Lesson Topic: Potential Energy

Objective:
Students will be able to:

1. Understand potential energy depending on objects' relative positions
2. Build and use a catapult to investigate potential energy

Time Required: 85 minutes

Materials Needed:

- Basketball & tennis ball
- Popsicle sticks
- Rubber bands
- Plastic spoon (1 per student)
- Small objects such as marbles, pom-poms, coins, unifix cubes, rubber balls, etc
- Meter stick (1 per group)
- Teacher computer with internet access
- Projector/Smartboard
- 1 computer/laptop/iPad per student with internet access
- Potential Energy handout (attached)

Teacher Preparation:

- Assign a Legends of Learning Instructional Quick Play playlist for the day(s) you will be teaching the lesson.
    - Instructional - Middle School - Potential Energy
- Assign a Legends of Learning Content Review Quick Play playlist for the day(s) you will be teaching the lesson.
    - Content Review - Middle School - Potential Energy
- Gather materials to build catapults
- Gather small objects for students to launch off catapults
    - *The small items listed previously are what students will be launching after they have built their catapult. Any small items on hand will work, as long as they are consistent among all groups.*
- Make copies of Potential Energy handout (1 per student)
- Make copies of Catapults and Potential Energy handout (1 per student)

Engage (15 minutes):

1. To engage the class, take the basketball and tennis ball and show them to the class.
2. Ask them which ball they think will bounce higher when dropped from the same position?
    a. *Accept reasonable answers and have students explain their thinking.*
3. First, drop the basketball, noting how high it bounced and then do the same with the tennis ball.
4. Next, ask the class what would happen if you put the tennis ball on top of the basketball, and then dropped it?
    a. *Accept reasonable answers and have students explain their thinking.*

b. *Note: The tennis ball is going to bounce much higher than before and the basketball is not going to bounce as high.*

5. After the balls are dropped, ask students why they think the balls bounced the way they did?
    a. *If needed, explain that the momentum (energy from the basketball) transferred to the tennis ball. The basketball lost energy and the tennis ball gained energy.*
6. Explain that the energy came from potential energy (the energy stored within an object due to size and/or position) and when the balls were dropped that energy changed to kinetic energy (energy of mass in motion). Explain to the class, "Today, you are going to delve deeper into potential energy."

Explore (20 minutes):

1. Have your students sign in to Legends of Learning. Instruct students to complete the Instructional playlist.
2. As students complete the assigned game, students should fill out the top portion of the Potential Energy handout.
3. Assist students as needed during game play, pause playlist if you need to address content or questions to the entire class.

Explain (10 minutes):

1. Review answers to the top portion of Potential Energy handout.
2. Show this video from Youtube to show the relationship between potential and kinetic energy with a real-world demonstration and then ask the class the question below.
    a. Potential Energy Demonstration
    b. What about the wrecking ball is used to alter its potential energy - mass or position?
        i. *Answer: The mass of a wrecking ball creates a large amount of potential energy that turns into kinetic energy when released. The wrecking ball will never go higher than the position at which it was released.*
3. Explain to students they are going to make a tool that can be used to see the relationship between position and potential energy.

Elaborate (30 minutes):

1. Explain to students that they will use their knowledge of potential energy to create catapults and then launch various objects on them.
2. Divide students into groups of 3 - 4 and disperse materials as needed.
3. Direct students to first follow the "How to Make a Catapult" handout.
    a. Model building the capacult for students if needed.
4. After groups have made their catapults, have them start working through the Catapults and Potential Energy handout, filling in all parts.

Evaluate (10 minutes):

1. After students have finished the project, give student volunteers time to share their findings.
2. Have your students sign in to Legends of Learning. Instruct students to complete the Content Review playlist.

3. Analyze student results to determine what concepts need to be a focus for reteaching.

Additional Lesson Strategies:

- To use Legends for additional instruction, create a custom playlist with an instructional game and pre and post assessment.
- To use Legends for a quick formative assessment, create a 5-question assessment in a playlist.
- To use Legends for a student-directed experience, create a targeted freeplay playlist.
- Encourage students to play on their own at home in Legends of Learning: Awakening for a student-driven experience including avatars, battling, and quests all centered around topics they are covering in class.

Potential Energy

1. What is Potential Energy?_____

_____

2. The more _____ an object has, the more potential energy it has.
3. The _____ of an object also changes its potential energy.

How to Make a Catapult

Materials:
-popsicle sticks
-rubber bands
-plastic spoon

Directions:

1. Take a stack of 5 popsicle sticks and rubber band them together on each end
2. Take 2 more popsicle sticks and stack them together. Rubber band them together on just one end
3. Pull the two popsicle sticks slightly apart and place the larger stack in between them
4. Rubber band the larger stack to just the top popsicle stick
5. Rubber band the plastic spoon to the top stick as well, pointing the scooping part of the spoon away from the center
6. Now your catapult is ready to experiment!

Catapults and Potential Energy

Directions: First, create your own catapult. Then, use the materials provided to fill in the chart below.

Materials	Estimate Distance	1st Shot	2nd Shot
1.			
2.			
3.			

Which material traveled the farthest distance? _____

Which material traveled the shortest distance? _____

Now, add 3 more sticks to your center stack in your catapult. Reassemble and use this version of your catapult to complete the next chart.

Materials	Estimate Distance	1st Shot	2nd Shot
1.			
2.			
3.			

Did your materials go further or shorter this time around? _____

Why do you think this happened? _____

_____

_____

_____

Potential Energy Key

1. What is Potential Energy?___stored energy an object has because of its mass, position, or state_____
2. The more __mass____ an object has, the more potential energy it has.
3. The ___position_____ of an object also changes its potential energy.

How to Make a Catapult

Materials:
-popsicle sticks
-rubber bands
-plastic spoon

Directions:

7. Take a stack of 5 popsicle sticks and rubber band them together on each end
8. Take 2 more popsicle sticks and stack them together. Rubber band them together on just one end
9. Pull the two popsicle sticks slightly apart and place the larger stack in between them
10. Rubber band the larger stack to just the top popsicle stick
11. Rubber band the plastic spoon to the top stick as well, pointing the scooping part of the spoon away from the center
12. Now your catapult is ready to experiment!

Catapults and Potential Energy Key

Directions: First, create your own catapult. Then, use the objects provided to launch with your catapult and measure with the meter stick. Test out all object twice before moving on to the second part.

Materials	Estimate Distance	1st Shot	2nd Shot
1.Marble	*accept	---- meters	---- meters
2.Unifix cube	reasonable	---- meters	---- meters
3.Pom-Pom	answers*	---- meters	---- meters

Which material traveled the farthest distance? _* accept accurate answer depending on objects_

Which material traveled the shortest distance? _* accept accurate answer depending on objects_

Now, add 3 more sticks to your center stack in your catapult. Reassemble and use this version of your catapult to complete the next chart.

Materials	Estimate Distance	1st Shot	2nd Shot
1. Marble	*accept	---- meters	---- meters
2. Unifix cube	reasonable	---- meters	---- meters
3. Pom-Pom	answers*	---- meters	---- meters

Did your materials go further or shorter this time around? __farther_____

Why do you think this happened? _This occurred because the extra popsicle sticks gave the catapult more room for me to pull back the lever. Since the position changed, I was able to launch the objects farther.