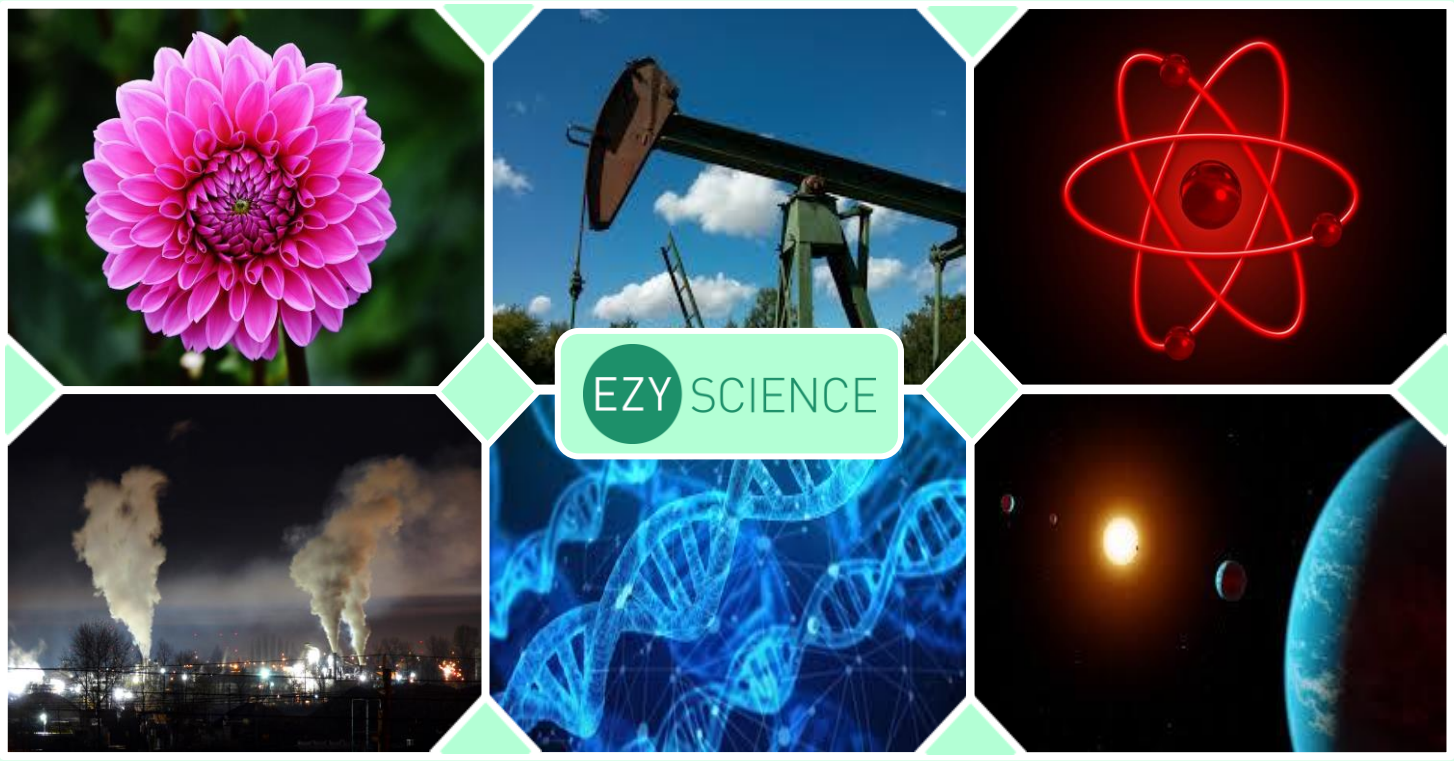
Science in the News



November Edition | **Written by Mark Simpson (EzyScience Course Leader)**

What Can You Expect?

Welcome to our monthly review of some of the most interesting snippets of Science news from around the world.

Here we will be analysing some of the recent discoveries, inventions and theories, and applying them to the relevant topic areas across GCSE Science. Alongside the news review, we provide you with examples of application questions from that story that you can attempt to challenge yourself in this topic area.

The content selected will be relevant for those studying AQA, Edexcel and IGCSE Science.

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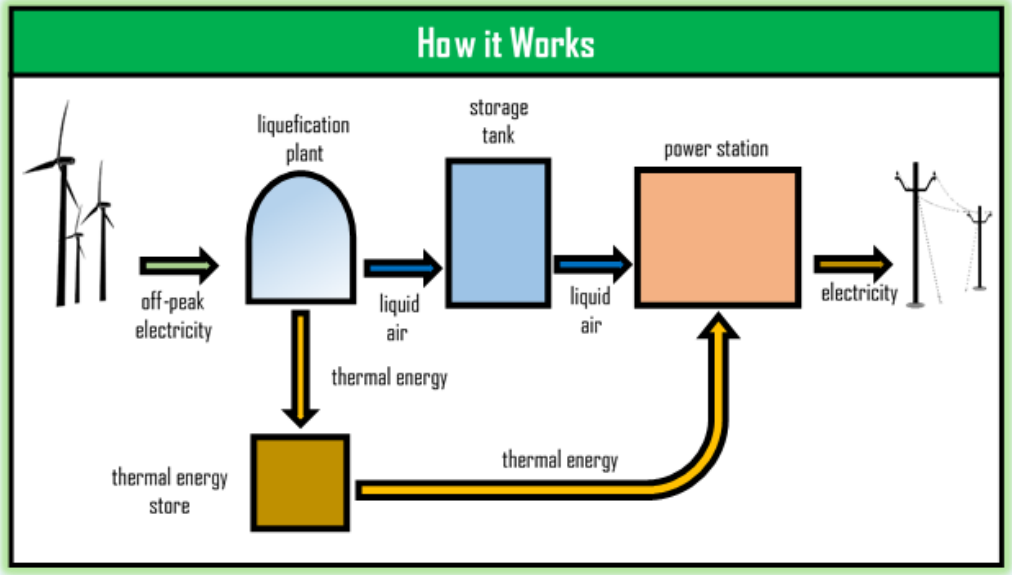
Inside This Edition

Using Liquid Air to Store Energy

A British company, Highview, has recently announced plans to build an energy storage facility that will ensure that more than 25,000 homes have a continuous supply of electrical energy generated through renewable, zero-carbon methods. The facility will store the electrical energy generated by wind turbines at night so that it can be used during the day at times of peak demand.

Wind farms produce electrical energy without producing carbon dioxide and so do not contribute to global warming. However, wind is not a very reliable source of energy and it is not always possible to match the output from wind farms to the demand for electricity. One way of matching supply more effectively to demand is to store the off-peak electrical energy so that it can then be used when demand rises.

Off-peak electricity is used to compress and cool air to -196 °C so that it changes from a gas to a liquid, which is then stored in a tank. In this process 700 m^3 air is compressed into a space of 1 m^3. Furthermore, the thermal energy that is removed from the air as it is liquefied can be absorbed by a suitable material and stored to be used later.



When demand for electricity increases, the stored thermal energy is used to heat the liquefied air and turn it back into a gas, and as it expands it drives a turbine to generate more electricity.

This is one of several ways of storing off-peak electrical energy to be used later. Batteries are a common way of storing off-peak electrical energy, as are pumped-storage systems. Because of losses of thermal energy to the surroundings, the storage of electrical energy using liquid air is less efficient than either batteries or pumped storage systems. However, batteries contain large amounts of expensive finite materials, such as rare earth metals, making them expensive, and must be replaced regularly, and pumped storage systems take up a lot of room. The liquid-air storage system makes use of a plentiful and free resource (the air) and a large amount of energy can be stored in a relatively small space. Furthermore, the technology for liquefying air is already well developed and understood, and a liquefication plant can be expected to last for at least 20 years.

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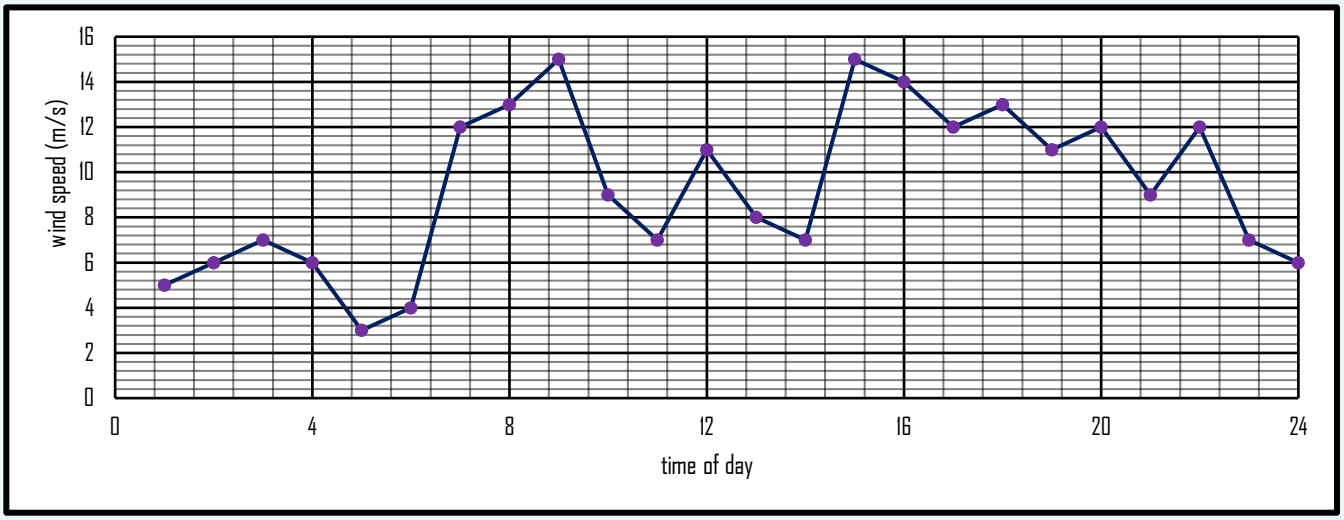
Review Questions

1. The graph shows how the speed of the wind at a wind farm changes over one day.

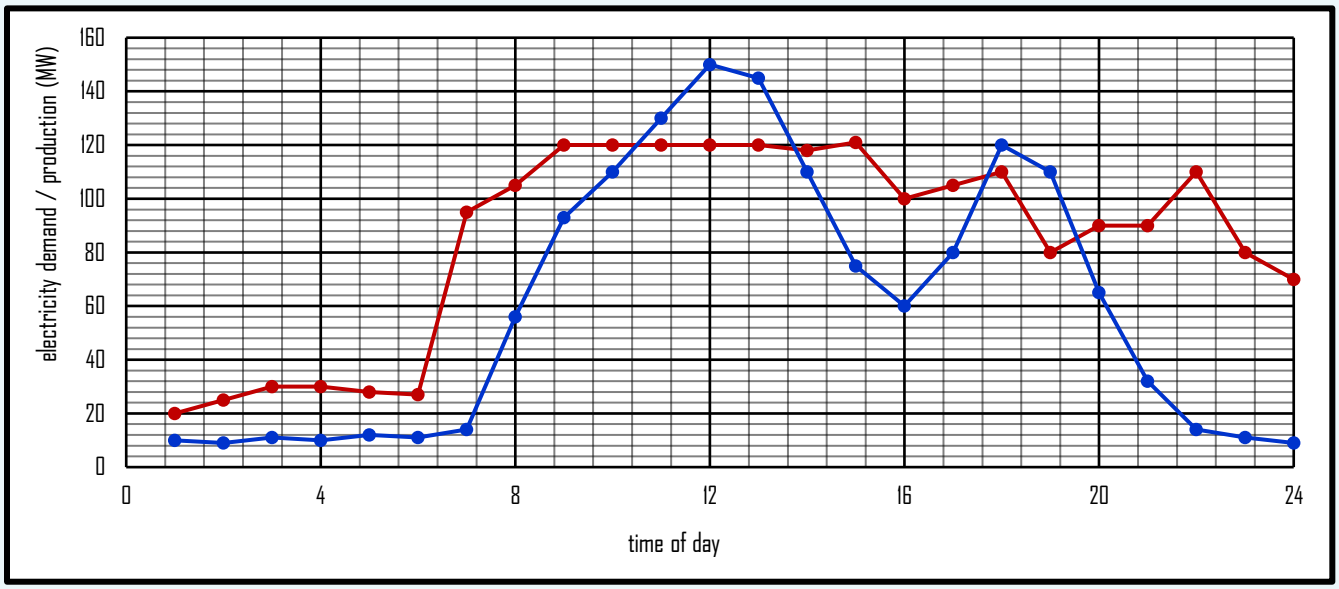


Use information from the graph to explain why wind farms on their own are not considered to be a reliable source of electricity.

[2 Marks]

2. A wind farm has been built to supply a small town.

The graphs show how the production of electricity and the demand for electricity in the town vary over one day.



When electricity production for the wind farm is greater than electricity demand for the town the excess electricity is used to liquify air.

For how many hours in the day is air liquefied?

[1 Mark]

3. A lithium-ion battery can store about 6 kWh energy for each kilogram of battery.

The liquefied air storage plant proposed by Highview will be able to store 50 MWh energy.

What mass of batteries would be needed to store the same amount of energy as the liquefied air storage plant?

[3 Marks]

4. A pumped storage system uses off peak electricity to pump water from a low reservoir to a high reservoir. When demand for electricity increases water is allowed to flow back from the high reservoir to the low reservoir, passing through a turbine as it does so. The turbine is in turn connected to an electrical generator.

Describe the energy transfers that take place when a pumped storage system is used.

[2 Marks]

5. Describe and explain the advantages of liquefied air energy storage over battery and pumped storage systems.

[3 Marks]

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Invention of the Plastic Carrier Bag

In 1962 Sten Gustaf Thulin invented a method to form polythene into simple bags, and so the first polythene carrier bag was born.

Thulin's plastic bags were found to be much stronger than the alternatives made from paper and his intention was that each bag would be re-used very many times and he certainly didn't see them as disposable – his son has described how Thulin always had one folded up in his pocket.

Since their invention countless polythene bags have been produced, and despite Thulin's intention of them being used repeatedly, many are used only once and then end up being thrown away and dumped in landfill sites and the oceans. This is an issue because the polythene from which these bags are made is not biodegradable – that is, the plastic does not quickly break down into simpler, harmless materials.

Over recent years the problems caused by discarded polythene carrier bags have been highlighted, particularly by David Attenborough, and as a results there have been attempts in many countries to reduce the number of these bags that end up being thrown away, and in some they have even been banned. However, when evaluating the impact of polythene bags on the environment we also must consider the impacts of their production and compare these to the impacts of producing alternatives, such as paper bags.

The table compares the production and use of polythene bags to the production and use of paper bags:

	Paper	Polythene
Mass of 1,000 bags (same size and strength) (kg)	50	6
Energy used in production (GJ)	1.7	0.7
Greenhouse gas emissions due to production (kg)	80	40
Freshwater consumed due to production (L)	4,000	220
Biodegradable?	✓	×
Recyclable?	✓	✓
Indefinite recycled life?	×	✓

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Review Questions

1. John likes to use a paper carrier bag when he goes shopping. He finds that on average one such bag can be used five times before it tears and can no longer be used.

John's sister Grace prefers to use a polythene carrier bag of the same size and strength when she goes shopping. Grace finds that on average she can use one such bag 25 times before it tears and can no longer be used.

Compare the impacts on the environment of John and Grace's preferences for carrying their shopping.

[6 Marks]

2. Grace suggests that more carbon dioxide is produced when transporting the paper bags from the factory to the supermarkets where they are used than when transporting polythene bags.

Explain whether Grace is correct.

[2 Marks]

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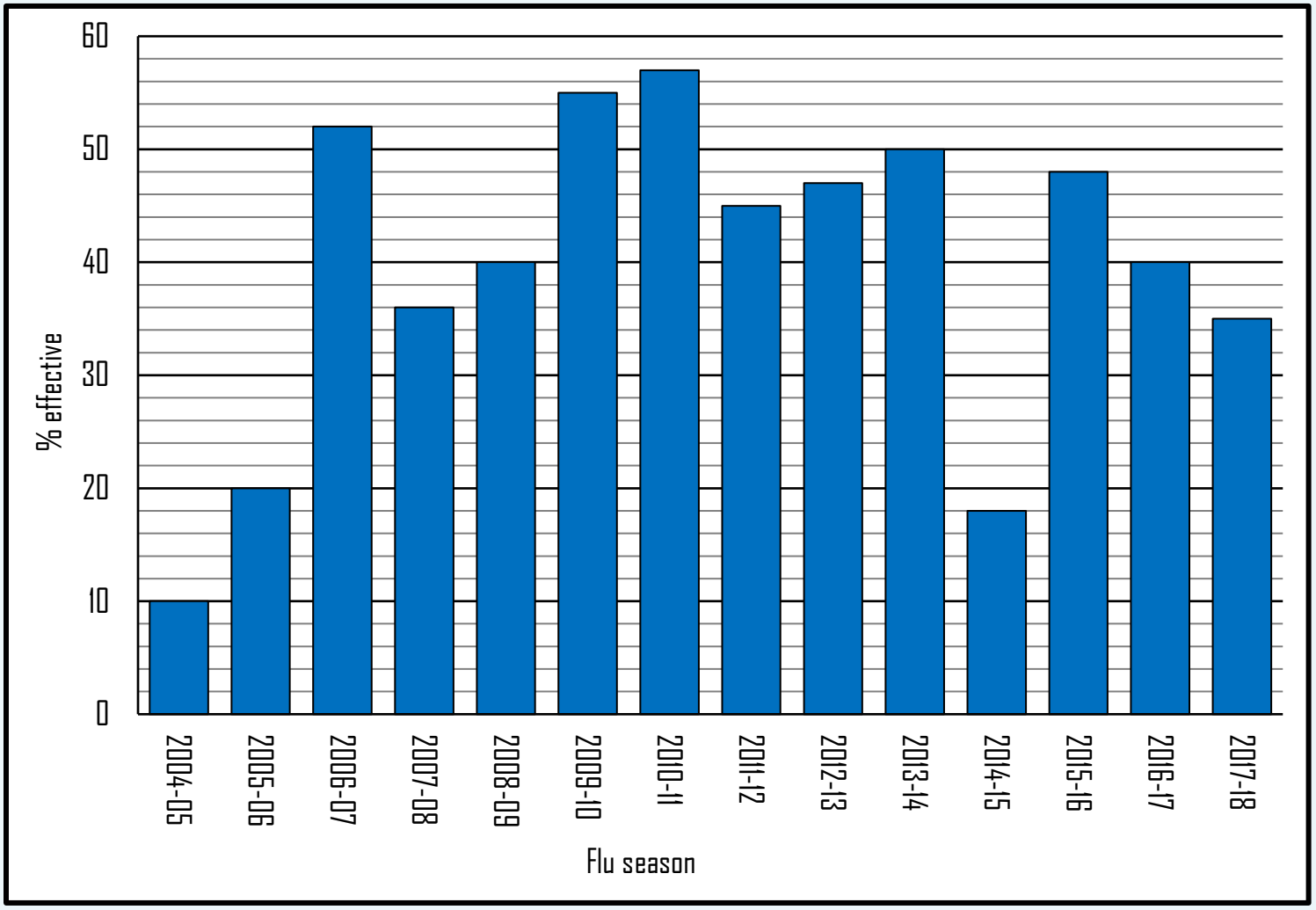
Assessing the Effectiveness of the Flu Jab

As we head towards winter people are being encouraged to visit their doctors to be vaccinated against flu.

The flu vaccine comes in different forms to meet the needs of different groups of people, but all of them protect against more than one type of flu, usually four. Each year, the viruses that are most likely to cause flu are identified in advance by the World Health Organisation (WHO), which recommends which strains of the flu virus to include.

Unfortunately, the vaccine cannot contain all the known strains of the flu virus and sometimes the virus mutates in unexpected ways. Consequently, having the flu jab is not a 100% guarantee of not getting flu. That said, if you do get flu after being vaccinated it is likely to be milder and shorter lived than it might otherwise have been.

The graph shows the effectiveness of the flu vaccine over the 14 years up to 2014.



Review Questions

1. Calculate the difference in effectiveness between the most successful year and the least successful year over the period shown.

[2 Marks]

2. In England in the period from 1st September 2017 to 28th February 2018, 294,000 pregnant women had the flu jab.

   How many of these women would you expect not to have suffered from the flu in this period?

[2 Marks]

3. In England in the period from 1st September 2017 to 28th February 2018, 10,000,000 patients aged 65 and over were registered with GPs. 72% of these patients were vaccinated against flu.

   How many of these patients would you expect not to have suffered from the flu in this period?

[2 Marks]

4. The NHS keeps data on the percentage uptake of the flu vaccine for particular groups such as pregnant women, people of age 65 and over and two-year-old children.

   Suggest why we can only estimate the number of people in each group who will not suffer from the flu in a particular year.

[3 Marks]

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