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Technology Integration Workshop 2016

Unit Title: Energy Conservation Car Engineering --- Conservation of Energy Engineering Project
Grade Level: *9*
Subject Area: *Physical Science*
Duration/Length/Number of class periods:
Description: **How can we make a car that will conserve the most energy going down a ramp?** **Students design their own car - or change an aspect of the car like where the mass is located in the car, the shape of the car, changing size or type of wheels, using different lubricants on the wheels.** **Students practicing calculating the percentage of energy transferred and transformed.** **Student figuring out how effective their design is in conserving energy using their mean energy conserved and comparing it to other's designs.** **This project would be done to teach the concept of the Conservation of Energy after learning GPE and KE in the physical science classroom.**
Established Goals (National, State, Local): **http://education.state.mn.us/MDE/EdExc/StanCurri/K-12AcademicStandards/Science/index.htm** Statistics STANDARD 9.1.3.4 Science, technology, engineering and mathematics rely on each other to enhance knowledge and understanding. Benchmark: 9.1.3.4.3 Appropriate Representations: Select and use appropriate numeric, symbolic, pictorial, or graphical representation to communicate scientific ideas, procedures, and experimental results. Benchmark: 9.1.3.4.4 Reliability of Data: Relate the reliability of data to consistency of results, identify sources of error, and suggest ways to improve data collection and analysis: Use statistical analysis or error analysis to make judgments Engineering 9.1.2.2.2 Develop possible solutions to an engineering problem and evaluate them using conceptual, physical and mathematical models to determine the extent to which the solutions meet the design specifications. For example: Develop a prototype to test the quality, efficiency and productivitiy of Force and Motion

BENCHMARK: 9.2.2.2.2 Acceleration
Explain and calculate the acceleration of an object subjected to a set of forces in one dimension (F=ma).
Energy Standards
STANDARD 9.2.3.2 Energy can be transformed within a system or transferred to other systems or the environment, but is always conserved.

What Enduring Understandings are desired?
Energy always has a source
Energy is never lost nor created
Energy can only transfer (go from one place to another)
Or be transformed (change from one kind of energy to another)
Energy has to come from a force applied through a distance or a mass being accelerated through a distance

What Essential Questions will be considered?

How can we analyze data to see if our designs/variable made a difference in the engineering of our car?
How is energy conserved by our car design?
What variables in our "system" are key to increasing the amount of energy transformed from GPE to KE?

Students will know / be able to:
I can calculate GPE on my own.
I can calculate KE on my own.
I can talk about where energy comes from and where it goes (I can describe where energy transfers).
I can explain what transformation of energy is.
I can calculate the transfer of energy from a system as a percentage.
I can calculate the transformation of energy from a system as a percentage.

Description *Units must include at least one of each formative, summative, introductory activity and learning activity. Check the appropriate box; one per row.*	Formative	Summative	Introductory Activity	Learning Activity	Student Technology Used	Teacher Technology Used	ISTE Standards
Day 1 Example for flipping this lesson in Peardeck **https://app.peardeck.com/presenter/tgmeec/projector** **Pdf format:** Energy Skate Park Presentation			X	X		X	1c
Day 2 1. Have students experience Energy Skate Park pheT simulation (Google "Phet Energy Skate Park html5" for iPads) and			X	X	X	X	1c

Answer Energy Skate Park questions After using Energy Skate Park, 2. Homework - flip lesson: Lesson on how to Calculate Transfer/Transformation of Energy Further Energy Skate Park Explorations							
Day 3: Students will learn to calculate the transfer and transformation of energy, **Conservation of Energy Worksheet** **Advanced or Extra Practice Conservation of Energy Practice**	**X**			**X**			
Day 4 1. Introduce context for Car Problem: We want to design a car that will conserve the most energy, causing as much of the Gravitational Potential Energy at the top of the ramp possible to be changed to Kinetic Energy at the bottom of ramp (Information and Budget Sheet) 2. Show a video on the Conservation of Energy from *EdPuzzle or You tube* Have students answer questions you find important for them to learn about the transformation and transfer of energy 3. Draw Some Car Designs you think will save energy & give verifications for its energy saving shape: Students can brainstorm ways in which their car shape could "save energy" using examples / doing research on internet to give reasons for their car design 4. Students take a picture of their pictures/designs and writing from their journals and submit into designated google doc. (teacher prepare a google form for them to submit this as an exit ticket)	**X**		**X**		**X**	**X**	**2d** **3a** **4a** **4d**
Day 5: Students can design their car.				**X**			
Day 6: 1. (Review of Acceleration) Students learn how to gauge their car's acceleration due to velocity using a photogate to determine velocity at two different points of the ramp where the car is going down. (Can review acceleration here) 2. **What was the acceleration of your vehicle?** Have students calculate the acceleration using their real data from no. 1 and the equation $a= v_2-v_1/t_2-t_1$; then submit their method along with no. 3 (next) 3. **If there was a barrier at the bottom of the ramp, what force would your car hit it with?** Have students submit their problem solving in google doc - a picture of their journal work OR Explain how you came to the answer using Video: **how do we calculate your car's force: share this on a Video/Camera site (screencastomatic or screenify or their camera app) &**	**X**				**X**	**X**	**2b** **2d**

Commented [1]: You just need to evaluate the activities to place checks in here.

share URL with me on today's google form (exit ticket) Teacher prepare a google form for today's exit so they have a place to submit							
Day 7 Begin Car TOE Lab Have students videotape car travel from the side, import video into LoggerPro (if students have already learned a how to use Logger Pro) have them locate their FINAL velocity this way.	**X**			**X**			**4c**
Day 8 **Formative Exit ticket: TOE Calculations Students will test their car's transfer/transformation of energy** (TOE's) and place their values into a google form like this example: TOE Calculation Exit Ticket! Aide for teachers to check their hand calculated TOE's. Have students check Enter their data on this form - mass of car, height of their ramp, ending velocity, their hand calculations for GPE and KE, their hand calculations for Transfer and Transformation of Energy, and then after students place their answers in, in your response spreadsheet set up formula's in columns to use for calculating the true values and help you assess if the students calculated GPE, KE and the transferring and transforming of energy correctly.	X			X	X	X	**4c**
Day 9 Data Analysis Google Form (example) as a Class Before redesign- Which design of car made the biggest difference? Make a Google Spreadsheet and have students place their names under the variable they changed, place in their numbers for GPE, KE, Transfer of Energy, Transformation of Energy vs. design of car/variable tested Redesign - change something simple about your car - an element of design in the car: A shape, the mass used in the car, placement of the mass, type of tires used,	**X**			**X**	**X**	**X**	**3d** **2a** **4c**
Day 10							

Materials, tools and resources
One could use pine derby cars/car kits if they have the resources and tools,
Other low cost ideas are to use builder's foam (pink foam insulation sheets) and cut up one board into possibly 100 blocks for one hundred student cars using paper clips for axles with Cardboard wheels inserted through straws so axles could rotate.
Another is to use toilet paper tubes with straws cut to size & also inserted into front and back for places for "axles" (wooden dowl - or skewers with sharp tips cut off) to rotate with choices of wheels (a possible variable) - cardboard wheels, foam wheels, pop cap wheels - hot glued on or brass pins could be punctured through wheel and then ends affixed around the skewer and taped
Hot glue
Brass pins
wooden skewers or thin wood dowels

Paint for decorations **Exacto knife for carving (if insulation sheets used)** **Scissors** **Masses to fit into their car - they can place it toward front, center, or toward the back of their car** **Engineering budget sheet** Use videos --look up different videos for energy add formative assessments Budege Sheet
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Additional credit given to Best Prep/ Paul Anderson, Tari Jung, University of Minnesota **http://www.kixcereal.com/kix-cereal-diy-cardboard-building-logs/** **http://nerdybaby.blogspot.com/search?q=toilet+paper+tube+cars** **http://www.handimania.com/diy/toilet-paper-roll-race-cars.html**