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TWENTY FIRST CENTURY SCIENCE
SCIENCE A**

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Unit 4 Ideas in Context (Higher Tier)

INSERT

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Afternoon

Time: 45 minutes



INSTRUCTIONS TO CANDIDATES

- This insert contains the three articles required to answer the questions.

This document consists of **8** printed pages.

Is PVC safe for our children?

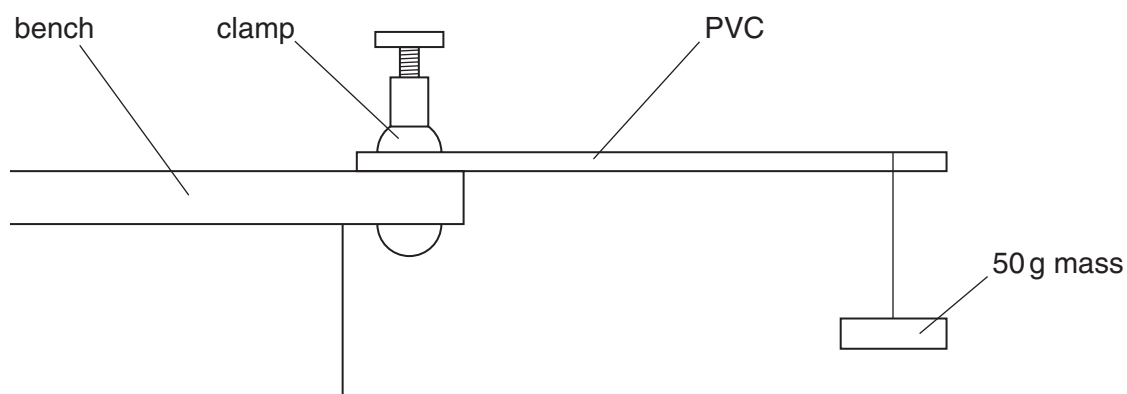
What is PVC?

Polyvinyl chloride (PVC) is a polymer. It is used to make a variety of articles, including car interiors, window frames, water pipes, cling film, food packaging, electric cable insulation, textiles and toys. PVC can be a tough, rigid material, or soft and flexible, depending on the use of plasticizers.

What do plasticizers do?

PVC polymer chains are strongly attracted to each other, which makes the plastic very rigid. The addition of a plasticizer allows the chains to slide against each other, making the polymer softer and more flexible.

Scientists can investigate the effect of a plasticizer on the flexibility of PVC. They measure the bending of PVC containing different amounts of the plasticizer. The apparatus they use is shown in the diagram.



Phthalates are the most common plasticizers used in PVC. Rigid PVC contains no phthalates. Semi-rigid PVC contains about 10 percent phthalates, and flexible PVC as much as 50 percent.

Are plasticizers safe?

Phthalates move easily out of the PVC polymer, since they are weakly bound to the PVC molecules. Phthalates are almost insoluble in water, but highly soluble in fats and oils. Significant amounts have been found in the surface layers of fatty foods, such as butter, cheese, and prepared meat products, packaged in PVC.

Single doses of phthalates show almost no toxic effects. However, phthalates may build up when small doses are taken in over a long period of time. This may result in toxic effects. Accumulation to a harmful level in humans may require up to 50 years. Extensive use of PVC started only during the 1960s, which means that we will not know if there are toxic effects in humans until after 2010.

In one study, monkeys were given weekly blood transfusions for one year with blood kept in PVC bags. Phthalates built up in various tissues. In another study, phthalates have also been found to cause liver damage in rats. No detailed data on the build up of phthalates in humans are available.

The livers of babies and small children do not break down phthalates as efficiently as those of adults, placing babies and small children at higher risk. Since 1999, the European Union has decided that phthalates cannot be used in PVC in toys for babies and small children. However, several major toy manufacturers think we should not be worried about the safety of using phthalates to soften children's toys.

PVC cling film containing phthalates has been on sale for many years. It has been used to wrap food without any proven ill effects. More recently, PVC cling film containing other plasticizers has become available. It is also possible to buy cling film made from poly(ethene), which does not contain any plasticizer. A consumer group advises, "It's impossible to say whether a tiny serving of plasticizers is risky or not. You should buy PVC cling film that does not contain phthalate plasticizer or cling film made from poly(ethene)".

Herceptin: a new cancer treatment

Cancer

There are many types of cancer; all involve uncontrolled cell division following changes to cell DNA. Usually the cell division leads to the production of a tumour. The growth of tumours can be very slow and hard to detect. Many cancers can spread and so can come back even after apparently successful treatment.

Herceptin

A new drug called Herceptin has been introduced. It stops cancer cells from dividing and so slows the development of the disease.

Herceptin has been used to treat women with advanced breast cancer, but not those with early breast cancer. Early results from three large trials have all shown that Herceptin may also help to reduce the risk of cancer returning after surgery to remove a tumour. All women were given chemotherapy, with or without Herceptin. In the trials, the women who received Herceptin had their risk of cancer coming back halved, when compared with those who received chemotherapy alone.

A longer follow-up study is needed in order to draw firm conclusions.

Testing new cancer drugs

Drugs are first tested in the laboratory. If it seems that they may be useful in treating cancer, they are tested in three phases. Without trials, there is a risk that patients could be given treatments which have no advantage, waste resources and might even be harmful to them.

Phase 1

The drugs are offered to people whose cancer has returned or spread and for whom there is no other available treatment. It is used to find out if the drug is effective for any patients and if there are any serious side effects.

The volunteers are monitored throughout the trial very carefully and make frequent visits to specialist hospitals. If the drug is shown to be effective, scientists start a phase 2 trial.

Phase 2

A phase 2 trial uses a greater number of patients with cancers at an earlier stage. The aim is to find out which kind of cancers can be treated and the percentage of patients for whom it will work well.

Phase 3

These trials compare the effectiveness of the new drug with the existing treatments. These are large trials involving hundreds or thousands of patients. Scientists measure how many years the patients survive without the disease coming back and how the patients' quality of life is affected. They also monitor occurrence of side effects.

Which drugs should be used?

If a drug passes all three trials, it will be granted a licence and can be used in healthcare. Herceptin is licensed for treatment of advanced breast cancer but not for use in women with early breast cancer.

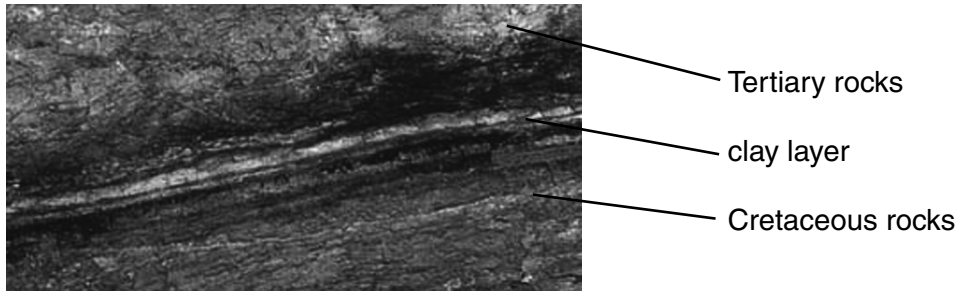
Cost analysis of Herceptin concluded that it is a promising but very expensive drug. Herceptin is more expensive than other drugs used to treat cancer but could prove to have long term economic benefits.

Once drugs have been licensed, NICE (the National Institute for Health and Clinical Excellence) decides whether or not to recommend their use by the NHS. NICE evaluates the evidence that a drug works and decides if it provides value for money. Once a drug is recommended, then the NHS must ensure that it is available to those people it could help.

How did the dinosaurs die?

Alvarez' work in Italy (1980)

The asteroid impact theory of the extinction of the dinosaurs started with research in Gubbio, Italy by geologist Walter Alvarez. Between the layers of sedimentary rocks from the Cretaceous and Tertiary periods, he found a thin layer of clay which had a lot of soot in it. He wanted to know how long this clay layer took to form, so he asked the advice of his father Luis.



Luis Alvarez was a famous physicist who had received the Nobel Prize in 1968. He had the idea of using meteor dust to find how long the clay layer took to form. Meteors burn up in the Earth's atmosphere all the time, and their fine dust settles everywhere. Meteors and asteroids contain iridium, which is very rare in the Earth's crust.

Luis realized that the Earth is getting a constant sprinkling of iridium from meteor dust and that this builds up at a steady rate in sedimentary rocks. Rocks with more iridium must have taken longer to form, so it should be possible to work out how long any layer took to form by measuring the iridium in it.

The iridium layer

Luis Alvarez knew Frank Asaro and Helen Michel, two chemists who had developed a technique for making precise measurements of very low concentrations of elements. Their laboratory was one of only a few in the world that could undertake the difficult analytical tasks required by this problem. Walter and Luis Alvarez sent their clay sample to Asaro and Michel to measure the amount of iridium present. It was far greater than the amount in the rocks above and below the clay layer.

The Alvarazes thought that all this iridium may have arrived on Earth in one go, in a giant asteroid which exploded, sending iridium all around the Earth. At the end of the Cretaceous period, nearly half of all species on Earth, including the dinosaurs, became extinct. This made Luis and Walter Alvarez suggest that a giant asteroid hit the Earth at that time, causing dense clouds of dust to rise throughout the atmosphere, cooling the Earth and killing off most plants. The impact would have also created world-wide forest fires.

Very soon, measurements of the iridium present at the Cretaceous-Tertiary boundary in other parts of the world were made. The concentrations were all found to be many times higher than the concentration of iridium in most rocks.

Further support came in the 1990s from the discovery of a huge, buried impact crater at Chicxulub, on the Mexican coast, dated at about the right time.

Continuing debate

Not everyone agrees with the asteroid theory. There are other theories for the extinction of the dinosaurs. These include massive volcanic eruptions in India in a region known as the Deccan Traps. These happened exactly at the end of the Cretaceous period. The eruptions would also have created world-wide forest fires and filled the atmosphere with dust and acid fumes.

An Earth scientist says:



Volcanic eruptions can inject large amounts of sulfur dioxide into the atmosphere. If there are a lot of eruptions in a short time, this will change the climate and have a big impact on the environment.

Most mass extinctions over the past 300 million years have coincided with large volcanic eruptions. The general rule is that massive volcanism like the Deccan Traps correlates with all major mass extinctions in Earth's history.

Supporters of this theory say that huge volcanoes give out iridium from deep inside the Earth, and that the Deccan Traps eruptions were much closer in time to the end of the Cretaceous period than the Chicxulub crater. These geologists also say that the Chicxulub crater was created 300 000 years before the dinosaurs died out. They suggest that there may have been other asteroid impacts whose craters have not been discovered. It has even been suggested that the Indian super-volcano eruption was caused by an asteroid impact, so that both theories could be correct.

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