

THE FUTURE'S CHANNEL  
FUEL CELL VIDEO - LESSONS

**Subject:** Science

**Grade Level:** 8th Grade, 9th Grade, 10th grade, 11th Grade, 12th Grade  
(CCSS [MS-PS1-5](#), [MS-PS1-6](#), [HS-PS1-4](#), [HS-PS1-7](#))

**Topics:** The Nature of Science and Technology, Experimentation, physics

**Concepts:**

- Conservation of matter and energy in designed or natural processes

**Knowledge and Skills Needed for the Project:**

- Is familiar with internet research
- Can create a diagram of basic machine models and flow lines
- Can present researched information clearly and in written form
- Can find similarities and differences and relate these to practical uses and problem solving
- Can create a pie chart with percentages

**Materials:**

Large paper or poster boards  
pens, markers, colored pencils, rulers, pencils  
Access to the internet for research

Watch TFC video of the Fuel Cell

**Lesson:**

Procedure: This project should be done by students in teams of two or three.

Tell students they are going to use conservation of matter and energy to help a company decide which engine they should use in their new car.

This project will help student see how knowing about conservation of matter and energy can help design new things and move society forward.

Introduce the concept of efficiency and waste as far as engines are concerned. Give the example of two engines, both given 1 gallon of fuel. Engine A can only go 10 miles on the one gallon of fuel. Engine B can go 25 miles on one gallon of fuel. Ask students which engine is more efficient? Explain to them that, the concept of a more efficient engine means that the engine can do more work on the same amount of fuel.

Compare the common combustion (car) engine at 15% - 25% efficiency to that of a hybrid engine at 25% - 30% efficiency and then to the fuel cell at almost 70% efficiency.

Relate this information to the concept of conservation of matter and energy as well as energy transfer. Discuss further the transfer of matter to energy and how most energy loss is in the form of motion or heat. Give real world examples where engines have been used to do work (cars, pumps, space ships, generators, etc)

Tell you students that though fuel is used in many engines, and for many things, in all of these cases once matter is transferred into energy, it does not disappear. It all goes somewhere. Knowing this, students can begin to think about how matter and energy is used and how to cut down waste.

## **STUDENT PROJECT**

You have been asked to create a presentation board for a company looking for a new type of engine. The company would like to compare the 3 most common engines - combustion, hybrid and fuel cell - as far as their efficiency is concerned before deciding which they will use in their new cars. The company is environmentally conscious and wishes to have an engine that will not be wasteful of matter and energy.

Do the following steps for the 3 types of engine mentioned above. (common combustion engine, hybrid engine and fuel cell engine)

1. Research how each engine takes its fuel in and processes it. This should be done for the combustion, hybrid and fuel cell engine. \*\*\*\*\*Website resources: [www.carandengine.com](http://www.carandengine.com), [www.youtube.com](http://www.youtube.com), suggested search "how does an engine work, simple", [www.energy.gov](http://www.energy.gov) suggested search "fuel cells", [www.fchea.org/fuelcells](http://www.fchea.org/fuelcells), [afdc.energy.gov](http://afdc.energy.gov), [www.fueleconomy.gov](http://www.fueleconomy.gov),  
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2. Create a large diagram of each engine. Using arrows, show how the fuel enters the engine, is processed by the engine and in

which forms the matter and energy leave the engine. Explain each part of the process.

3. For each of the above engines, use percentages to make a pie chart showing where the energy goes after the fuel is processed. This may be in the form of heat, motion, etc.
4. Present your findings to the class. Recommended presentation types, poster board and drawings, google slides or powerpoint.

End of lesson