Lesson 7:Uphill Climb

Objective: Students will be able to analyze all the forces acting on a car traveling up an incline and will design/construct a car that is able to move up and over an incline

Learning Goal: When two object interact energy can be transferred from one object to another. Amount of force needed to propel car must be greater than forces acting in opposite direction.
Vocabulary:

Engage:

1. Teacher will first show students pictures of some of the steepest hills in LA which can be found through Google images.
2. Teachers prompt students, "With these images in mind write down the impact these hills may have on public transportation?"
3. Students will share some of the ramifications of these hills may be, citing the previous downhill investigations.

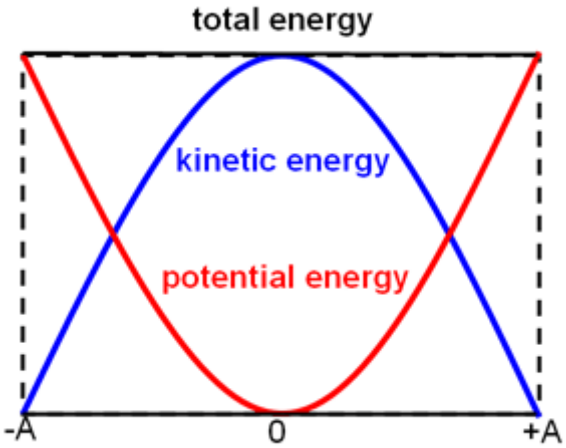
Explore:

1. Following a similar setup to the downhill investigation, students will investigate the impact 3 different inclines will have on the acceleration of the vehicles.
2. Students record the data for each of the trials for each incline (total 9)
    - **Teacher Note:** Getting all of the cars to be able to travel up an incline may take a class period to edit/revise vehicles to ensure the cars are generating enough force.

Explain:

1. The teacher begins the explanation with the question " How did this investigation differ from the downhill investigation?"
2. The teacher explains that the amount of force needed to propel must be greater than the forces acting in the opposite direction. So if there is more force in the opposing direction there must be more force applied in order for the vehicle to go uphill (Unbalanced Forces).

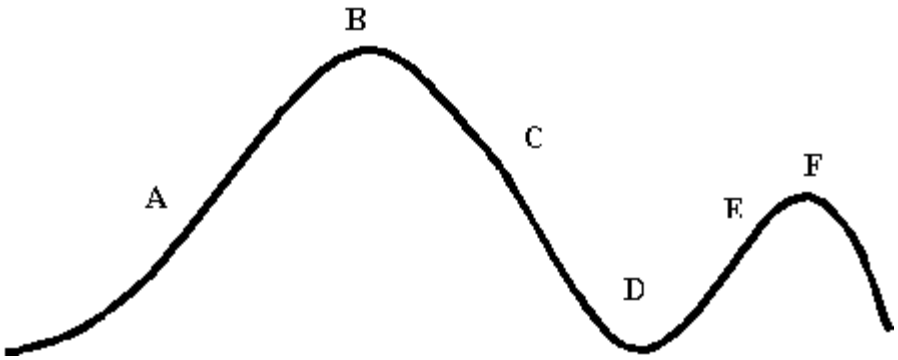
Students are introduced to the idea of kinetic energy and how it is transformed into potential energy as the vehicle travels uphill and vice versa as it travels downhill.



- As the amount of potential energy decrease the amount of potential energy increase proportionally.

Elaborate:

1. Students diagram the change of kinetic energy to potential energy as the car begins to ascend the hill.
    - Possible student diagram:



2. Students consider the implications this has on fuel economy, as the vehicle must exert more force in order to make it up the hill.

Evaluate:

1. Students are evaluated on the diagrams and follow up questions on the transition of kinetic to potential energy and vice versa.
2. Students address the question " how can we use the built up potential energy to add to the fuel efficiency of the vehicle?" Students must cite data/ diagrams that they have created to support their answers.

Additional Resources:

PhET Simulation of Kinetic/Potential energy

http://phet.colorado.edu/en/simulation/energy-skate-park

PhET Simulation of forces on an incline

http://phet.colorado.edu/en/simulation/the-ramp

http://phet.colorado.edu/en/simulation/ramp-forces-and-motion