**

- Prior to this lesson, students will understand the concepts of *mechanical energy*, *mass*, *force*, and *work*.
- Show the video.
- Discuss the directions for “Investigating Mechanical Energy” Activity.
- Model how to set up the materials.
- Students complete activity with a partner or in a small group.

**Take It Further:** Line the cardboard tubes with thin strips of bubble wrap to introduce *friction*. Repeat the activity and compare the results with the original activity.

**Cross-Curriculum Connection:** Have students investigate the history of the game of marbles and produce a digital presentation showcasing what they learned. Students should include pictures, graphics, animations, and other images to make their research more accessible and appealing to their audience.





## Investigating Mechanical Energy

Grade 7 Science

Name: \_\_\_\_\_

Date: \_\_\_\_\_

In the *Knock Out!* video, you learned about the game of marbles. In this activity, you will investigate the science behind the game.

**Reminders: Mechanical energy is the energy an object has due to its motion or its position. Force and mass affect the mechanical energy of an object. Work is what happens when force is applied over a distance.**

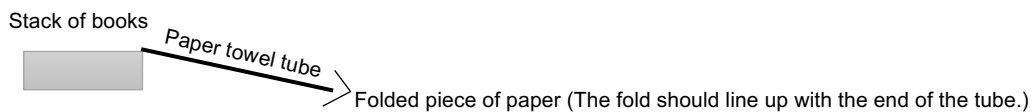
This activity is best done on the floor. You will work with a partner or in a group and will need the following:

- Marbles (a standard-sized one and a larger “shooter”)
- Paper towel tube
- 3 textbooks
- A piece of notebook paper, folded over twice (like you’re making a card)
- A ruler

### **PART 1: INVESTIGATING THE EFFECT OF FORCE**

You will be investigating the force of gravity by measuring the distance a marble moves the paper when it hits it after coming out of the tube. You will use different amounts of textbooks to raise your paper towel tube to different heights.

Here’s how you should set up your equipment:



Use this table to record your results, then answer the questions. For the most accurate data, do at least 2 trials for each roll and find the average.

NUMBER OF TEXTBOOKS USED	DISTANCE THE PAPER MOVED (in cm)
1	
2	
3	



# OLD SALEM EXPLORATORIUM

## Investigating Mechanical Energy



1. What happens to the force of gravity as you increase the number of textbooks?

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2. What happens to the distance the paper moved as you increase the number of textbooks?

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3. How is the force of gravity related to the distance an object moves?

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4. Which number of textbooks used results in the **greatest** potential energy of the marble?

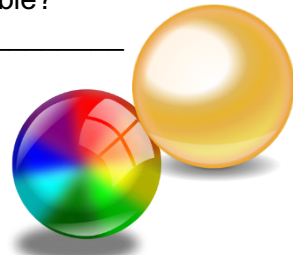
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### **PART 2: INVESTIGATING THE EFFECT OF MASS**

You will now investigate the effect of mass on the movement of an object. Set up your equipment as before except use a constant height of 2 textbooks.



*Use this table to record your results, then answer the questions. For the most accurate data, do at least 2 trials for each roll and find the average.*

TYPE OF MARBLE USED	DISTANCE THE PAPER MOVED (in cm)
Standard size	
Shooter	
Standard size AND shooter at the same time	

1. What happens to the distance the paper moves as you increase the mass of the marble?

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2. Why does this happen? (Use the term “energy” in your answer.) \_\_\_\_\_

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3. Which marble has the **least** kinetic energy? \_\_\_\_\_

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4. How does the mass of an object affect work? \_\_\_\_\_

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## Investigating Mechanical Energy

Grade 7 Science

### ANSWER KEY

In the *Knock Out!* video, you learned about the game of marbles. In this activity, you will investigate the science behind the game.

**Reminders: Mechanical energy is the energy an object has due to its motion or its position. Force and mass affect the mechanical energy of an object. Work is what happens when force is applied over a distance.**

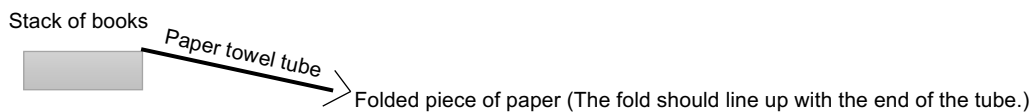
This activity is best done on the floor. You will work with a partner or in a group and will need the following:

- Marbles (a standard-sized one and a larger “shooter”)
- Paper towel tube
- 3 textbooks
- A piece of notebook paper, folded over twice (like you’re making a card)
- A ruler

### **PART 1: INVESTIGATING THE EFFECT OF FORCE**

You will be investigating the force of gravity by measuring the distance a marble moves the paper when it hits it after coming out of the tube. You will use different amounts of textbooks to raise your paper towel tube to different heights.

Here’s how you should set up your equipment:



Use this table to record your results, then answer the questions. For the most accurate data, do at least 2 trials for each roll and find the average.

NUMBER OF TEXTBOOKS USED	DISTANCE THE PAPER MOVED (in cm)
1	(Should be least number in table.)
2	(Should be median number in table.)
3	(Should be greatest number in table.)



# OLD SALEM EXPLORATORIUM

## Investigating Mechanical Energy



1. What happens to the force of gravity as you increase the number of textbooks?

Responses may be similar to: "As the number of textbooks increases, the force of gravity increases."

2. What happens to the distance the paper moved as you increase the number of textbooks?

Responses may be similar to: "As the number of textbooks increases, the distance the paper moves increases."

3. How is the force of gravity related to the distance an object moves?

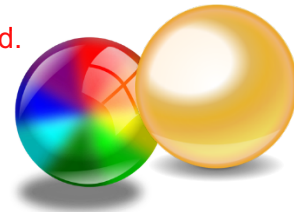
Responses may be similar to: "The greater the force of gravity, the greater the distance an object moves."

4. Which number of textbooks used results in the **greatest** potential energy of the marble?

The greatest potential energy of the marble occurs when there are 3 textbooks stacked.

### **PART 2: INVESTIGATING THE EFFECT OF MASS**

You will now investigate the effect of mass on the movement of an object. Set up your equipment as before except use a constant height of 2 textbooks.



Use this table to record your results, then answer the questions. For the most accurate data, do at least 2 trials for each roll and find the average.

TYPE OF MARBLE USED	DISTANCE THE PAPER MOVED (in cm)
Standard size	(Should be least number in table.)
Shooter	(Should be median number in table.)
Standard size AND shooter at the same time	(Should be greatest number in table.)

1. What happens to the distance the paper moves as you increase the mass of the marble?

Responses may be similar to: "As the mass of the marble increases, the distance the paper moves increases."

2. Why does this happen? (Use the term "energy" in your answer.)

Responses may be similar to: "The mass of an object is related to that object's energy. As mass increases, the energy also increases. The increase in energy causes the paper to move farther."

3. Which marble has the **least** kinetic energy? The marble with the least kinetic energy is the standard size marble.

4. How does the mass of an object affect work?

Responses may be similar to: "As the mass of an object increases, the amount of work also increases."

