

NGSS MS-PS3-1

Curriculum Bundle

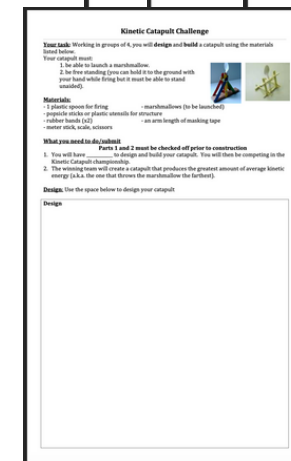
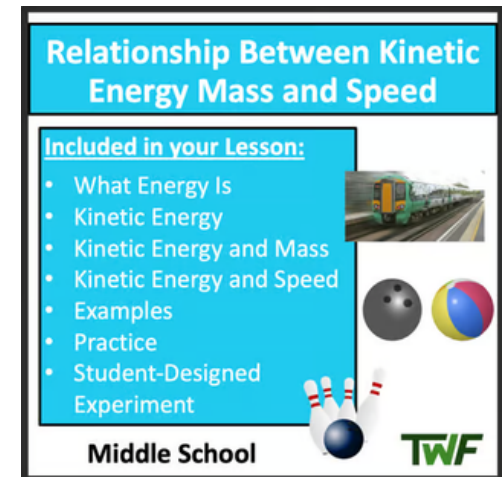
Kinetic Energy, Mass & Speed

- ✓ 1 Lesson and 2 Activities
- ✓ Everything You Need to Teach NGSS MS-PS3-1



Resources Included

- ✓ 1 Lesson
- ✓ 2 Activities
 - Relationship Between Kinetic Energy Mass & Speed – Lesson
 - Rolling Into Energy - Lab Investigation
 - Kinetic Catapult Challenge



Everything You Need to Teach NGSS MS-PS3-1

Relationship Between Kinetic Energy Mass and Speed

Included in your Lesson:

- What Energy Is
- Kinetic Energy
- Kinetic Energy and Mass
- Kinetic Energy and Speed
- Examples
- Practice
- Student-Designed Experiment



TWF

Middle School

Rolling Into Energy: Investigating the Relationship Between Mass, Speed, and Kinetic Energy

Objective:

To investigate the relationship between mass, speed, and kinetic energy.

Materials:

- 1. Choose one ball (tennis ball, baseball, basketball, etc.)
- 2. Release the ball from a height of 1 meter.
- 3. Measure time it takes to hit the ground.
- 4. Calculate kinetic energy.
- 5. Record in a notebook.

Procedure:

Part 1: Kinetic Energy vs. Mass (Speed Constant)

1. Choose one ball (tennis ball, baseball, basketball, etc.)
2. Release the ball from a height of 1 meter.
3. Measure time it takes to hit the ground.
4. Calculate kinetic energy.
5. Record in a notebook.

Part 2: Kinetic Energy vs. Speed (Mass Constant)

1. Choose one ball (tennis ball, baseball, basketball, etc.)
2. Release the ball from a height of 1 meter.
3. Measure time it takes to hit the ground.
4. Calculate kinetic energy.
5. Record in a notebook.

Trial #
1
2
3
4

Graphing Instructions:

Graph 1: Mass (x-axis)

Graph 2: Speed (x-axis)

Analysis Questions:

1. What pattern do you observe between mass and kinetic energy?
2. What happens to the kinetic energy as the speed increases?
3. Which factor had a greater effect on kinetic energy—mass or speed?
4. What might happen if you doubled both mass and speed?

Conclusion:

Write a short paragraph explaining the relationship between kinetic energy, mass, and speed.

Answer Key:

Analysis Questions:

1. What pattern do you observe between mass and kinetic energy?

As the mass increases (while keeping speed constant), the kinetic energy increases. This shows a direct relationship—more mass results in more kinetic energy.

2. What happens to the kinetic energy as the speed increases?

Kinetic energy increases rapidly as speed increases. Since speed is squared in the formula $KE = \frac{1}{2}mv^2$, even small increases in speed cause a large increase in kinetic energy.

3. Which factor had a greater effect on kinetic energy—mass or speed?

Speed had a greater effect on kinetic energy because it is squared in the formula. For example, doubling the speed caused the kinetic energy to increase by a factor of 4, while doubling the mass only doubled the energy.

4. What might happen if you doubled both mass and speed?

If both mass and speed are doubled, the kinetic energy would increase by a factor of 8. That's because $KE = \frac{1}{2}mv^2 \rightarrow$ doubling mass = $2m$, and doubling speed = $2v \rightarrow KE = \frac{1}{2}(2m)(2v)^2 = \frac{1}{2}(2m)(4v^2) = 4 \times \text{original } KE = 2 \times 4 = 8 \times \text{original } KE$.

Example Conclusion Paragraph:

This investigation demonstrated that both mass and speed affect an object's kinetic energy, but speed has a greater impact due to its exponential relationship in the formula $KE = \frac{1}{2}mv^2$. Our data showed that as we increased the mass of the object while keeping the speed constant, the kinetic energy increased proportionally. However, when we kept the mass constant and increased the speed, the kinetic energy increased much more dramatically. For example, when speed doubled, kinetic energy quadrupled. This shows that the faster an object moves, the more energy it carries, even if its mass doesn't change. The experiment supported the idea that kinetic energy depends on both mass and speed, but speed has a stronger influence due to being squared in the equation.

Kinetic Catapult Challenge

Your task: Working in groups of 4, you will design and build a catapult using the materials listed below.

Your catapult must:

1. be able to launch a marshmallow.
2. be free standing (you can hold it to the ground with your hand while firing but it must be able to stand unaided).

Materials:

- 1 plastic spoon for firing
- popsicle sticks or plastic utensils for structure
- rubber bands (x2)
- meter stick, scale, scissors
- marshmallows (to be launched)
- an arm length of masking tape

What you need to do/submit

1. You will have 15 minutes to design and build your catapult. You will then be competing in the Kinetic Catapult championship.
2. The winning team will create a catapult that produces the greatest amount of average kinetic energy (a.k.a. the one that throws the marshmallow the farthest).

Design: Use the space below to design your catapult

Design

The Standard is Explained and the Resources it Incorporates are Outlined

California Preferred Integrated NGSS Course Model – Grade 8 MS PS3 Energy

MS PS3-1: Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.

Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a wiffle ball versus a tennis ball.

Resources:

- Relationship Between Kinetic Energy Mass & Speed – Lesson
- Rolling Into Energy - Lab Investigation
- Kinetic Catapult Challenge

Rolling Into Energy: Investigating the Relationship Between Mass, Speed, and Kinetic Energy

Objective:
To investigate the relationship between mass, speed, and kinetic energy.

Materials:
• 1 meterstick
• 5 marbles
• 1 stopwatch
• 1 ramp
• 1 scale
• 1 calculator

Part 1: Kinetic Energy vs. Speed (Mass Constant)

1. Choose one ball to use.
2. Release the ball from the top of the ramp.
3. Measure time.
4. Calculate kinetic energy.
5. Record in a table.

Procedure:

Trial #	Speed (m/s)	Kinetic Energy (J)
1		
2		
3		
4		

Graphing Instructions:
Graph 1: Mass (x-axis) vs. Kinetic Energy (y-axis)
Graph 2: Speed (x-axis) vs. Kinetic Energy (y-axis)

Analysis Questions:

1. What pattern do you observe between mass and kinetic energy?
2. What happens to the kinetic energy as the speed increases?
3. Which factor had a greater effect on kinetic energy—mass or speed? Why?
4. What might happen if you doubled both mass and speed?

Conclusion:
Write a short paragraph about the relationship between kinetic energy, mass, and speed.

Example Conclusion Paragraph:
This investigation demonstrated that both mass and speed affect an object's kinetic energy, but speed has a greater impact due to its exponential relationship in the formula $KE = \frac{1}{2}mv^2$. Our data showed that as we increased the mass of the object while keeping the speed constant, the kinetic energy increased proportionally. However, when we kept the mass constant and increased the speed, the kinetic energy increased much more dramatically. For example, when speed doubled, kinetic energy quadrupled. This shows that the faster an object moves, the more energy it carries, even if its mass doesn't change. The experiment supported the idea that kinetic energy depends on both mass and speed, but speed has a stronger influence due to being squared in the equation.

Relationship Between Kinetic Energy Mass and Speed

Included in your Lesson:

- What Energy Is
- Kinetic Energy
- Kinetic Energy and Mass
- Kinetic Energy and Speed
- Examples
- Practice
- Student-Designed Experiment

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Kinetic Catapult Challenge

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Your catapult must:

1. be able to launch a marshmallow.
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- rubber bands (x2)
- meter stick, scale, scissors
- marshmallows (to be launched)
- an arm length of masking tape

What you need to do/submit:

Parts 1 and 2 must be checked off prior to construction

1. You will have _____ to design and build your catapult. You will then be competing in the Kinetic Catapult championship.
2. The winning team will create a catapult that produces the greatest amount of average kinetic energy (a.k.a. the one that throws the marshmallow the farthest).

Design: Use the space below to design your catapult

Design:

Who is this Bundle for?

- **Teachers who teach middle school science and use the NGSS**
- **Teachers who want multiple resources at their fingertips including lessons and a variety of activities, in order to meet the standard**
- **Teachers who don't have time to develop their own resources or organize what to teach and when**