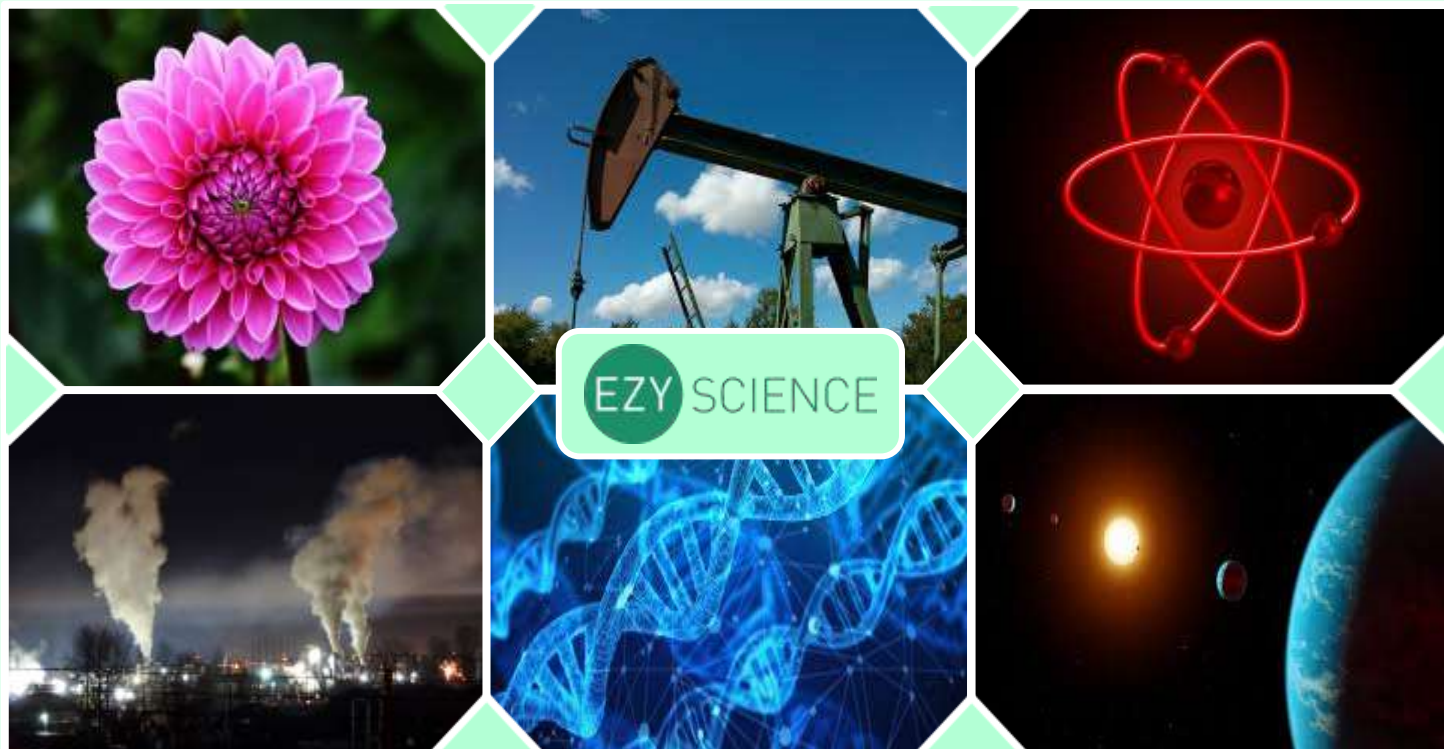


EZY

# Science in the News

EZY



EZY SCIENCE

January 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*

### **Phages**

This story looks at phages – a special group of viruses - and discusses the medical application of phages in fighting off bacteria.

### **Pollution in India**

This story looks at the causes of air pollution and analyses the increase in air pollution levels in Delhi.

### **Broadband Options**

This story looks at the different forms of broadband connection that are currently deliverable to UK households.

## Phages

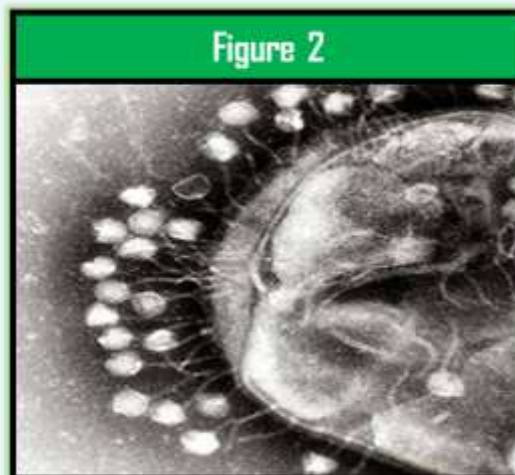
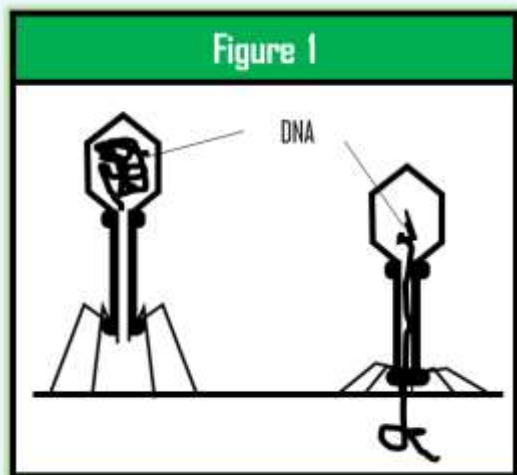
Most students taking the GCSE Science courses have some idea of what bacteria and viruses are.

Some of those students might realise that while some bacteria can cause diseases, such as cholera, others can be beneficial, such as those that aid digestion.

Most of those students would probably view all viruses as harmful, remembering perhaps how viruses, such as the flu virus, destroy living cells.

However, it turns out that some viruses called bacteriophages, or simply phages, cause us no harm whatsoever, and may prove to be highly beneficial to us.

Phages are a type of virus that attack bacteria only.



Viruses attack cells by injecting their own DNA into the cells, as shown in **Figure 1** and **Figure 2**. The viral DNA takes control of the cell and forces it to produce many copies of the virus. These copies then burst out of the cell and destroy it.

Phages act in the same way, but they are very specific – each phage attacks only a small number of different bacteria. Phages are found throughout the environment, but because they are so specific they do not cause widespread damage and do not damage our cells.

Phages were discovered in 1915 and were first used to treat a disease in 1919: Professor Victor-Henri Hutinel first ingested the prepared phages to test for safety and then administered them to a 12-year-old boy with severe dysentery, whose symptoms ceased after a single administration. In the 1920s and 1930s phages were used in Russia, Romania and the United States to treat a small number of diseases.

The antibiotic penicillin was discovered in 1928 and by 1939 a method to produce it in large quantities had been discovered. Penicillin was found to kill a wide range of bacteria and so could be administered with confidence, even if the actual bacteria causing the illness had not been identified.

Although the use of phages continued in Eastern Europe up to the modern day, in the West attention was focused on the development of new antibiotics.



## Pollution in India



At the end of 2019 many cities in India were hit with a serious air pollution problem, with the residents of Delhi reportedly suffering pollution levels almost 40 times higher than those deemed as healthy.

One component of air pollution that causes permanent damage to the lungs is the PM2.5 particulates. This pollution, which is caused mainly by combustion, consists of solid particles smaller than  $2.5 \times 10^{-6}$  m in diameter, which can reach deep in the lungs, resulting in serious health problems.

Sources of PM2.5 pollution in Delhi include car exhausts, solid fuel stoves in homes and stubble burning by farmers in neighboring states, which is common in the months of November and December.

**Figure 1** shows how the PM2.5 concentration in the air in Delhi varied over a 24-hour period in late 2019, as measured at one monitoring station in Delhi.

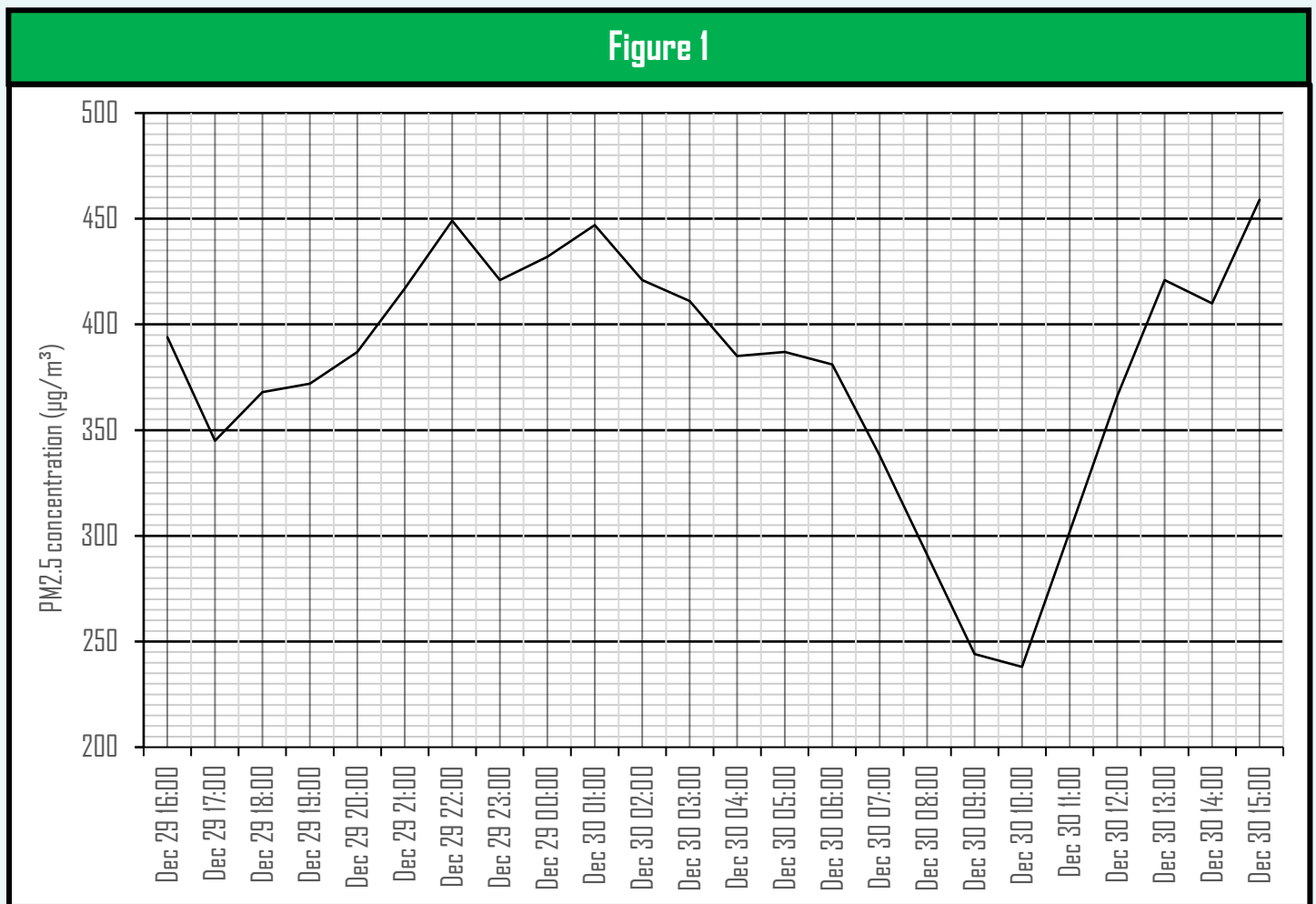
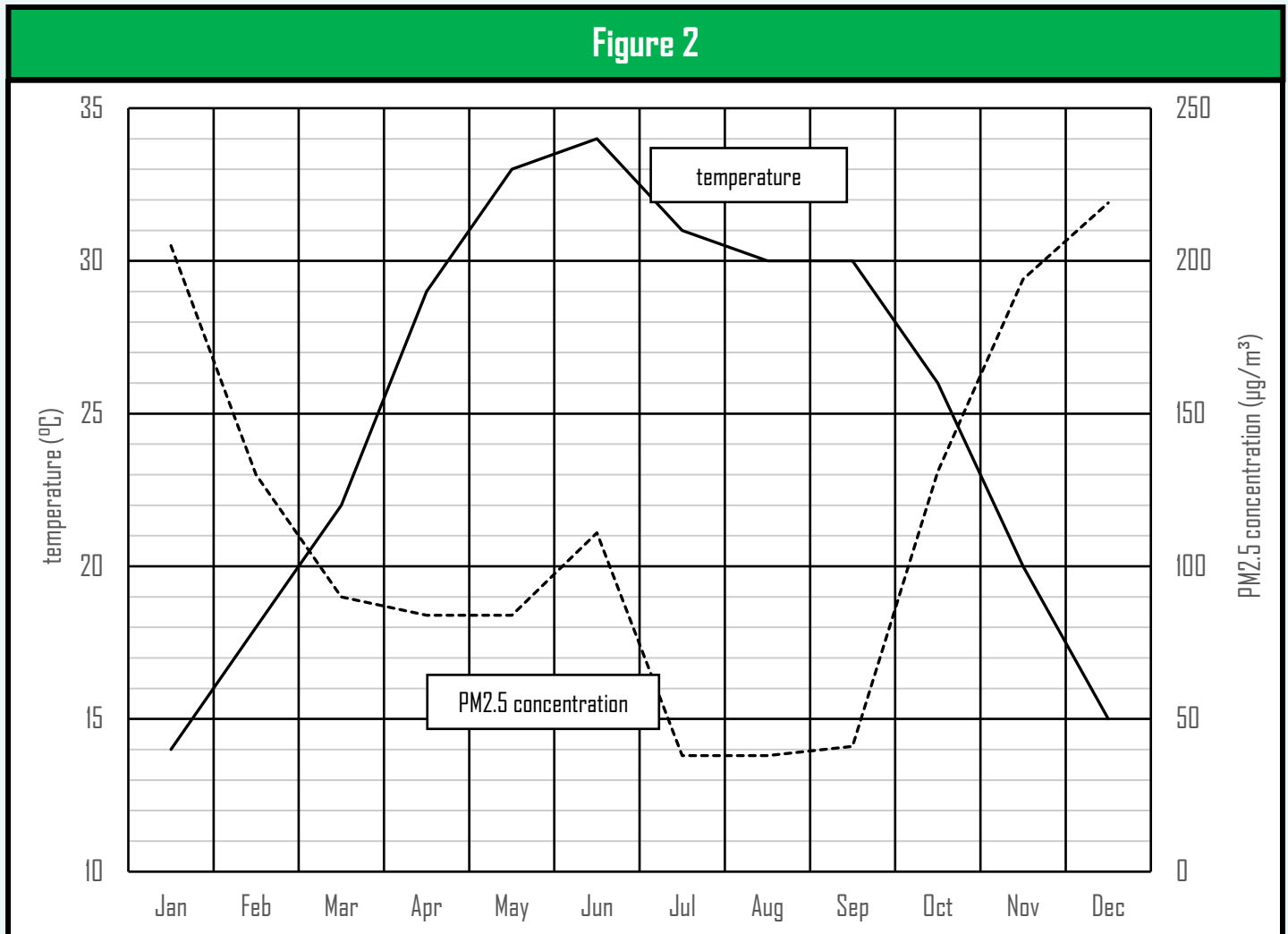


Figure 2 shows how the PM2.5 concentration and average temperature in Delhi varied over the year 2018.



## Review Questions

1. Explain why the unit  $\mu\text{g}/\text{m}^3$  is used to measure the concentration of PM2.5 pollution.

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[2 marks]

2. The World Health Organisation (WHO) recommends that humans should not be exposed to PM2.5 pollution greater than  $10 \mu\text{g}/\text{m}^3$ .

Describe how the PM2.5 concentration shown in **Figure 1** compares to the WHO recommendation over the 24-hour period shown.

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[3 marks]

3. Describe how the concentration of PM2.5 pollution shown by **Figure 1** varies over the 24-hour period shown and suggest reasons for this.

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[3 marks]

4. Describe how the concentration of PM2.5 pollution shown by **Figure 2** varies over the one-year period shown and suggest reasons for this.

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[3 marks]

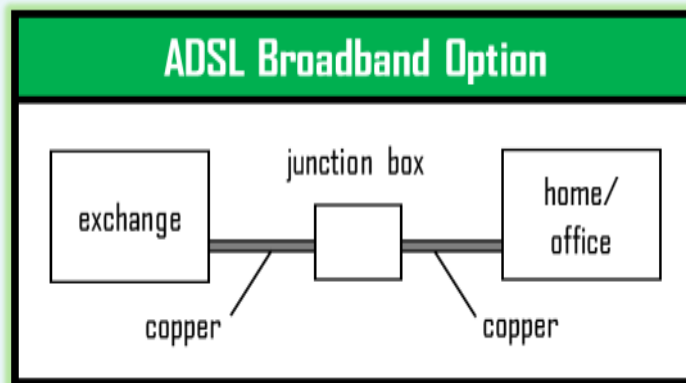
## Broadband Options

One issue that was discussed and argued about in the campaign for the December 2019 general election was the provision of broadband, with promises being made to provide full-fibre broadband to all parts of the country by all the main parties.

The two main ways of transmitting broadband signals between the local telephone exchange and your home or office are through copper wires or through optical fibres. Sometimes a combination of these is used.

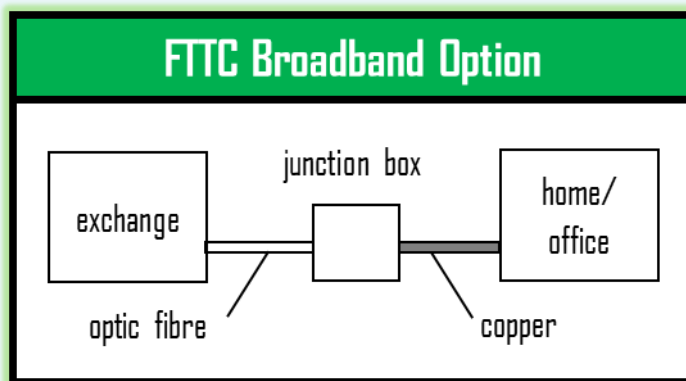
The standard measure of internet speed is the Megabit per second (Mbps). Higher speeds mean more information can be transferred per second, which in turn means that a greater number of devices can be used at the same time without problems.

**ADSL broadband** (asymmetric digital subscriber line) uses copper wires between the exchange and a junction box in the street, and then copper wire again from the junction box to the home or office.



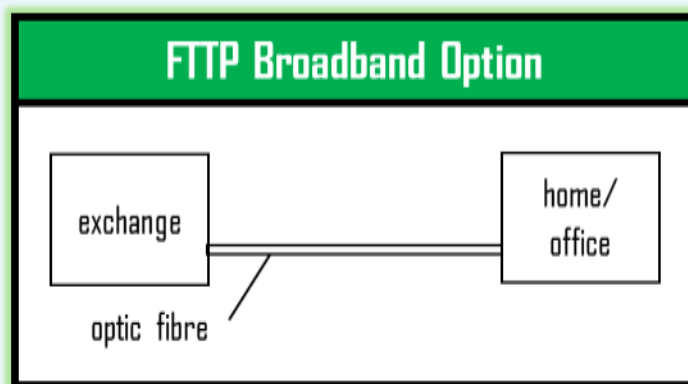
In theory, the most basic ADSL system can deliver a speed of around 8 Mbps, but in practice it is usually much slower.

**FTTC broadband** (fibre to the cabinet) uses a faster optic fibre cable between the exchange and the street level junction box, or cabinet, and then a copper wire between the cabinet and the home or office.



The FTTC system can deliver a speed of up to 66 Mbps.

**FTTP** broadband (fibre to the premises) connect households or offices to the exchange using optic fibre only.



The FTTP system can deliver speeds of up to 1 Gbps.

Copper wires have been used to carry telephone calls for over a century and copper wires still make up a significant part of our current telephone system, which carries both phone calls and broadband. Copper telephone wires carry information on modulated alternating currents. However, copper is a dense material and the wires are relatively thick. Furthermore, the resistance of the copper means that electrical energy is converted to heat energy and as consequence the signal must be amplified at regular intervals by repeater stations.

Optic fibres are a recent innovation. They carry information in the form of light pulses and many different wavelengths of light can travel along the same optic fibre at the same time. The fibres themselves are very thin and even when bundled into cables they are relatively light. A high-quality optic fibre can carry a light wave over a very large distance without significant energy losses, and so few repeater stations are needed.

The cost of manufacturing 1 km of copper telephone cable is significantly lower than the cost of manufacturing the same length of high quality optic fibre cable.



## Review Questions

1. How much faster is the FTTP system compared to the FTTC system?

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[2 marks]

2. Compare the advantages and disadvantages of the three systems outlined above.

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[6 marks]