**Moving Cars into the Future**

Target Grade Level(s): 7th and 8th grade

Subject(s): Math and Science

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**Problem Statement:**

Gasoline is considered a fossil fuel which is a non-renewable resource. Eventually we will run out of oil which is used to create gasoline. This is fast becoming a major problem that engineers around the world are trying to solve.

Although many objects in this world rely on non-renewable resources, there is one that consumes the most and that is our modes of transportation. Whether you use a car, bus, motorcycle, or even a scooter, the odds are that you are using gasoline to get to where you need. Many automobile manufacturers have been working hard to create vehicles that are not relying on gasoline. It is possible that you have ridden in an electric or hybrid car or on a hybrid bus. Unfortunately there are not enough designs or ideas out there to assist in moving us entirely away from fossil fuels.

The Environmental Protection Agency has decided to run a competition for 7th and 8th graders in Washington State to generate ideas for alternative energy powered vehicles. We need the following conditions to be met in order to have your design entered into our competition:

* Cost-efficient
* Powered with alternate energy source (chemical, elastic, etc)
* Operable

Other considerations that you may want to think about when making your car:

* Weight
* Speed
* Appearance
* Reliability

As your work on this project, please keep in mind that when our engineers work to design a project, they often do not get to the best answer the first time. We know that you will probably go through several different designs before you find your favorite. It is of utmost importance that you keep copies of your previous designs and submit them with your final product. We look forward to seeing these designs, your budget, and your test results to show us that your car is operable.

**Unit Overview and Table of Contents**

Prior to this unit, students should have seen lessons on the following topics:

* How to calculate velocity, speed and acceleration
* Gravitational force, force applied, force normal, friction, balanced and unbalanced forces

They should also have experience working in groups for 21st century skills as well as processing and decision making within a group.

1. Lesson 01: Project Introduction
2. Lesson 02: Energy Transformations and Transfers

Students will learn how circuits work, and what energy transformations and transfers are

1. Lesson 03: Design Your Car

Students will begin to plan out their design to their car. They will start by doing research on how to build a car. They will be given a list of materials, a budget, and a list of requirements. In their teams they will draw a prototype for their car.

1. Lesson 04: Build Your Car

Students will use the given materials to propose a budget and then use their drawing to build a car to match their prototype.

1. Lesson 05: Design and Apply Experiments

Students will design experiments that they can use to test their cars in order to meet the requirements set before them. (i.e. survive an impact, reach a given speed in a given amount of time, impact/collision, etc.) They will then use those experiments to test their prototype.

1. Lesson 06: Analysis of Design and Redesign/Rebuild

Students will work with their group to analyze the results of their experiments. They will then redesign their car and rebuild it in order to make it better. Even if they met all of the requirements, they can still redesign their car to make it better.

1. Lesson 07: Reflection and Analysis

Students will reflection on individual learning and the car build success/failure and develop ideas that could make it better.

1. Lesson 08: Sell It To Me

Students will develop a presentation as if their were the manufacturer and try to sell their car to the class. They will report the data they have on their car.

**Provide the following items for the entire unit:**

**Standards (NGSS, CCSS, CTE):**

NGSS Science Standards:

* Models can be used to represent systems and their interactions – such as inputs, processes, and outputs – and energy and matter flows within systems. (MS-PS3-2)
* [Energy may take different forms (e.g. energy in fields, thermal energy, energy of motion). (MS-PS3-5)](http://www.nap.edu/openbook.php?record_id=13165&page=94)
* [The transfer of energy can be tracked as energy flows through a designed or natural system. (MS-PS3-3)](http://www.nap.edu/openbook.php?record_id=13165&page=94)
* [Apply scientific ideas or principles to design, construct, and test a design of an object, tool, process or system. (MS-PS3-3)](http://www.nap.edu/openbook.php?record_id=13165&page=67)
* A solution needs to be tested, and then modified on the basis of the test results in order to improve it. There are systematic processes for evaluating solutions with respect to how well they meet criteria and constraints of a problem. (secondary to MS-PS3-3)
* [Plan an investigation individually and collaboratively, and in the design: identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data are needed to support a claim. (MS-PS3-4)](http://www.nap.edu/openbook.php?record_id=13165&page=59)
* Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.(MS-PS2-4)
* Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object. (MS-PS2-2)
* The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2.A)
* Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. (MS-ETS1-3)
* Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. (MS-ETS1-4)

CCSS Math Standards:

* Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers (7.NS.A.1)
* Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers (7.NS.A.2)
* Solve real-world and mathematical problems involving the four operations with rational numbers (7.NS.A.3)
* Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. (7.EE.B.4)
* Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form, using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (7.EE.B.3)

**Soft Skills:**

Collaboration, Communication, Creativity and Innovation, Problem-Solving, Critical Thinking, Resilience

**Locally and/or Personally Relevant for Students:**

The Boeing Company has always been the one that builds the best airplanes but now they are being beat by Airbus because Airbus can build cheaper airplanes. This project helps students see that sometimes building the best is not always the cheapest. In addition, many new cars will be on the road when students begin to drive and become adults. This will help them better understand how cars are built and designed and what to look for in a car.

**Connections to career and educational pathways:**

* Product design engineer
* Mechanical engineer
* Stress engineer
* Electrical engineer
* Designer
* Communications fields
* Marketing