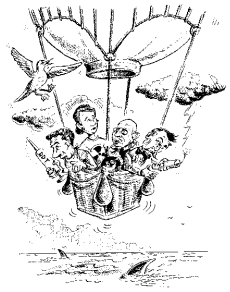
Most noble Nobel



UNIT 7

This unit looks at four important scientists and their discoveries in the field of chemistry, each of which had the potential of being used for good or ill.

Using this unit

Some knowledge of the Haber process and of the use of pesticides may be helpful but the work does not require any specialist knowledge.

The material could be used as the basis of a balloon debate, the four scientists being linked in several ways:

- they are all connected with the Nobel prizes, in that Nobel bequeathed the prizes, and Haber (chemistry), Curie (chemistry and physics) and Mueller (medicine) all won prizes; and
- their work has been of considerable benefit to humankind but the misuse of it has led to considerable harm.

Students will require a dictionary for work on Nobel and a dictionary, Hazcards and a textbook for work on Haber.

Links with GCSE

Sc3 Materials and their properties

- How nitrogen can be converted to ammonia in industry.

Sc0 Application of Science

- Ways in which science is applied and used.
- The benefits and drawbacks of scientific and technological developments for individuals, communities and environments.
- Use of scientific knowledge and understanding to evaluate the effects of some applications of science on health and on the quality of life.
- The power and limitations of science in addressing industrial, social and environmental issues and some of the ethical dilemmas involved.

Moral and spiritual aims

- To show that scientists are not morally neutral and that scientific discoveries can be used for good or evil.
- To help students to see the need to accept responsibility for their actions and the need to think through the likely outcomes of their actions - including their effects on others.

TEACHER'S NOTES

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Notes on the activities

Students could be given one of the biographies to prepare a balloon debate. The next lesson would then be taken in having four 'volunteers' take part in the debate and the class could then vote/discuss whom they feel was most worthy of surviving and/or receiving a Nobel Prize. For this activity, each student would need one of the biographies to prepare their 'evidence'. If sufficient time was allowed before the debate, students could be encouraged to seek further information from text books or CDROM (*Encarta*, *Grolier's* and *Compton's Encyclopedias*, for example, all have useful information) but this will depend on the availability of both resources and time.

Activity 1: Alfred Nobel

1. *Pacifist:* one who is opposed to war or who believes all war to be wrong.
   Bequest: a legacy. An object (sum of money) legally passed on to someone else following the owner's death.

2. (a)

'Good' uses	'Bad' uses
Quarrying (saves human energy)	Bombs/bullets/land-mines and anti-personnel mines
Mining (as above)	Fishing! Drop an explosive into the water and the shockwave stuns or kills all the aquatic life nearby (including that not wanted because it is inedible or too small)
Demolition (faster and safer for the workers)	Sport - the use of guns to kill for 'sport'

2. (b) For the motor car:

Good	Bad
Faster travel - this enables: (i) emergency services to arrive more quickly, so saving lives and property; (ii) travel to 'broaden the mind'; and (iii) convenience - easier to visit distant friends and relatives	Large number of injuries and fatalities every year
	Harmful effects of pollution: lead poisoning, increase in asthma
	Destruction to wildlife habitats in search for oil
	Greenhouse effect - damage to ozone layer

2. (c) Has student used all the information? Is it balanced or has a more 'tabloid' approach been used? Does it make interesting reading? Note: perhaps in the preparation for this some discussion of possible styles of presentation would be useful.

3. (a) and (b) No right answers - are the students able to give a reasoned, balanced reply?

4. (a) Chlorine.
   (b) Probably because his arms would flail about as he was overcome and sank into the 'sea' of chlorine gas that would lie heavily over the land. Chlorine is rather heavier than air.
   (c) The first extract does not give too clear an impression of Owen's thoughts but students will probably suggest something of the horror of war.
   (d) Even through the horrors of war, he can see God in the people around him.

Activity 2: Fritz Haber

1. N = Percentage nitrogen; P = Percentage phosphorus; K = Percentage potassium.
2.

Property	Facts
Colour	Greenish-yellow
Group in the Periodic Table	Group 7 (or VII)
State (at 20ºC)	Gas
Density (air = 0.0013 kg/dm^3)	0.0032 kg/dm^3
Dangers to humans	Has a destructive effect on the respiratory tract
Made by the reaction between ...	Concentrated hydrochloric acid and manganese (IV) oxide (heat required) or concentrated hydrochloric acid and potassium manganate (VII) (no heat required) or dilute acid on bleaching powder

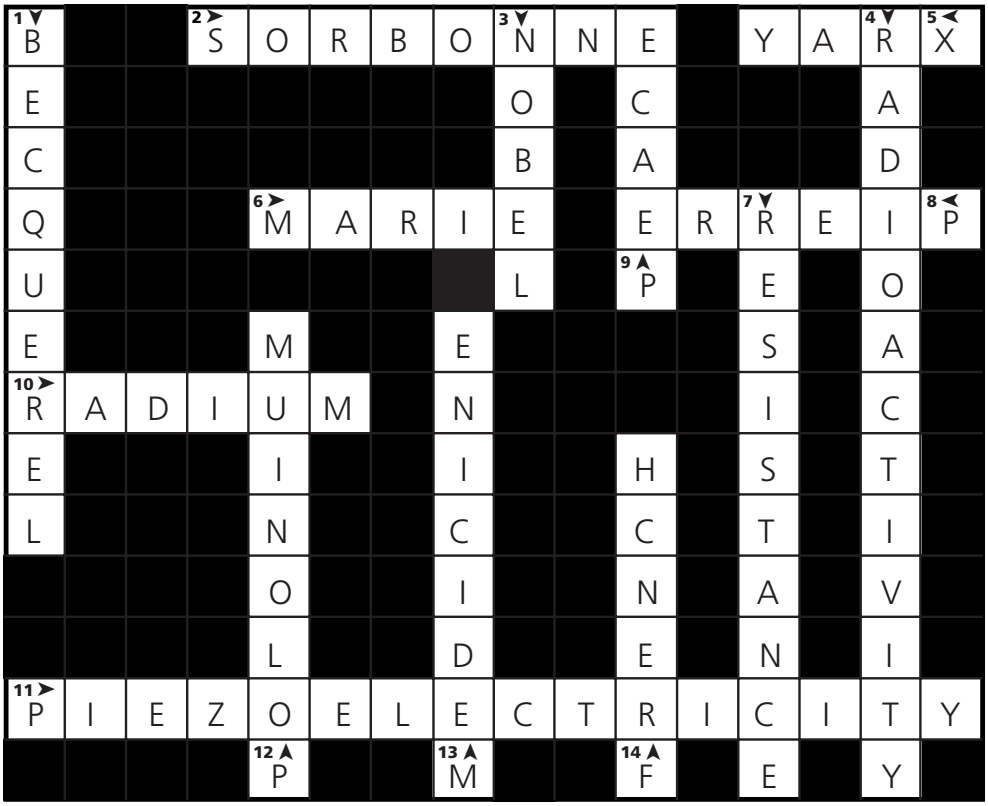
3. (a) Elemental nitrogen in the air.
   (b) The effects of partial, but very significant, damage to the respiratory system.
   (c) This was the large sum of money demanded by the Allied forces to pay toward the repair of damages caused by the Central Powers ('German' will probably be used by students) forces during the war.

4. Patriot: someone who places the needs of their country above all other needs.

5. A reasoned, balanced view is to be looked for here.

Activity 3: Marie Curie

1.



2. Students should acknowledge that she felt the need to develop ways of caring for the vast numbers of people injured during the war to be of greater importance than the subject that had, so far, been her life's work. This was even though she may have wished to expand the work further both for her own reputation but also in memory of her husband.

3. This is related to question 2. She gave up her work to save lives and then realised that this was more important than the pursuit of scientific knowledge for its own sake. This is evident in that, after the war, she narrowed her field of work to those aspects of radioactivity that would save lives.

4. This is an open question, asking the students to reflect on their values and beliefs.

TEACHER'S NOTES

Activity 4: Paul Mueller

1.

Advantages of using DDT	Disadvantages of using DDT
1. Saves many lives	1. Human deaths due to cancer, etc.
2. Increases life expectancy	2. Loss of wildlife
3. Increases crop yields	3. Insect mutation (strictly speaking, the resistance comes from a form of 'natural selection', the insecticide-resistant members breed whilst the others die)
4. Employment in manufacturing and in research and development	etc.
etc.	etc.

2. (a) A balanced discussion needed here. It is the cheap, 'effective' solution in the developing countries but the richer countries can afford to use 'safer' alternatives.
   (b) A partial ban reduces the global effects of a dangerous material. Like CFCs, still used in Third World refrigerators, the less good alternative has to continue in use, sometimes for a complex mixture of reasons.

3. Possible (but not exhaustive) suggestions:
   (a) initially only 'small' amounts were put into the environment.
   (b) the benefits were so obvious that 'minor' problems were overlooked or ignored.
   (c) other things blamed.
   (d) 'another government cover-up!' etc.

4. Some possibilities:
   (a) testing on cultures;
   (b) testing on animals (the LD50 test used to establish the Lethal Dose for 50% of the population);
   (c) testing on 'field samples' (this would be a relatively small area for an insecticide or a limited number of humans if a drug is being tested).
   There are other possibilities.

5. Again, there are many possible views but the opinion expressed should be clear and organised.

TEACHER'S NOTES

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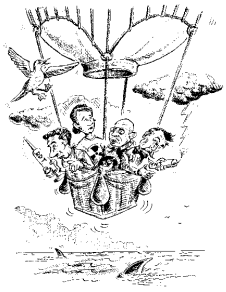


UNIT 7

This unit looks at four important scientists and their discoveries in the field of chemistry. Each of these discoveries can be used for the good of the human race and the environment in which we live. Each can also be used to harm us and our environment.

1 Alfred Nobel (1833-96)

- Born Stockholm, Sweden, on October 21st, 1833
- His father, Immanuel, was a self-educated inventor
- Third of four sons
- Moved to St. Petersburg, Russia, in 1842
- His father manufactured rifles and land- and water-mines
- He made nitroglycerin in Sweden
- A factory explosion killed several people, including his younger brother
- He had to continue his work in a small factory he built on a barge moored in the middle of a lake
- Explosions around the world led to a widespread ban on the transportation of nitroglycerin
- He invented dynamite - much safer than nitroglycerin
- He set up factories in the USA and around Europe
- He patented blasting gelatin in 1876 - an even more powerful explosive
- With his brothers, he developed oil fields in Russia during 1878
- He invented a smokeless explosive in 1888
- He never married
- He made many discoveries about explosives
- He held over 350 patents
- Letters from a leading pacifist led him to make a bequest to set up a peace prize
- He died in Italy on December 10th, 1896
- Most of his fortune was left to found Nobel prizes

1. Using a dictionary, explain 'pacifist' and 'bequest'.

2. Nobel made a vast fortune by developing and manufacturing explosives that could kill or maim ever greater numbers of people, but some historians have claimed that he was trying to produce an explosive of such terribly destructive power that no nation would care to use it. In this way, he may have hoped to bring an end to warfare.
   (a) Many inventions/discoveries can be used for good or evil. Draw a two-column table headed 'Good' and 'Evil' and place into the correct column some of the uses to which explosives can be put.
   (b) Do the same for another technological development of your own choice. (If you cannot think of one of your own, do this for the motor car.)
   (c) Imagine you are writing Nobel's obituary (notice of his death) for a newspaper. Using the '◆' statements, and adding to them if you wish, write the article showing how good, or evil, his life's work was.

3. Robert Oppenheimer was director of the Manhattan Project that developed the atomic weapons which were used on Hiroshima and Nagasaki in 1945. (The destruction of these two Japanese cities led to the ending of the Second World War.) He resigned from the project, in part because he expected the weapon to be used only as a threat.
   (a) Under what circumstances, if any, do you think it would be acceptable to kill thousands of innocent people?
   (b) Who do you think was to blame for the dropping of the atom bombs - the politicians, the scientists or the military? Give reasons for your answer.

4. *"Gas! GAS! Quick boys! - An ecstasy of fumbling,*
   Fitting the clumsy helmets just in time;
   But someone still was yelling out and stumbling
   And flound'ring like a man in fire or lime,
   Dim, through the misty panes and thick green light,
   As under a green sea, I saw him drowning."

   (An extract from *Dulce et Decorum Est* by Wilfred Owen)

   Wilfred Owen fought in the First World War and was killed just before it ended.

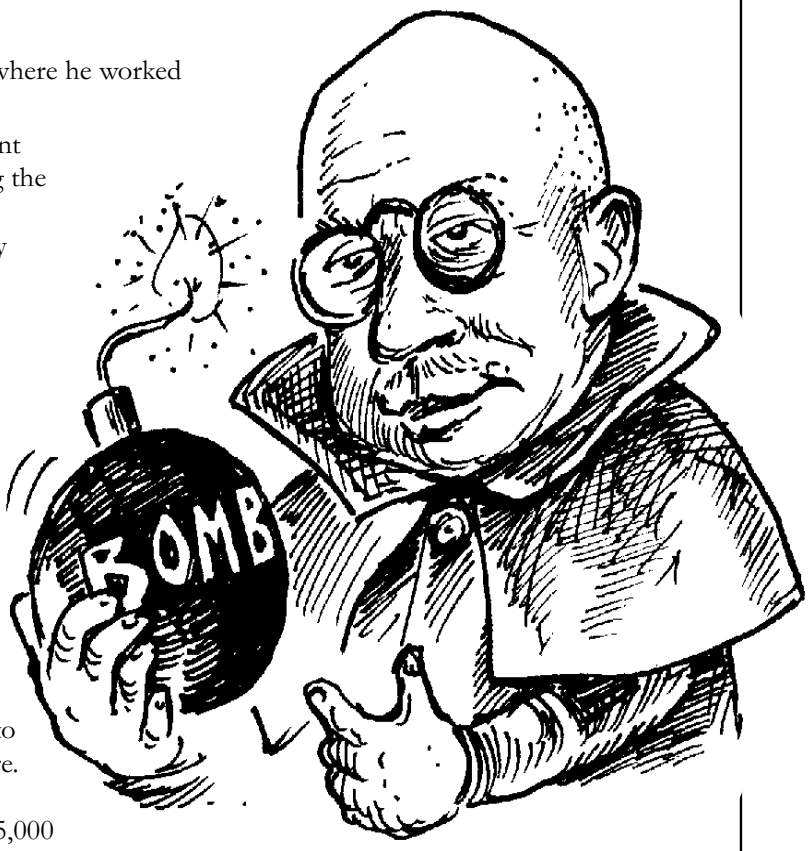
   (a) What gas was being used?
   (b) Why do you think he talked about the gassed man 'drowning' ?
   (c) What do you think Owen thought about war?

   "I, too, saw God through the mud,
   The mud that cracked on cheeks when wretches smiled.
   War brought more glory to their eyes than blood,
   And gave their laughs more glee than shakes a child."

   (An extract from *Apologia Pro Poemate Meo* written by Wilfred Owen in November 1917)

   (d) Does this extract change your answer to (c)?

2 Professor Fritz Haber (1869-1934)



- Born in Germany in 1869
- Became a lecturer in Karlsruhe where he worked on nitrogen chemistry because:
  (i) it is important for healthy plant growth and by supplementing the usual animal and plant waste sources increased productivity was possible; and
  (ii) it was vital to the production of high explosives - nitroglycerine (invented by Nobel in 1867) and T.N.T.
- Discovered how to convert atmospheric nitrogen into ammonia - the vital first step in the production of fertilisers and explosives
- During the First World War he persuaded the German military to experiment with chemical warfare. He released chlorine gas along 5.5 km of trenches in Flanders. 5,000 Allied deaths, along with 6,000 captured and 15,000 being gassed were the results - but the German generals were not satisfied with their new weapon
- In 1918 he received the Nobel prize for Chemistry
- After the First World War, he experimented with the idea of getting gold from sea-water in order to pay the fines imposed on Germany as reparation
- In 1933 he had to leave Germany as the Nazis came to power - he was of Jewish descent
- He worked, briefly, in Cambridge before his death

1. The 'NPK' values of fertilisers are usually quoted on the bag. For what do these letters stand?

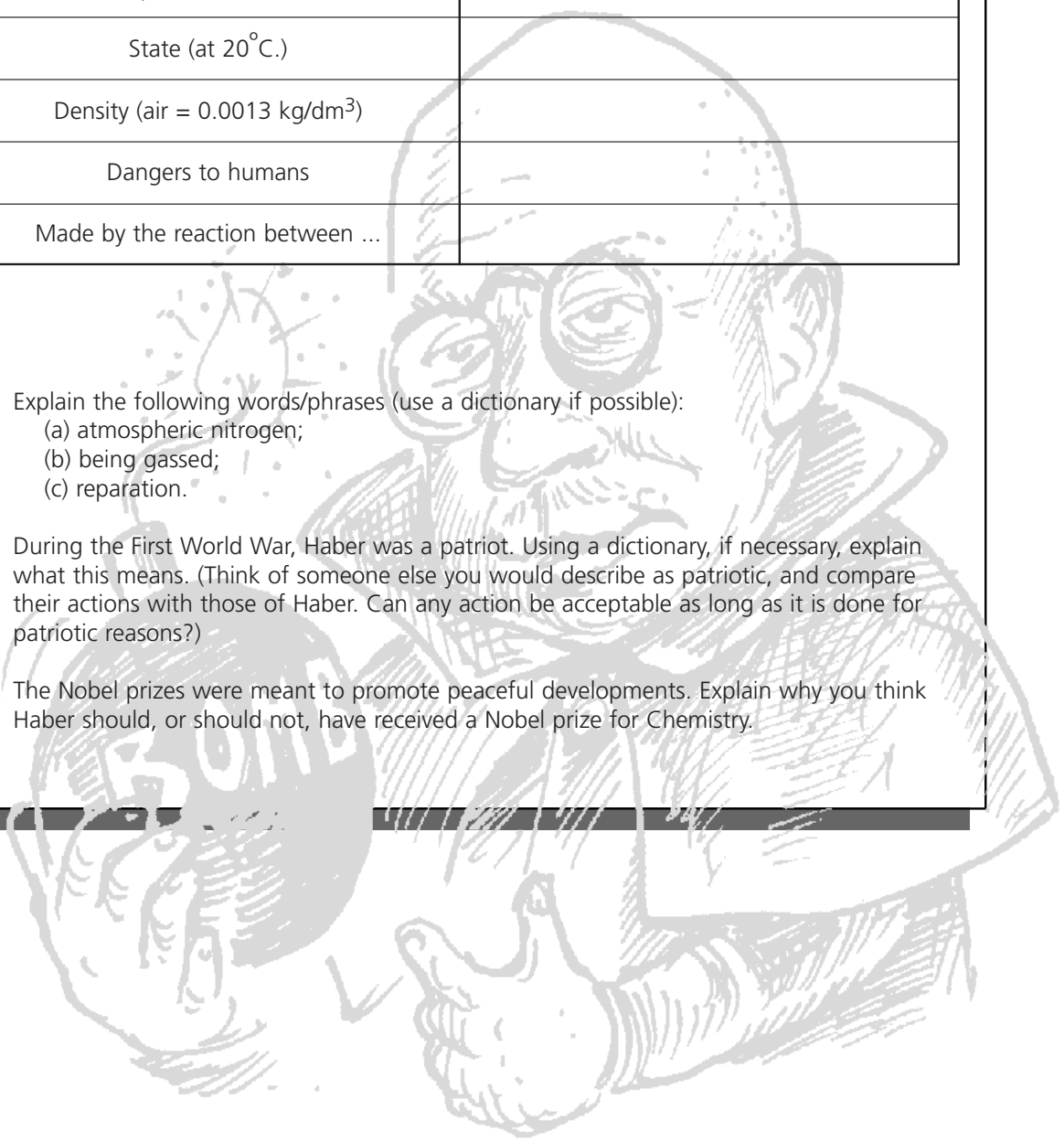
2. Copy and complete this table about the properties of chlorine (you will need to consult a text book and, possibly, a set of Hazcards):

Property	Facts
Colour	
Group in Periodic Table	
State (at 20°C.)	
Density (air = 0.0013 kg/dm^3)	
Dangers to humans	
Made by the reaction between ...	

3. Explain the following words/phrases (use a dictionary if possible):
   (a) atmospheric nitrogen;
   (b) being gassed;
   (c) reparation.

4. During the First World War, Haber was a patriot. Using a dictionary, if necessary, explain what this means. (Think of someone else you would describe as patriotic, and compare their actions with those of Haber. Can any action be acceptable as long as it is done for patriotic reasons?)

5. The Nobel prizes were meant to promote peaceful developments. Explain why you think Haber should, or should not, have received a Nobel prize for Chemistry.



3 Marie Curie (1867-1934)

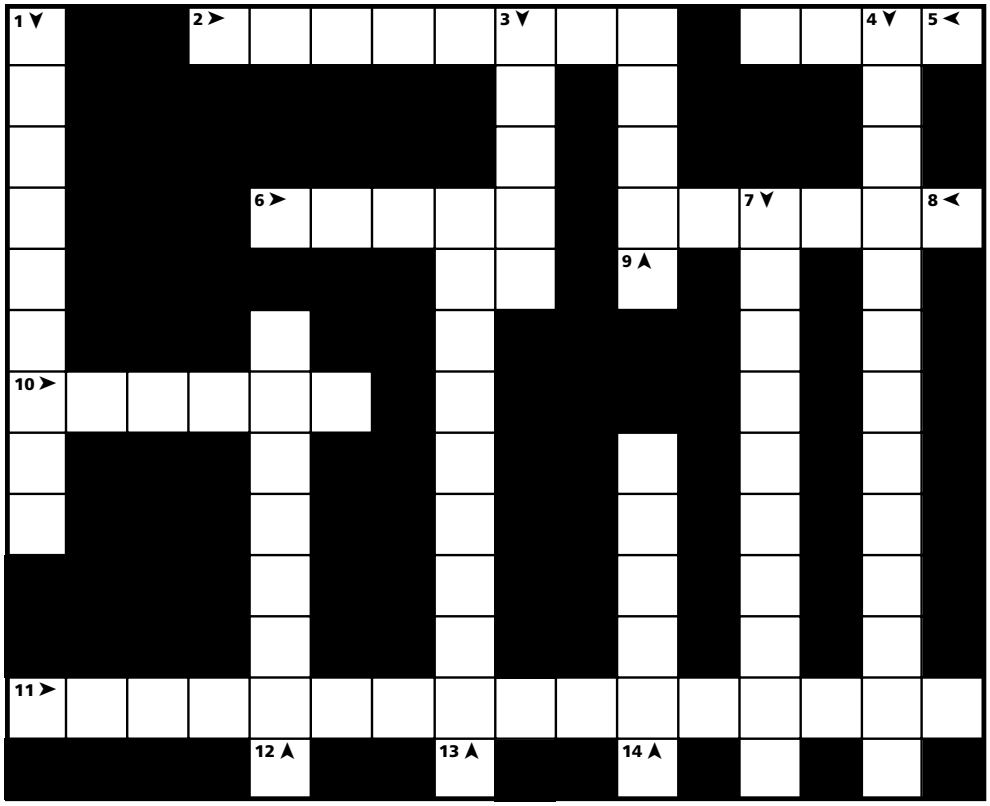
- Born Maria (or Manya?) Sklodowska
- Married Pierre Curie (who was already a well known scientist - he'd discovered piezoelectricity, which is used to make sparks for gas lighters)
- With her husband, she worked in the new field of radioactivity (discovered by Henri Becquerel)
- Discovered polonium - named after her native country, Poland
- With her husband and Becquerel, she shared a Nobel Physics prize for her work on radioactivity
- She continued with the work after her husband was killed in a road accident
- She became the first female lecturer at the Sorbonne in Paris and, later, a professor
- In 1911 she received her second Nobel prize, in Chemistry, for her work on radium
- During the First World War she gave up her studies of radioactivity and concentrated on developing the uses of X-rays and their medical applications
- After the war she returned to her study of radioactivity, working only on its use in medicine
- One of her daughters continued her work and also won a Nobel Chemistry prize
- During the Second World War, both her daughters supported the French Resistance movement

1. By the start of the First World War, radioactivity was still a new area of study and its destructive potential was certainly unknown. There would have been no problem in it being used for the occupying German army's war effort. Why, then, do you think Madame Curie gave up her passionate study of this topic?

2. Is there anything in the information about her given above that might suggest that her experience of war had a major effect on her view of life? Explain.

3. Is there anything you feel very strongly about? (Are you, for example, a dedicated fan of a pop group?) What sort of changes might make you give up this passion and give the time to something else?

1. Complete the following crossword by answering the clues below. (Note: This is not an ordinary crossword as the answers go from right to left and up the page as well as in the usual directions!)



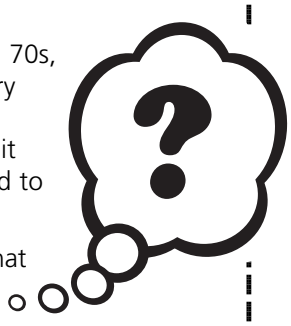
Clues:

1 down	Man who shared the Curies' first Nobel prize (9)
2 across	University where the Curies worked (8)
3 down	He made his money from explosives but tried to promote peace after his death through a series of famous prizes (5)
4 down	Area of science worked on by most of the Curie family (13)
5 backwards	A medical development often associated with radioactivity (4)
6 across	Madame Curie's forename (5)
7 down	See 14 up (10)
8 backwards	Killed in a road accident (6)
9 up	One of the prizes in 3 is for promoting this (5)
10 across	An element discovered by the Curies (6)
11 across	Work on this made Pierre's reputation (16)
12 up	A Polish discovery? (8)
13 up	Marie Curie devoted her later life to this (8)
14 up and 7 down	The organisation that the younger Curies supported during the Second World War (6)

4 Paul Mueller (1899-1965)

- DDT was first made in 1874 by Zeidler but he did not recognise its potential as an insecticide
- Mueller rediscovered it in 1939 and found that it would kill insects whilst appearing to have no effect on plants or animals
- It was heavily used during the Second World War both to treat epidemics among civilians and protect soldiers in insect-infested parts of the world
- After the war, DDT was used to destroy the malaria-carrying mosquito. The disease was virtually eliminated from 20 countries
- The use of DDT reduced cases of malaria from 75 million a year (with 1 million deaths) to less than 5 million cases (and 5,000 deaths) a year
- Not only were the pests killed and health improved, but crop yields increased greatly
- Mainly due to the use of DDT, life expectancy in India rose (over the period 1945-60) from 32 to 47 years
- It was noted, however, that the dusting of lakes to kill the mosquito larvæ seemed to be linked with the loss of aquatic birds as the insecticide moved up the food chain
- The extent of the problem was highlighted by the publication of the book '*Silent Spring*' by the biologist Rachel Carson in 1960
- During the early 60s, it was noticed that DDT and other insecticides developed following its success were not always being effective as insects became immune
- More recently, DDT has been linked with cancers in humans
- DDT is now banned in Europe and the USA, but is still used to fight malaria

Many scientific discoveries are, more or less, accidents. In this case, DDT was overlooked in 1874 and its value not noted until 1939. In the late 1960s and 70s, the Chemistry Department at Birmingham University had a research laboratory making organic compounds involving fluorine. One substance they made seemed to have no useful application but another university later noted that it made surfaces very slippery and took out a patent on PTFE which is now used to make non-stick saucepans.



What important discoveries have been overlooked and, more importantly, what resources are there in nature that we should be conserving for the future rather than exploiting or destroying for short-term gain? Of the estimated 20 million living species on the earth, only around 2 million have been studied. It is claimed that tens of species of plants are being lost every week because of 'slash and burn' farming worldwide - any of which might be a natural cure for cancer!

1. Using the information sheet and other sources (such as text books, encyclopedia and CD-ROM as available), complete a copy of the table below, giving the advantages and disadvantages of DDT:

Advantages of using DDT	Disadvantages of using DDT
1.	1.
2.	2.
3.	3.
etc.	etc.

2. Using the information you have put into your table,
   (a) Should DDT be completely outlawed right around the world? Give reasons for your answer.
   (b) Is the ban in Europe and the USA sensible and fair? Give reasons for your answer.

3. Suggest some reasons why the effects of DDT on animal life were not identified when the insecticide was first produced.

4. Try to find out how new insecticides and medicines are tested before they are put on the market. Record your findings.
   Note: Pharmaceutical firms have been known to carry out very careful tests on drugs only to find some side-effect shows up after the drug has been on sale for a few months. (This happened to Boots when they developed a drug to treat some heart problems. They had to withdraw the drug and 'write off' the millions of pounds spent in research, development, production and advertising.)

5. "Thou shalt not kill; but need'st not strive
   Officiously to keep alive."
   (extract from *Peschiera* by Arthur Hugh Clough (1819-61))

   With the boom in medical technology and knowledge, there was a period when doctors felt obliged to do all they possibly could to keep a patient alive. More recently, there has been a move to consider the quality of life rather than the mere preservation of life. This has resulted in the medical profession sometimes 'allowing nature to take its course'. By recording the 'pros and cons' of this latter stance (perhaps in a table, as in 1 above), give your views.

5 Balloon debate

A balloon debate is when you have to imagine you are a famous person in a balloon that is slowly sinking into shark infested waters. In order that at least one of you may survive, you need to agree that the rest must jump overboard.

Each of you then has to explain why he/she should be the one to survive.

You then vote to see who should remain in the balloon. (You are not allowed to vote for yourself.)

Imagine you are either:

1. Alfred Nobel
2. Fritz Haber
3. Marie Curie
4. Paul Mueller

(a) give a list of as many reasons as possible why you should stay in the balloon.

(b) write a list of reasons others may give for throwing you out.

(c) how would you counter the criticisms in (b)?

