MADDEN NFL

FOOTBALL BY THE NUMBERS

ELEMENTARY LESSON PLAN

Tackling Potential and Kinetic Energy

Overview

In this lesson, students explore concepts of energy and relate them to tackling in football. Using manipulatives, such as marbles or ball, students will investigate potential energy, kinetic energy, and observe transfer of energy. They will discuss the implications of potential and kinetic energy and Newton's Laws of motion on football as well as investigate examples of transfer of energy in tackling.

Target Audience

Grades 3-5

Content Area

Science

Activity Duration

45-60-minute class session

Essential Questions

- What is potential energy?
- What is kinetic energy?
- How is potential energy transferred to kinetic energy in football?
- How do Newton's Laws of Motion apply to the game of football?

Objectives

Students will:

- Describe the place value system
- Identify potential energy
- Identify kinetic energy
- Identify instances of potential energy being converted to kinetic energy during a football game
- Identify instances of Newton's Laws of Motion during a football game
- Identify instances in their everyday lives where potential energy is converted into kinetic energy

Standards

Next Generation Science Standards

3-PS2-1.

- Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. 4-PS3-1.
- Use evidence to construct an explanation relating the speed of an object to the energy of that object.

4-PS3-3.

- Ask questions and predict outcomes about the changes in energy that occur when objects collide.

Common Core Math Standards

CCSS.Math.Content.3.MD.B.4
Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

CCSS.Math.Content.4.MD.A.1
Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table.

Materials

Teacher

- 1 tennis ball
- Energy Demo PDF

Student Groups

- 1 large marble
- 1 small marble
- 2 1-inch binders (to serve as ramps)
- 1 ruler with a groove down the center (2 rulers if you do not have a ruler with a groove to serve as guides for the ramp)
- student worksheets
- 1 meter stick to measure with

Note: If you are on a floor that will not slow or stop the marble, such as tile or wood, you will also need a small wooden block, a regular sized die, a domino, or another small object that will move when the marble hits it.

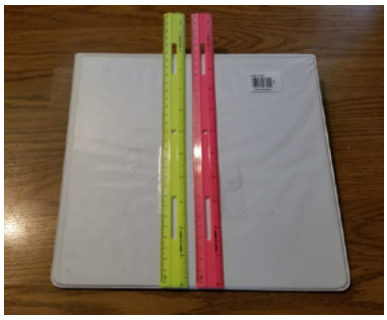
Vocabulary

- kinetic energy
- potential energy
- Newton's Laws of Motion
- transformation of energy

Teacher Preparation

1. Prepare two ramps for each group according to pictures below. Be sure to place the 0 end of the ruler at the bottom of the ramp.
   a. For rulers without a ridge in the middle, leave a .5 cm gap between them for the marble.
   b. For the rulers with a ridge in the middle, be sure to not tape across the ridge. It will affect path of the marble.

For rulers with a ridge in the middle.



For rulers without a ridge in the middle

2. Print out student worksheets.
3. Print out the exit cards.
4. Divide students into small groups.
5. Create a materials station containing the following for each group:
   - a measuring device (yard or meter stick depending on grade)
   - a large and small marble
   - 2 ramps

Procedure

1. Ask students, "What is energy?" After students share some ideas, engage students by standing in front of the classroom and dropping a tennis ball to the floor. Ask students, "When did the tennis ball have energy?"
2. Explain that the tennis ball did indeed have energy as it moved. This is what we refer to as **kinetic energy**. But, the ball also had energy as it was sitting still. This is known as **potential energy**.
3. Kinetic energy is the energy of motion. Any time an object is in motion, it has kinetic energy. Potential energy is energy that is stored and waiting to be used in an object that is still. Ask, "What are some other examples of kinetic and potential energy?"
4. Explain to the students they will work together to investigate potential and kinetic energy as well as **Newton's Laws of Motion** and how they all apply to the game of football.
5. Arrange the students into their small groups and model how they are to conduct their energy exploration.
    a. Demonstrate to the students a marble rolling down the ramp. Explain to students that you are releasing the marble from your fingers and not pushing it down the ramp. Pushing it would ruin the experiment results, so for a valid investigation, we have to try to keep all the variables the same.
    b. Explain that 0 is at the bottom of the ramp and the measurements they will be using go up the ruler from that point.
6. Roll the marble again and ask the students where the marble had kinetic energy and where it had potential energy.
7. Explain **transformation of energy** by discussing how the potential energy transformed into kinetic energy.
8. Distribute the supplies and worksheets to the small groups. Allow them to practice releasing the marble down the ramp several times.
9. Review the directions and recording sheets for Exploration #1. (These will differ slightly based on whether or not you are using a floor material that will stop the marble.)
10. Monitor and guide groups as they complete Exploration #1 and the recording sheet.

11. When finished with the data collection, have students complete the Exploration #1 Handout.
12. Explain to students that they can also demonstrate Newton's First Law of Motion with the marble set up they have.
13. Explain that Newton's First Law of Motion states that an object at rest will stay at rest unless acted on by an outside force and an object in motion will stay in motion unless acted upon by an outside force.
14. Review the directions and recording sheets for Exploration #2. Have students perform Exploration #2 with the marbles and ramp to demonstrate this concept.
15. Discuss the student observations and how it relates to Newton's First Law of Motion.
16. As a class, watch The Winning Drive: Lob Pass from 0:00 – 0:08. Have students identify how Newton's First Law of Motion was demonstrated.
17. Show students the Energy Demo PDF and discuss where they see potential and kinetic energy demonstrated.
18. Have students complete the Exit Card.

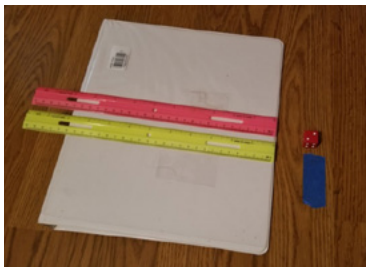
Exploration #1 Directions

On Carpet

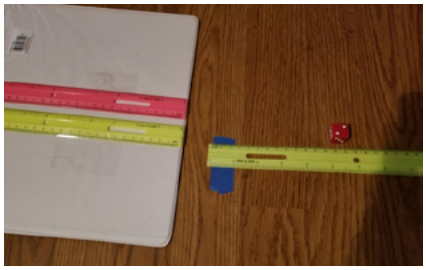
1. Set up one ramp in an area where the marble can roll to a stop.
2. Place the large marble on the ramp at the first distance on your chart.
3. Let go of the marble and let it roll.
4. Measure the distance from the bottom of the ramp to the marble.
5. Record the measurement on your recording sheet.
6. Repeat steps 1 – 5 until your chart is filled with data.
7. Answer the questions related to the chart.

On Tile/Wood

1. Set up one ramp in an area to roll your marble.
2. Measure 1 inch (3 cm if using the metric) from the bottom of the ramp and place a piece of tape to mark the measurement.



3. Place the object given to you by your teacher at the 1-inch (3 cm) mark.
4. Hold the marble at the appropriate mark on the ruler according to your chart and release it.
5. Measure the distance from the 1-inch (3 cm) mark to where the object stopped moving. Record the distance on your chart.



Exploration #1 Data Recording Sheet (Carpet)

Ramp Setting	Distance Travelled (cm)	
	Large Marble	Small Marble
3 cm		
5 cm		
8 cm		
10 cm		
13 cm		

Exploration #1 Data Recording Sheet (Tile/Wood)

Ramp Setting	Distance Travelled (cm)	
	Large Marble	Small Marble
3 cm		
5 cm		
8 cm		
10 cm		
13 cm		

Exploration #1 Handout

1. What was an example of potential energy in the experiment?

2. Where was kinetic energy shown in the experiment?

3. What was a trend that you noticed in your recorded data between the large marble and the small marble?

4. What do your results tell you about potential energy and kinetic energy?

Exploration #2 Directions

1. Place the ramp in a position to be able to roll the marbles down the ramp.
2. Place the small marble 3 cm away from the bottom of the ramp.
3. Hold the large marble at 6 cm and let go. Record what happens.
4. Repeat this action for 10 cm and 15 cm as well. Record what happens.
5. Repeat steps 2 – 4, but place the large marble 1 inch from the bottom of the ramp and roll the small marble from the measurements.
6. Place the two ramps facing each other with 7 inches of distance between them.
7. Roll one marble down each ramp to determine what happens when they meet. Don't be afraid to try different combinations of marble size and distance on the rulers and record observations!

Exploration #2 Recording Sheet (Part 1)

Rolling the large marble, place the small marble at 3 cm.

Distance	Observations (What happened?)
6 cm.	
10 cm.	
15 cm.	

Rolling the small marble, place the large marble at 3 cm.

Distance	Observations (What happened?)
6 cm.	
10 cm.	
15 cm.	

Exploration #2 Recording Sheet (Part 2)

Marbles Used (1 large, 1 small or 2 small, or 2 large)	Distance on Ramp (small at 2 in. and large at 2 in.)	Observations: What happened?

Exit Card

Is the football in these pictures demonstrating potential or kinetic energy?

1. _____

2. _____

3. Identify examples of potential and kinetic energy in the picture below:

4. Explain how Newton's 1st Law of Motion is demonstrated during an NFL game.

5. Identify and explain examples of potential and kinetic energy in your own life. Include an example of potential energy *transforming* into kinetic energy.

Energy Demo PDF