Name: _____

Per: _____Science Number: _____

Energy and Roller Coasters: WebQuest 2pts ec printing

Your Goal: Learn about different types of energy involved with rollercoasters, BUILD a rollercoaster with 2 loops and 2 hills, and create a **Coaster Poster** that demonstrates your knowledge of the basic physics behind roller coasters, specifically motion, forces, and the transfer of energy.

Part 1 : Roller Coaster History: Watch Video 1 and write 2 bullet points about something you learned!

_____

_____

Part 2 : Roller Coaster Records: Answer these questions: https://en.wikipedia.org/wiki/List_of_roller_coaster_rankings:

Height Rankings: Tallest Steel:_____ Tallest Wooden:_____

Speed Rankings: Fastest Steel: _____ Fastest Wooden:_____

Part 3 : Roller Coaster Elements: : https://en.wikipedia.org/wiki/Roller_coaster_elements - Thrill_elements/ Video2

Batwing Butterfly Inversion Camelback Cobra Roll Corkscrew Hammerhead Turn Heartline Roll Horseshoe Immelmann Loop Pretzel Loop Raven Turn Sea Serpent Roll Top Hat

List your FAVORITE 3 elements. Describe what is so cool about each:

_____

_____

_____

Draw your favorite rollercoaster element here (in pencil !) ☺

_____	_____	_____

Want more cool Roller Coasters? Check out these cool coasters! Video Notes: click on Video number in the video folder. Write 2 notes

Kingda Ka Roller Coaster **Video 3**	From the front seat! **Video 4**	**Video 5**

Physics Fundamentals & The Future's Channel Roller Coaster **Video Notes #6**: 3 bullet points

1._____

2._____

3._____

After watching the videos, what would your dream rollercoaster look like? :

Physics Terms To Know! *Use your own words to define the following terms* Click here for definition help

Use Google to help or http://www.learner.org/interactives/parkphysics/glossary.html

Acceleration:	***Centripetal Force***	***G force***
Newton's 2nd Law	***Kinetic Energy***	***Potential Energy***

Need some more help on those terms? Watch these videos and see if they help!

Physics of Roller Coaster – Energy

What is potential energy? **What is kinetic energy?** **Watch these videos & Write 2 bullet points for each!**

How Roller Coaster's Work Video 7	*Eureka: Potential Energy* Video 8	*Eureka: Kinetic Energy* Video 9

Step D: BrainPOP http://www.Brainpop.com mms308 Marshall Watch: Potential Energy (PE) & Kinetic Energy (KE)

1. KE & PE are the 2 types of energy that relate to:
a. Change b. Friction c. Density d. Motion

2. Which object has the most PE? A ball:
a. resting on the ground b. thrown at 100 mph
c. on top of a refrigerator d. resting on a cliff

3. When does a yo-yo have the most PE? When it's:
a) at its highest point b) at its lowest point c) moving at top speed

4. When is PE transformed into KE? When an object
a. at rest is lifted to a higher elevation b. at rest remains at rest
c. at rest is put into motion d. in motion is stopped and put at rest

5. Which is the best synonym for PE?
a. Stored energy b. Energy of motion
c. Energy due to gravity d. Mechanical energy

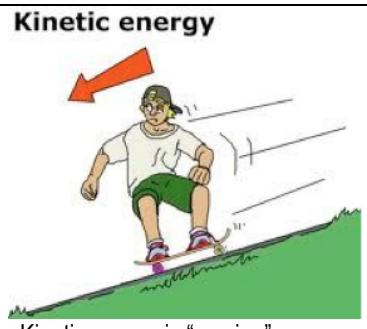
6. The amount of KE an object has depends on its
a. Mass & volume b. Volume & friction
c. Mass & speed d.Speed & density

7. Why do object at high elevations have more PE than objects at low elevations?
a. Because the thinner air at higher elevations means objects have a greater potential to move fast
b. Because gravity gives objects at high elevations the potential to fall much further

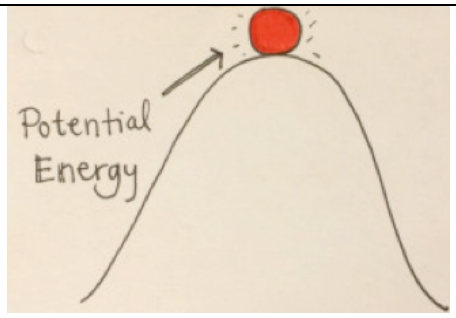
8. Which of the following has the most KE?
a. A car traveling at 80 kph b. A tractor-trailer traveling at 80 kph
c. A cheetah running at 80 kph d. A motorcycle traveling at 80 kph

9. When is KE transferred from object to object? When:
a. Those objects pass one another
b. Those objects collide
c. the first object outweighs the second object
d. the 1st object has more PE than the 2nd object

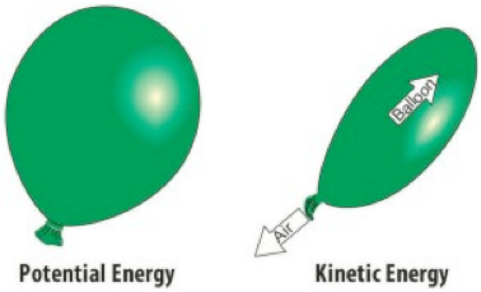
10. There is a finite amount of energy in the universe, which means:
a. Energy is destroyed & created all the time.
b. There is a limited amount of energy in the universe.
c. Stars generate most of the energy in the universe



Kinetic energy is "moving" energy



Potential energy is "stored" energy



Potential energy can turn into kinetic energy & vice versa.

$KE = \frac{1}{2} \times mass \times velocity^2$

$KE = \frac{1}{2}mv^2$

$PE = mass \times gravity \times height$

$PE = mgh$

where $g = 9.8\ m/s^2$

Energy is measured in Joules

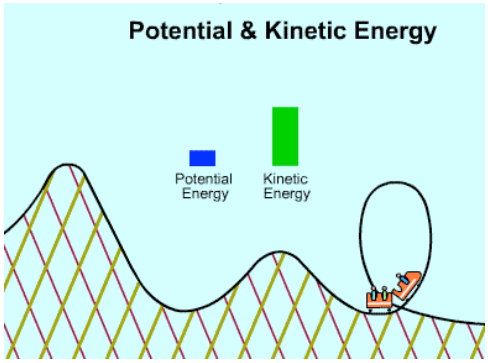
$$1\ \text{Joule} = 1\ \frac{\text{kg m}^2}{\text{s}^2}$$

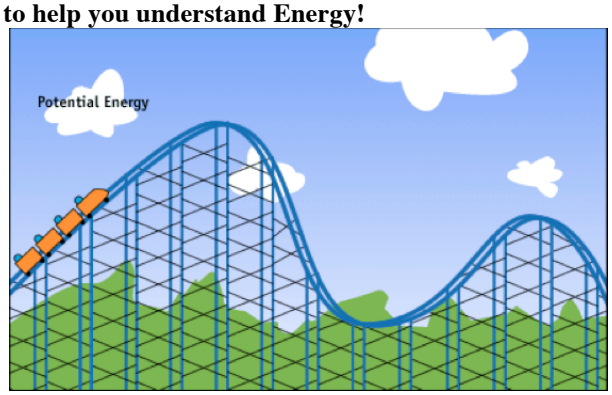
Energy Math: *Show your work!*

1. A 12 kg dog is running at a velocity of 5 m/s. How much kinetic energy does it have?	2. A 5000 kg truck is moving at a velocity of 30 m/s. How much kinetic energy does it have?	3. If you lift a 50 N watermelon to the top of a 2 m fridge, how much potential energy does it have? *Want to check your answers? Click here*
4. Your angry teacher is holding a 1 N book over your head at a height of 0.5 m. How much potential energy does the book have?	5. Two divers are standing at the end of a 10 m diving platform. The first diver, Andy, weighs 20 N. The second diver, Jim, weighs 30 N. Which one has more potential energy?	

Energy in Roller Coasters: How does Kinetic & Potential Energy relate to roller coasters?

Watch the videos: and work with the animations below to help you understand Energy!



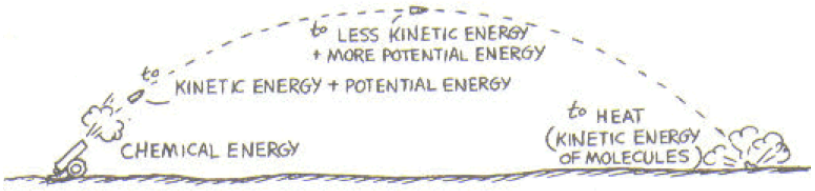


What is Energy Conservation?

The Law of Conservation of Energy states that **energy cannot be created or destroyed**, but **transforms from one form to another.**

Think about clapping your hands – they start off not moving (potential energy), then move (kinetic energy), then make noise (sound energy) and perhaps even heat (thermal energy).

Energy never appears or disappears…
it just changes forms
(sounds just like the Law of Conservation of Mass!).



Energy Cannot Be Created or Destroyed
(It just changes forms)

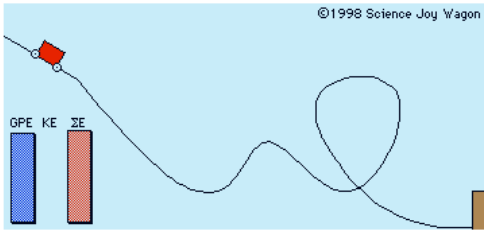
Energy Conservation Math: The KE & PE before an action should always equal the KE & PE after an action.

$$PE_{before} + KE_{before} = PE_{after} + KE_{after}$$

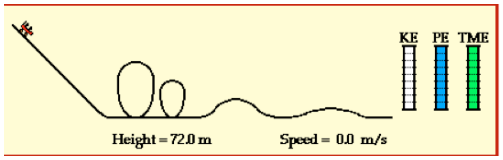
Energy Conservations in Roller Coasters: Click on the drawings below to explain how .

Did you know that roller coasters use an engine to power the coaster ONLY AT THE VERY BEGINNING??? They're dragged up to the top of the first hill, but from then on, no more external energy is added.

WHY? How does a roller coaster continue to move through the twists and turns of a track if it only uses an engine at the very beginning?! It has to do with Energy Conservation.



Energy of a Roller Coaster



Energy Transformation on a Roller Coaster

Roller Coaster Motion

How does a roller coaster continue to move through the twists and turns of its track if it only uses an engine at the beginning?

_____

_____

_____

Check Your Understanding: Think you got it? **Label where on a roller coaster is the most KE, least KE, most PE, and least PE.**

Designing Rollercoaster: *Funderstanding Roller Coasters*

1. How does friction affect the speed of a roller coaster?_____
   _____
2. What other forces affect the speed of a roller coaster?_____
   _____

Simulator #1: click here http://discoverykids.com/games/build-a-coaster/
Have fun with this simulation! See how far up the "fear meter" you can get your design!

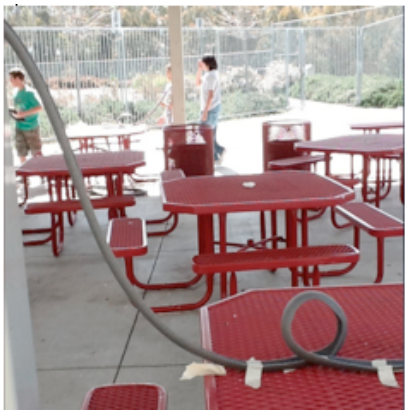
Build your rollercoaster on line: click here http://www.learner.org/interactives/parkphysics/coaster/

You decide on the following settings that would allow the roller coaster to achieve its maximum seed, stay on the track, & travel the whole track.

Trial #1 Hill 1 = _____ Hill 2 =_____ Loop = _____ Speed =_____ Mass =_____ Gravity =_____ Friction =_____
Run the simulator with these settings.
Did it stay on the track? _____ Did it make it all the way? _____
Maximum Speed: _____ Maximum Time: _____

Trial #2 Hill 1 = _____ Hill 2 =_____ Loop = _____ Speed =_____ Mass =_____ Gravity =_____ Friction =_____
Run the simulator with these settings.
Did it stay on the track? _____ Did it make it all the way? _____
Maximum Speed: _____ Maximum Time: _____

Roller Coaster Models



Testing: Now Go Build that Roller Coaster

1. In a group of 3-4 students Obtain supplies:
6 foam tubes
1 bag with marble, plastic cup, measuring tape, stopwatch, masking tape
2. How long is the track? Measure & record the length of the 6 tubes in METERS.
3. Make the best & most creative coaster that you can
Spread out and find a good area away from others.
The end of the coaster should empty into the cup.
Feel free to take pictures or video on your phone.
4. Obtain & RECORD measurements
Measure each element (start height, height & width of loops, track length, drop heights, corkscrew lengths, etc.) in **centimeters**.
5. Calculate the *approximate* **kinetic energy** of your marble.
6. Calculate the **potential energy** of the marble at the top of the coaster, to the best of your ability.
The average marble has a **mass of 0.0055 kg.**
7. Time how long it takes the marble to complete the track. Record the time here: _____
Calculate the **average speed** of the marble.
Record the average speed of your marble here: _____ (average speed= total distance/total time)
8. Cleanup
Carefully remove all tape. Disconnect your foam pieces and band them together with the rubber band. Return all supplies

Conclusion Questions to answer:

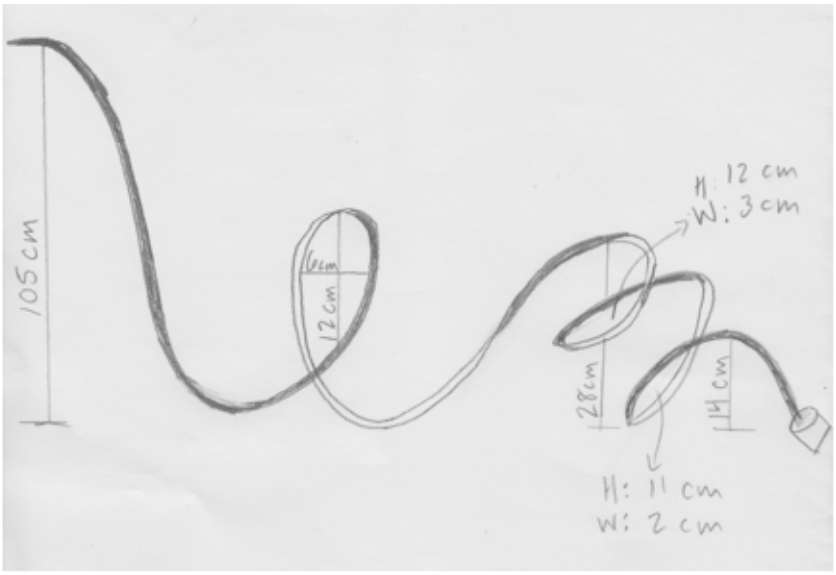
1. What happened to the PE & KE of the marble as it traveled through the track? Explain.

2. Which force opposed the motion of the marble as it moved? Explain.

3. Does your roller coaster obey the law of conservation of energy? Explain why or why not.

4. What happened to the velocity of the marble as it accelerated down its first hill?

5. List 3 important rules about building a successful coaster.



Coaster Poster: Due Friday by end of Class

Include the following on your poster:

- Coaster Name
- Your names
- Neat drawing of the coaster
- ALL measurements with units
  - height of hills
  - height/width of loops
  - overall length of coaster
- Indicate where KE/PE is the greatest and the least
- **Average speed** of the marble
- Discuss how the marble's energy is conserved using physics academic language
  - *Consider including your KE & PE calculations as part of this discussion*
- All other details are up to you!

This is how your poster will be evaluated:

Roller Coaster Physics Poster

Does Not Meet Expectations 1	Below Grade Level Expectations 2	Meets Grade Level Expectations 3	Above Average Expectations 4	Exceeds Grade Level Expectations 5
Demonstrates **no** or **little understanding** of RC physics.	Demonstrates **little understanding** of RC physics, including **some** of the following: - Physics vocab - KE & PE on a RC - Marble coaster measurements	Demonstrates **some understanding** of RC physics, including **most** of the following: - Physics vocab as related to RCs - KE & PE on a RC - Energy conservation - Marble coaster measurements - KE & PE calculations	Demonstrates a **good understanding** of RC physics, including **most** of the following: - Physics vocab as related to RCs - KE & PE on a RC - Energy conservation - Marble coaster measurements - KE & PE calculations	Demonstrates a **thorough understanding** of RC physics, including **all** of the following: - Physics vocab as related to RCs - KE & PE on a RC - Energy conservation - Marble coaster measurements - KE & PE calculations

Be sure to turn in your poster with ALL your team members

Plus everyone's WebQuest Handout