***Test your knowledge before and after reading and investigating the topic of hydrogen and fuel cells.***

***Please encourage research and discussions about the topic before and after the activity.***

**New Hydrogen Fleet – KS4-5**

Background of the new Translink Hydrogen Bus – Did you know?

The decarbonisation of public transport in Northern Ireland has taken a significant leap forward with a new contract for 145 zero and low emission buses. The buses have been supplied by local firm Wrightbus and the associated infrastructure.

They form a key part of Translink’s Net Zero Emissions Strategy and will be fundamental in creating cleaner and greener transport to positively impact the climate emergency and air quality.

The 100 zero emission buses comprise **80 Battery Electric Vehicles and 20 Hydrogen Fuel Cell Electric Vehicles** and will be the most environmentally-friendly buses in Ireland!

They will be deployed between Metro in Belfast and Foyle Metro services in Derry.  There will also be 45 low emissions buses for Ulsterbus services across Northern Ireland.

**How much do we know about hydrogen and fuel cells?**

Hydrogen and fuel cell technologies power cars, buildings and more. But how much do you know about them? Test your knowledge with this quiz!

1. How do fuel cells generate electricity?

* Combustion
* Fusion
* Electrochemical reaction – *Much like a battery, a fuel cell produces electricity through an electrochemical reaction, which generates electricity without any combustion. Unlike batteries, fuel cells don't wear out and continuously provide electricity as long as there's a constant source of fuel and oxygen*
* Organic reaction

1. What do fuel cells emit?

* Oxygen
* Hydrogen
* Nothing
* Water - *Fuel cells typically generate electricity using hydrogen and emit only water and heat. For polymer electrolyte membrane (PEM) fuel cells, hydrogen is fed into one side of the fuel cell, and oxygen is fed into the other. Hydrogen ions pass through a membrane and react with the oxygen on the other side to form H2O (or water) and create electricity*

1. When was the first fuel cell invented?

* 1701
* 1901
* 1839 - *Welsh scientist Sir William Robert Grove is credited for inventing fuel cells in 1839. However, the technology wasn't used commercially until the 1960s*
* 1879

1. How do you boost the amount of electricity a fuel cell system produces?

* Adding oxygen
* Adding hydrogen
* Adding cells - *A single fuel cell produces about one volt of power. To increase the amount of electricity generated, individual fuel cells are combined to create a fuel cell stack. Depending on the application, a fuel cell stack might only contain a few cells, such as when used for portable power generation for laptops or other consumer electronics, or hundreds of individual cells, like when used to power passenger vehicles*
* Adding protons

1. When were fuel cells first used in space?

* Apollo Program
* Space Shuttle Program
* Project Mercury
* Gemini Program - *NASA first used fuel cells in 1965 to power on board electronics during the Gemini 5 mission, which broke the world's manned spaceflight endurance record. Fuel cells not only provided power but also water for astronauts. The technology improved and was used on all subsequent manned space missions including the Apollo and Space Shuttle programs*

1. Globally, how many hydrogen fuel cell cars are on the road?

* 5,000
* 15,000
* 25,000 - *Many countries in Europe, the Americas, and Asia have deployed hydrogen fuel cell cars as part of their national hydrogen strategy. These countries are part of the International Partnership for Hydrogen and Fuel Cells in the Economy―a government to government partnership with 19 country members and the European commission working together to accelerate progress in hydrogen and fuel cells. There are currently three fuel cell vehicles in production: the Honda Clarity, Toyota Mirai, and Hyundai Nexo*
* 50,000

1. What are the two most common ways to produce hydrogen gas used in fuel cells?

* Electromagnetism and quantum mechanics
* Steam reforming and electrolysis - *Since hydrogen does not exist as a gas on Earth, it must be separated from other elements. Hydrogen atoms can be separated from water, natural gas molecules or biomass. The two most common ways to produce hydrogen are steam reforming (using high-temperature steam to produce hydrogen from natural gas) and electrolysis (splitting water)*
* Electrolysis and absorption
* Thermal conductivity and refraction

1. How do you refuel a fuel cell electric vehicle?

* Fill the tank with water
* Plug the vehicle into a charging station
* Pump hydrogen gas directly into the tank - *To refill a fuel cell electric vehicle, you pump hydrogen gas from a hydrogen fuelling station directly into the tank. Fuel cell electric vehicles can have a driving range of more than 300 miles on one tank of hydrogen. Since fuel cell systems are more than two times as efficient as an internal combustion engine, you need half the amount of hydrogen to go just as far*
* Pump gasoline into the tank

1. How much of the known universe mass is made up of hydrogen?

* 99 percent
* 75 percent - *Hydrogen is the most abundant element in the universe. About 75 percent of all matter is composed of hydrogen*
* 25 percent
* 50 percent