Roller Coaster Energy

Teach 1	Names of student(s) teaching:
Teach date: Teach time: Teach length: 45 minutes	Title of lesson: Roller Coasters Source (Kit, Lesson, Page #):

Concept statement/Main idea:
Law of Conservation of Energy

Standards for the lesson:
National Science Teachers Association (NSTA) standards for this lesson. PS3.B Conservation of Energy and Energy Transfer and Engineering Design. – Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. – Students must define the problem, develop possible solutions and imp rove on the designs following testing/prototypes.

Objectives	Evaluation
Write objectives in SWBAT form	Write at least one question to match the objective you listed or describe what you will look at to be sure that students can do this.
SWBAT **describe** the difference between kinetic and potential energy.	A car resting at the top of a hill would have what type of energy?
SWBAT **differentiate** and apply the different types of energy while constructing a roller coaster.	

SWBAT **determine** where the change between kinetic and potential energy takes place.	

Engagement

Estimated time: 4 minutes

Description of activity: To catch their attention, watch:

https://www.youtube.com/watch?v=0LnbyjOyEQ8

What the teacher does	What the student does	Possible questions to ask students — think like a student and consider possible student responses
Show students the video of Newton's Cradle. OR Instead of a video the teacher can do a demo with hot wheels: the teacher will have a ruler and ask the students how the height of the incline will affect the distance the hot wheels travel. Introduce terms: Kinetic and Potential Energy	Watches video and observes how the balls are moving The students will be predicting how far the toy cars travel depending on the height of the incline.	Why do the balls keep moving even after hitting one another? Why do the balls not slow down at all during this process? How do they keep moving with no one or nothing pushing them? What type of energy is making the balls move? At which height will the car travel the furthest? How is the angle of the incline related to the distance the car traveled?

Resources needed:

Computer and projector

OR

Hot wheels and a ruler/meter stick

Safety considerations:

Exploration

Estimated time: 15 minutes

Description of activity: Students will construct a fully functioning roller coaster utilizing materials given in class while applying their new knowledge of kinetic and potential energy. Later, the class will combine their roller coasters to make a "mega coaster" and the teacher will ask the students if their "mega" coaster worked when the students combined them.

What the teacher does	What the student does	Possible questions to ask students — think like a student and consider possible student responses
Monitor and guide the students as they build a roller coaster. *Once a group gets their roller coaster to work, have the class watch their roller coaster to see what adjustments their group may need to make. If the roller coaster demo is utilized the students can use what they just saw to construct their roller coaster.	Students will work in groups of 3-4 to build a roller coaster that will function properly (get the marble from the start to the end of the roller coaster with constant motion) *Students will write down their results, what worked and what didn't work for their roller coaster	Why did the marble not go back up the hump to finish off the roller coaster? Will the starting height of the roller coaster affect how fast or slow the marble will go? Ask questions based on what the students are experiencing throughout their exploration Is the first part of the roller coaster important? If the marble stops in the middle of the roller coaster, why do you think that happened?

Resources needed per group:

Marbles, tape, cut-out pipes, rulers, meter sticks, scissors

Safety considerations:
Sharp scissors and flying marbles

Explanation

Estimated time: 10 minutes

Description of activity: Students will explain whether or not their roller coaster functioned properly. The teacher will also ask the students if any changes to their roller coaster, changing the height of the loop or adding loops, would affect how their roller coaster functioned.

What the teacher does	What the student does	Possible questions to ask students — think like a student and consider possible student responses
Ask students why or why not their roller coaster functioned properly?	The students will think of ways to make roller coasters better. They will ask the group questions on why they structured the roller coaster the way they did.	Did your roller coaster function as you thought it would? Would changing the height of the loop affect how fast the marble moved? Would adding loops affect the kinetic and potential energy of the marble? If you started the beginning of the roller coaster at a lower height or high height would that affect the potential and/or kinetic energy of the marble? What happened to the energy when the roller coaster stopped? Was it moving? What if you used a heavier marble? Would it travel further? What about a lighter marble?

Resources needed:

Roller Coaster Worksheet

Safety considerations:

Elaboration

Estimated time: 10 minutes

Description of activity: Students and the teacher will discuss the importance of working together to construct a roller coaster in real life. After this discussion, students will combine their roller coaster from the "engage" to make a "mega coaster" that functions properly.

What the teacher does	What the student does	Possible questions to ask students — think like a student and consider possible student responses
Ask questions about how actual roller coasters are built in real life. http://www.japantimes.co.jp/news/2003/12/06/national/disneyland-roller-coaster-derails/#.WI-TobE-K1s Have students connect all their working roller coasters together and then ask questions regarding the new "mega coaster".	Answers questions	What do engineers have to consider when building a roller coaster? Does the length of an actual roller coaster affect the kinetic and potential energy? Do the size and weight of the cart (marble) affect the kinetic and potential energy? After connecting all their roller coasters, ask students if they were able to get them to work all together? Did the roller coaster work when all the coasters were assembled? Why or why not? What changes, if any, needed to be made to the "mega

		coaster" in order to get it to function? Why was it so important to connect all the coasters together evenly? What happened when there were gaps, uneven rails, etc.? How important was it for y'all to work together? Could only one group have put all the coasters together? Why or why not? (Answer: each group knew how their own coaster worked and what made it work and what didn't)

Resources needed:

Roller Coaster Worksheet

Safety considerations:

Evaluation

Estimated time: 5 minutes

Description of activity: Students will complete their evaluations on their own without help from their peers or the teacher. After the evaluation students will complete an online demo on skate park roller skating from Phet interactive simulations.

What the teacher does	What the student does	Possible questions to ask students — think like a student and consider possible student responses

Administers evaluation quiz that students will complete on their own. After the students take their evaluation quiz, students will complete a "skate park" demo using the following website: https://phet.colorado.edu/en/simulation/legacy/energy-skate-park *you will need java to run the demo Have students move the different points of the ramp to see how moving the points can affect the skater's motion on the ramp.	Complete the evaluation quiz on their own. Students will move the points of the ramp and see how the different lengths and angles affect the skater's motion on the skate ramp.	One question could have various images that demonstrate kinetic and potential energy. When you shortened one end of the ramp, what happened to the skater? When you made the angle of the ramp steeper, what happened to the skater? How did the skate ramp look when you were able to keep the skater moving in constant motion without falling off the ramp? (Have students draw this picture on the back of the worksheet given to them during the first half of the lesson)

Resources needed:

Evaluation Quiz

Safety considerations:

Name:_____
Date:_____

Roller Coaster Worksheet

1. **What is <u>your</u> definition for potential energy?**

2. **What is <u>your</u> definition for kinetic energy?**

3. **Do you think having more loops or less loops will help the marble move with constant motion? Why or why not?**

Construct a roller coaster that will get the marble from the beginning to the end with constant motion using the following supplies:

- **Tape**
- **Scissors**
- **Marble**
- **Foam(hollow black things in 208)**
- **Cup (to catch the marble at the end of the ride)**

1. **Draw a picture of how your roller coaster looks when it is first put together.**

2. **Draw a picture of how your roller coaster looks when the marble can move from the beginning to the end with constant motion. Label where the change between kinetic and potential energy takes place.**

3. **Did the first model you made work properly? (the marble moved from beginning to end without stopping) Why or why not?**

4. **If it didn't work properly, what changes had to be made to get the roller coaster to work properly?**

Alternate worksheet addition

5. **Did the roller coaster work when you combined all of the roller coasters together? Why or why not?**

6. **What changes, if any, had to be made when combining all the roller coasters? Did one group have to shorten or lengthen their roller coaster? Remove or add more loops?**

PHET Skate Park Demo:

7. **When you shortened one end of the ramp, what happened to the skater?**

8. **When you made the angle of the ramp steeper, what happened to the skater?**

9. **How did the skate ramp look when you were able to keep the skater moving in constant motion without falling off the ramp?**

Name: _____

Date: _____

Roller Coaster Evaluation

1. A car resting at the top of a hill would have what type of energy? Why?

_____

_____

_____

_____

_____

_____

2. Which is an example of kinetic energy?

A) A cat sitting in a tree

B) A car parked in a garage

C) A ball flying through the air

3. Correctly identify the type of energy that image contains: