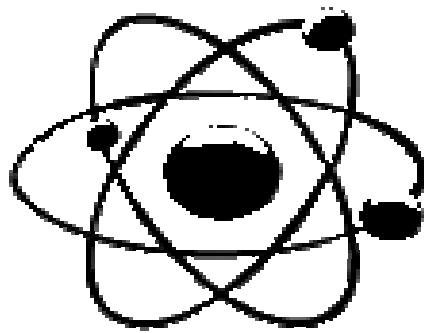


Issues in Science TY Science Module



Student Handout

Written By:

Ciara Hayes

Series editor:

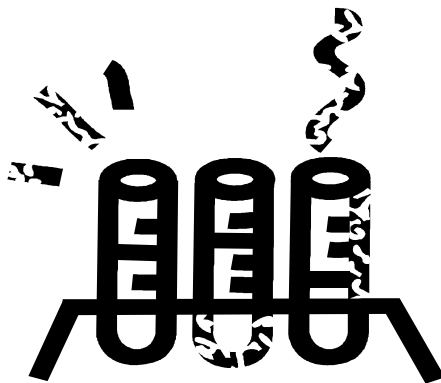
Peter E. Childs

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Experiment Safety for pupils



- Laboratory coats to be worn at all time
- Safety glasses to be worn at all time
- Wear plastic gloves when handling chemicals
- Long hair should be tied back away from face
- All accidents to be reported to teacher immediately
- All spills to be cleaned straight away
- Wash hands before and when leaving the laboratory
- No eating and drinking in the laboratory

TY Science

Issues in Science

Introduction for Pupils

'A person educated in mind and not in morals is a menace to society'

Guanita Kidd Stout

Through out the centuries people have always had a thirst for knowledge. With this knowledge came new discoveries - some that have helped the world and some that have damaged the world.

In science the quest for knowledge has led to some discoveries that one day may prove very beneficial in our everyday lives, whether it is combating world hunger or solving the energy crisis etc. But with every new discovery in science ethical issues arise. The question arises as to whether the benefit is worth what may be lost or offsets harmful side-effects. The only way to make this judgement is to be presented with the scientific facts and then make a decision after weighing up the evidence.

Scientific discoveries can offer a cure to many problems but as humans we must remember that sometimes we need to take a step back and ask the question 'would it be ethically right'?

In this module we will look at some science-based issues which have become controversial, with strong arguments for and against them. You may already have seen, heard or read about some of these. We will try to understand the science involved, the arguments for and against, and then you have the opportunity to make **your** mind up about the issues.

Unit 1.

Risk assessment

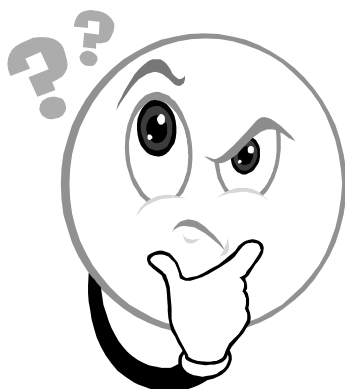


Unit 1: Risk assessment and Global Warming

Lesson 1: What is risk? (Single lesson)

Introduction

In the eight weeks you will be looking at issues in science that could potentially affect your everyday life. In this lesson you will see how important these issues are to you now and how much you know!



Many of the issues that you will be looking at are controversial. This means that these topics have both negatives and positives involved. It will be your job as a class in the next eight weeks to make decisions on each of the issues.

How to make a informed decision

Before you can make decisions on these topics you must understand what risk assessment is. So what is risk assessment?

Risk assessment begins with firstly recognising a hazard that may be present

What is a hazard?

After the hazard has been determined the risk involved can be determined.

An example:

It is the year 2040, and research in science has created a vaccine that causes a delay in the aging process of some humans. It has the potential to prolong their lives by 45 years! However, scientists know that the vaccine will not work in about 35% of the population and will cause immediate death to them if taken. There is no way of knowing whether the vaccine will be accepted or rejected by a human being.

What is the benefit involved in this idea?

What is the risk involved?

Is the benefit of a prolonged life in 65% of the population worth the risk?

It may be easy to answer this question now, and many would argue that 35% potential deaths of the world's population is not worth it. A 1 in 3 chance of dying is not good odds. However, what if I told you that at the right price a test could be done that could show if your body will accept the vaccine or not? Would you be so quick to decline the vaccine?

Activity One

In this activity you will be answering a number of questions on your views on certain topics. Try to answer as honestly as possible.

In the spaces write your views on the topics.

- Global warming

- Genetically modified foods

- Stem cell research

- DNA identification

- Biofuels

- Nuclear power

- Electromagnetic radiation
- Fluoridation of water supplies

Out of the eight issues listed above, which do you believe holds the most promise of affecting our everyday life in the future?

Which would you list as the least important issue in science right now, and why?

Which would you list as the most important issue in science right now, and why?

In terms of risk involved could you list these rank these issues. Number one being the issue with most risk involved.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Try to look up the risks associated with various activities like flying, travelling by car, smoking, hang-gliding, parachuting, bungee jumping, playing football etc. Sometimes what we **feel** is more dangerous turns out to be less dangerous than something we accept quite readily. Being a soldier is more dangerous than being a bus driver, but is walking to school more or less dangerous than driving to school? Science can tell you which activity is more dangerous, but we don't always do what is good for us!

Unit 1. Risk assessment

Lesson 2 ~ Understanding global warming (double lesson)

In the following weeks you will work on units which present scientific evidence on a number of issues. However, many of these topics are controversial in our society. You will have to think like scientists yourselves and weigh up the argument on both sides before making a scientific decision. A scientific decision should be based on reason and experimental evidence and not on feelings or anecdotes.

In this Unit we will look at an example of a controversial issue that is imminent in our society today global warming.

Scenario

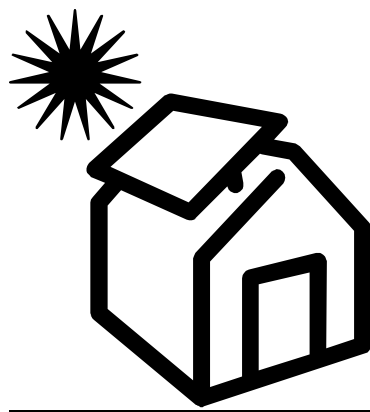


Did you ever wonder why the ice caps are melting and sea levels are rising? Why so many cities around the world are experiencing floodings? Why the weather seems hotter in the summer and rainier in the winter than it used to be?

Well all this can be linked to global warming, which means that the earth's average temperature is slowly rising.

First we will look at what causes this phenomenon called global warming and that is known as the Greenhouse Effect.

The Greenhouse Effect



Question:

Why do we sometimes use a greenhouse to grow our plants?

Now think of the earth as a massive greenhouse, where the 'glass' of a greenhouse covering the earth is now made up of atmospheric gases.

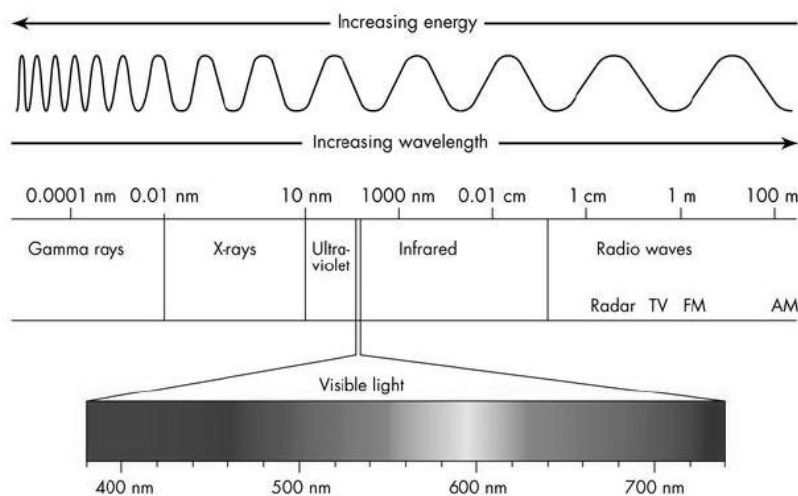
Atmospheric gases include oxygen, nitrogen, carbon dioxide, water vapour, methane, CFCs, ozone and nitrous dioxide.

The sun's rays (visible and UV light) normally enter our atmosphere, pass through these gases, and are absorbed by the earth, warming it up. However, some of the heat is radiated back into space through the atmosphere as infrared (IR) radiation. Some of the molecules in the atmosphere, like carbon dioxide, can absorb IR radiation and when they do so they warm up. This means the atmosphere warms up as well. Fortunately oxygen and nitrogen do not absorb IR radiation but many of the other gases do.

Question:

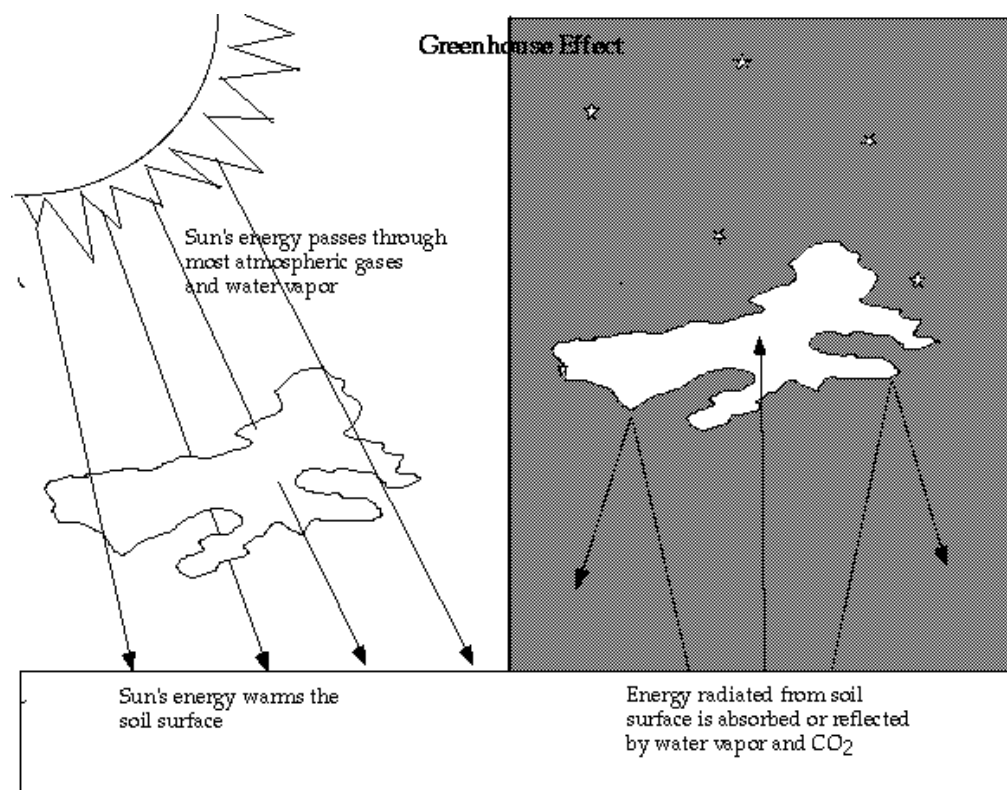
What do you think would happen if a lot more of the atmospheric gases like carbon dioxide that absorb IR radiation were present?

The abundance of gases like carbon dioxide causes more of the radiated heat to be trapped, so they cannot escape back into space. This leads to the warming of the earth's atmosphere and also the surface i.e. global warming. The atmosphere acts a blanket around the earth trapping heat. The more heat that is trapped the more the earth warms up. The electromagnetic spectrum below shows us that there are different types of radiation - some high energy, some low energy. We can't see UV or IR radiation, only visible radiation. This is dealt with further in a later unit.



http://www.antonine-education.co.uk/physics_gcse/Unit_1/Topic_5/em_spectrum.jpg

Let's look at the diagram below to see how the Greenhouse Effect works.



<http://www.ces.ncsu.edu/depts/hort/hil/gif/705-fig1.gif>

Can you explain what is happening in the diagram?

If there was no atmosphere there would be no greenhouse effect. The moon has no atmosphere but is exposed to the sun's rays like the earth. Would you expect the moon to be hot or cold?

We will now try a simple experiment to illustrate the greenhouse effect.

Experiment 1: To demonstrate the greenhouse effect**Materials Needed:**

2 shoe boxes	2 Thermometers
2 sheets of thick black paper	Sheet of plastic wrap
Adhesive Tape	

Procedure:

1. Each group receive two shoe boxes A and B
2. Place the black paper on the insides of the shoe boxes
3. Place two thermometers in the two boxes and place by the window in order to get full sunlight for ten minutes.
4. After ten minutes record the temperature in the two boxes.
5. Place plastic film over one of the boxes (box B) and place tape around to hold.
6. Leave both boxes standing for 15 minutes in sunlight.
7. Record the temperature in the two boxes.

Results:

Temperature	Box A	Box B
At ten minutes		
At twenty five minutes		

Conclusions:

1. Which box had the highest temperature after 25 minutes?

2. Why did we use black paper to cover the inside of the boxes?

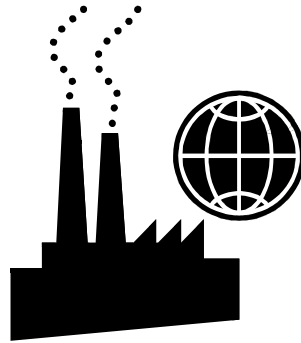
3. Can you think of how we can relate this experiment to global warming?

While you are waiting for your boxes to heat up, do the following activities.

Activity 1:

Think of **six** ways that the heating of the earth can have negative effects on people or wildlife. You may have read about these or seen them on TV.

1
2
3
4
5
6

**Activity 2:**

As we mentioned earlier increased amounts of gases in our atmosphere like carbon dioxide, which can absorb IR radiation, cause global warming. So who is to blame? Can you think of three ways that carbon dioxide is produced?

1.

2.

3.

Unit 1. Risk assessment

Lesson 3 ~ The debate on global warming (single lesson)

In the previous lesson you learned that due to an increase production of some atmospheric gases our world is heating up, which is causing an increase in sea levels etc. This is the theory put forward by scientists. However, not everyone accepts the theory of global warming or how it is caused. There are arguments for and against and this is when you have to think like a scientist and weigh up both arguments.

Activity:

In the following activity you will read arguments from both views on global warming. In groups read through these arguments and discuss both views. You may be able to add some more arguments yourself.

Scientists' views on Global warming	Critics' views on global warming
Carbon dioxide is one of the main atmospheric gases, which are causing the heating of earth. Carbon dioxide molecules can trap IR radiation, which leads to warming of the atmosphere. Scientists see human activity as the major source of increased levels of carbon dioxide. There has been a steady increase in global temperatures in the past century, and many of the warmest years have been since 1990. Other factors have cooled the planet in the last 10 years and cancelled out some of the global warming. Carbon dioxide once in the atmosphere is difficult to break down. However by cutting down on our carbon dioxide emissions we will not add to the problem that already exists.	Human activity cannot be the single blame for the rise in carbon dioxide levels. Research has shown that carbon dioxide levels in the atmosphere are a result of increased temperature. Studies show that oceans emit carbon dioxide as they warm up and absorb it when they cool down. In the last ten years there has been little change in average global temperatures, despite some hot summers. This shows that other factors are involved in affecting global temperatures. Critics believe that even if humans cut down on their carbon dioxide emissions, we will not see the results in our lifetime and the temperature of the earth's surface will still rise. Temperature changes are due to other factors than carbon dioxide concentrations in the atmosphere e.g. solar activity.

Long term increases in temperature from increased carbon dioxide emissions could change the natural world around us and cause climate change. For example, the melting of the polar ice caps will not only lead to the rise in sea levels, which will flood low-lying lands, but it will also endanger animals such as polar bears and penguins. The change in temperature could mean the introduction of new species into Ireland. For example mosquitoes thrive in warmer, humid weather. This will bring life-threatening diseases such as malaria. Greater change in temperatures could alter the currents of the oceans such as the North Atlantic Drift and affect the Gulf Stream. This would be very dangerous to Ireland and England and would have a negative effect on our climate, bringing colder weather to our region.	An increase in temperature could in fact prove beneficial at the beginning, for example, in northern countries, which would experience warmer weather and longer growing seasons for their crops. The climate has always changed and people have learned to adapt to it. Warmer temperature could prove economically beneficial as a warmer climate would allow farmers in Ireland to grow crops that they could not to so already and extend the growing season. It is a known fact that through out the centuries the earth's climate has changed naturally, and in the past, for example, Ireland went through several ice ages. This was a natural phenomenon unaffected by human activity
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In your groups try to answer these questions

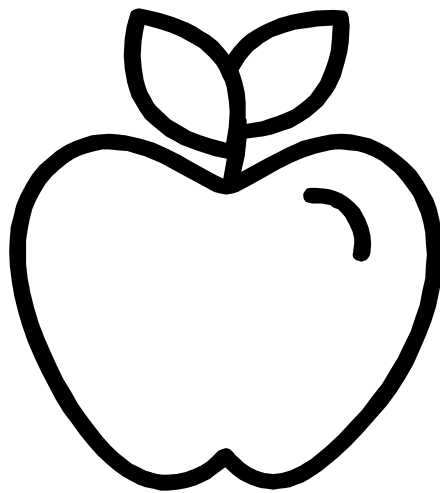
In your opinion which argument (for or against global warming) do you believe to be the most scientifically sound, and why?

Which argument do you believe to be the least scientifically sound, and why?

What has this lesson taught you about knowing the scientific facts before making a decision on an argument?

Unit 2.

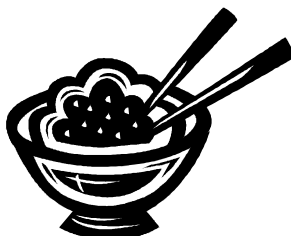
Genetically modified (GM) Foods



Unit 2: Genetically modified (GM) foods

Lesson 1 ~ The debate on GM foods (single lesson)

Scenario



You and your family decide to go to a restaurant and have a meal. The waiter brings out two large bowls of rice. You take a helping from one bowl and then you take a helping from the second bowl. They taste the same and look the same, but the waiter then tells you that one bowl is a GM rice, while the other bowl is naturally grown. How do you react when they both taste the same? But what is a GM Food and what is the difference?

So what does the term genetically modified (GM) food mean?

GM foods are made from genetically modified organisms, which have had their DNA altered by the transfer of one or more genes from one organism to another. This is done by a method known as genetic engineering. In the past plant breeders also altered the genetic makeup of plants and food by using selective breeding techniques within or between plant species. Very few food crops are wild, they have all been modified by human intervention. But genetic modification allows genes from totally different species to be transferred, which cannot be done by traditional breeding.

Drought resistance genes, pesticide and herbicide resistance genes are examples of some of the genes placed into other organisms such as plants.

In this lesson we will look at some of the arguments for and against GM foods.

So why do we have genetically modified Foods? Let's look at an example.

Did you know that in the world today there are more than 6.7 billion people and it is set to increase to 9 billion by the year 2042? Currently 15 million children die each year from hunger.

What would the effect of having such a dramatic increase in population be on our food supplies?

Why do you think that so many people die each year of hunger?

So how can this be overcome?

One of the arguments for GM foods is that it would allow crops to grow in parts of the world with unfavourable soil or with poor climates e.g. such as, Africa as the GM crops would contain drought resistant genes. This would help to reduce the amount of people that die of starvation in this region. This may seem like a major advantage, however, not every country is convinced.

Can You Think of any other gene that might be useful to place in crops grown in Africa or that you have heard about?

True story



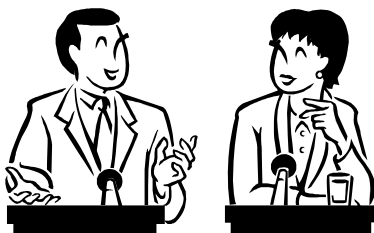
In Southern Africa, in a country called Zambia, severe drought has affected the population, with more than 2.9 million people who require food aid. When food aid was offered to Zambia by other countries, the President Levy Mwanawasa rejected the corn, stating it was 'poison', as it had been genetically modified. The same corn is eaten in the USA without any problems or reaction.

Why do you think a country like Zambia, in desperate need of food, would reject an offer to save its people?

Do you believe that the President was right to reject the corn, why?

The full article on Zambia's rejection can be found on
<http://www.pbs.org/newshour/extra/features/july-dec02/zambia.html> .

Activity ~ pros and cons of GM foods



The following are a list of the arguments for and against the GM foods. Working in groups, separate the pros and cons and write them on the poster. Remember these are just some arguments for and against; in groups also try to think of your own.

- Pest Resistance: Every year crops around the world are ruined by pests, meaning loss to farmers and leading to starvation in many countries. Some GM foods contain genes that would give pest resistance, so when the pests try to eat these crops the pest would die.
- Disease resistance: Many crops such as the potatoes are prone to fungal or bacterial diseases. Some GM crops contain genes that allow them to become more resistant to such diseases.
- Human Health: Some GM crops may contain genes that cause allergic reactions in some individuals. Long-term health effects of eating GM foods are not known.
- Disease prevention: GM crops could allow people in the third world countries to be inoculated from diseases by simply eating a banana. This would cut the need for distributing inoculations through the use of needles.
- Labelling: The labelling of genetically modified food products is not mandatory in some countries, for example, in the U.S.A., so some people don't know what they are really eating.
- Against religious teaching: Some religions believe that science should not tamper with nature by the mixing of genes among species. Eating an animal which contains a human gene is a form of cannibalism.

- Cross-fertilisation: GM crops grown alongside naturally grown crops could cross-pollinate and spread the foreign genes more widely. Thus farmers that did not intend to grow GM crops may be growing them and passing them into the food chain.
- Food improvements: The introduction of vitamins into rice could help people in continents such as Asia where rice is the main food source, preventing vitamin deficiency.
- The introduction of the GM crops would allow large business to take control of seed distribution. These large companies buy the rights to the GM seeds. Often these seeds are too expensive for third world countries to buy.
- Pest resistant crops may affect more than just pests and may kill beneficial insects.
- Many crops have herbicide genes placed in them which make them resistant to weed killer. This allows killing the weeds without harming the crops.
- Transfer of genes from one crop to another. What if the gene for weed resistance found in weeds. Then there would be no herbicide that would kill them, creating a form of super weed.
- Many fruits and vegetables contain genes which prevent them from ripening; therefore can be shipped over large distances.

Can you think of any other pros and cons of genetically modified crops or foods?

Are you in favour or against of genetically modified foods? Give reasons for your opinion.

Do you think that people should have a choice in what they eat?

Unit 2: Genetically modified (GM) foods

Lesson 2~ Debate on GM foods part 2 (Double lesson)

In the previous lesson you have learned how GM crops are made and some of the arguments for and against.

For this lesson we will look more into the issues surrounding GM foods through role play and establishing what you as a class feel is important to consider.



Before the role play

Is any method of planting crops completely safe?

Can you name the continent or country which is the biggest producer of GM foods?

Does every country label the food which is genetically modified, and why?

Can you name the three crops which are genetically modified that are allowed to be grown in Europe?

1.

2.

3.

Activity:

In this activity you as a class will pretend to take part in a radio talk show. You should use the information from the previous class in making your presentation or formulating your questions.

What is required for the role play:

You need to select people for the following roles:

A presenter

The presenter will introduce the topic and act as a mediator between the speakers. It is the job of the presenter to ask the speakers questions and break up any discussion that may be off the topic. The presenter may also allow people from the audience to participate in the debate and ask questions.

Speakers

1. An environmental campaigner that is against GM crops. As this campaigner it is your job to tell the audience the environmental consequences that GM crops will have on the environment.
2. A farmer from a developing country that is in favour of GM crops. As the farmer in favour it is your job to tell the audience why GM crops will benefit your family and friends.
3. A scientist that takes a balanced view between the two arguments. As the scientist it is your job to give the arguments for and against, without showing favour for one or the other.

Audience

As the audience it is your job to raise your hand and ask questions that you feel are important. At the end of the debate it will also be your job to vote for or against the use of genetically modified foods. Remember it is very important to stay objective and try not to vote with your emotions but based on the information and facts presented to you.

Final Questions after listening to both sides of the arguments

How have your opinions changed, if any, on GM foods?

Would you be comfortable to eat GM foods or not and why?

Do you think science has the right to interfere with nature in this way?

What is the difference between traditional plant and animal breeding and the use of genetic modification?

Unit 2: Genetically modified (GM) foods

Lesson 3 ~ Further look at GM food (Single lesson)

In this lesson you will be looking further into the science of genetically modified foods. Let's look at some basic biology first!

Activity 1:

Pick the words from the box which you think match the sentences

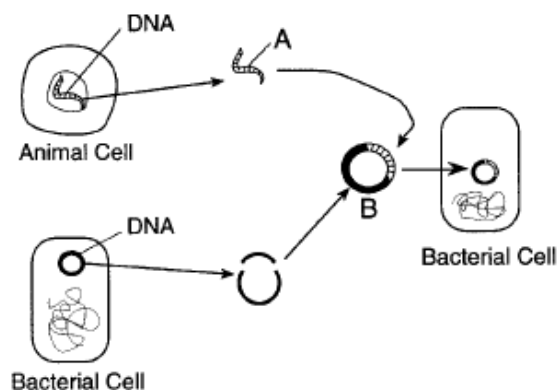
- *Gene*
- *Membrane*
- *DNA*
- *Twenty three pairs*
- *Protein*
- *Nucleus*
- *Cells*
- *Twenty three pairs*
- *Chromosomes*

1. Our bones, skin, blood and hair etc are all composed of _____
2. Each cell is surrounded by a _____ which contains the parts of the cell including the _____
3. The nucleus of each cell contains _____. For e.g. the human nucleus contains _____ of chromosomes.
4. Chromosomes are structures made of _____ and _____.
5. A _____ is a short section of DNA which contains the information for the formation of a protein.

In the next activity, you will see how the transfer of genes from one organism is carried out in the laboratory!

Activity 2:

Read through each of the steps. In groups number the steps in a sequence which you believe to be correct.



- **Insertion of genes into a transfer vector**

The vector is normally a plasmid. A plasmid is a small DNA ring found in bacteria. The target gene is placed into the DNA of the vector.

- **Transformation**

Is the uptake of the plasmid which contains the desired gene into the bacterial cells. Most plasmids as well as containing the desired gene also contain the A gene which make them resistant to antibiotic.

Scientists place the bacterial cells in an antibiotic, those that have not taken in the plasmid will therefore die.

- **Isolation of the gene needed**

Isolation refers to removing the desired gene from one organism which will then be placed into another organism.

- **Cloning**

Each transformed bacterium is then grown on agar and the ones that contain the specific gene required are separated from the other plasmids.

The plasmids containing the desired gene are now ready for use in industry etc.

Correct Sequence of Genetic Engineering	
1.	
2.	
3.	
4.	

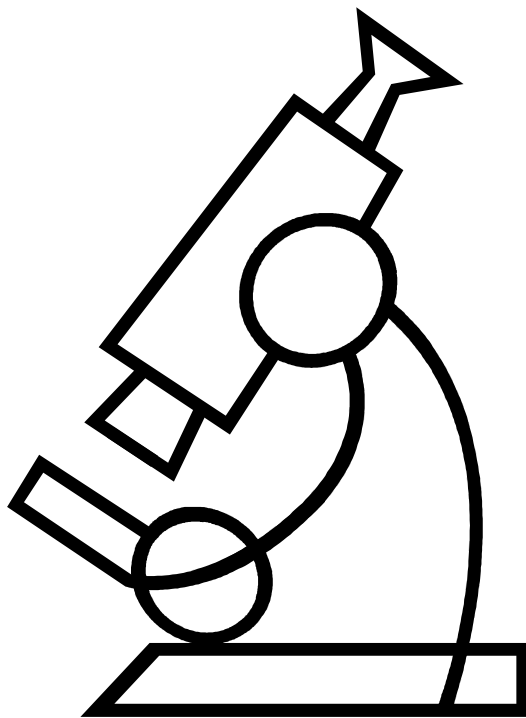
This is how scientists in the laboratory can produce GM foods by inserting a gene from somewhere else into the gene of the food plant!

Drought resistant genes, pesticide and herbicide resistant genes are examples of some of the genes placed into other organisms such as plants.

Why do you think scientists would spend time taking genes from one organism and placing them into another?

Unit 3.

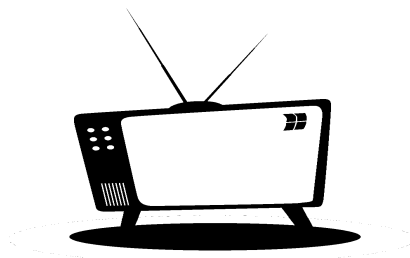
Stem cells



Unit 3: Stem cell research

Lesson 1: What is stem cell research? (Single lesson)

Scenario



One day you come home from school and decide to watch a bit of television before doing your homework. You flick on the television to see a news flash appearing across the screen: 'All major diseases cured'. As you sit and listen the newsreader states that such diseases like Alzheimer's, Parkinson's, cancer, heart disease, diabetes and many more have been cured. No longer will people suffer from these illnesses and will be free to live a normal life all because of this amazing new technology called stem cell therapy.

1. What would be the advantages of this new technology to the world?

2. What would the negative effects be, if any?

Let's look at some technical terms that maybe useful when learning about stem cells and their function.

Fertilisation ~ fertilisation is the fusion of the male sperm with the female ovum.

Embryo ~ An embryo is a multi-cellular organism which forms from the fusion of a sperm and ovum.

In vitro ~ this is a process whereby the egg and sperm are fused together outside the womb. A number of fertilised eggs are then placed in the womb with hopes that one will attach to the lining of the womb. (*In vivo* means inside a living organism.)

Cell ~ the cell is the functional unit of living organisms. In the cell the nucleus is found (the brain of the cell), which contains genetic information.

Unicellular organisms are made up of only one cell. Multicellular organisms are made up of many cells.

Tissue ~ A tissue is composed of similar cells, for example muscle tissue.

Organ ~ An organ is composed of a number of similar tissues which perform a specific function.

Further look



Diagram of stem cells

Stem cells are cells that are found in multicellular organisms. They are different from other cells in the body as they are unspecialised and are capable of renewing themselves.

Dr. Marc Hedrick of UCLA has been quoted in several news sources (http://www.guardian.co.uk/uk_news/story/0,3604,470978,00.html), saying "Stem cells are like little kids who, when they grow up, can enter a variety of professions. A child might become a fireman, a doctor or a plumber, depending on the influences in their life - or environment. In the same way, these stem cells can become many different tissues by making certain changes in their environment."

There are three different types of stem cells.

- **Embryonic stem cells**

Embryonic stem cells are stem cells derived from embryos. These embryos have been fertilised in-vitro (IVF) and then grown in the laboratory by a technique known as cell culture. Stem cells are usually taken from the inner mass of the embryo called the blastocyst. As mentioned these stem cells come from embryos created by IVF. For example if a couple cannot conceive a baby by natural means, IVF is used where by the sperm and egg are fertilised outside the womb and then placed in the woman's uterus. The unused embryos from the treatment can be used to create stem cell lines.

- **Adult stem cells**

Adult stem cells like the name suggests come from adults. These stem cells can usually be extracted from the peripheral system or from the bone marrow.

- **Umbilical cord stem cells**

These stem cells are extracted during pregnancy from the umbilical cord and then may be frozen so that if an illness ever arose in the family these cells could be used.

Note: Embryonic stem cells are found to be the most beneficial as they are unspecialised and so can differentiated into various tissues.

Of the three methods used to extract stem cells can you see any one being controversial and why?

So why do so much research on stem cells?

Stem cell research was begun in the 1960's by two scientists and since then a lot of research has been carried out in this area. Stems cells have the potential of developing into many different types of cells and tissues.

For example one stem cell from the skin can be grown by cell culture to produce a sheath of skin cells.

Can you think of any people that may benefit from this type of process involving skin cells?

Let have a look at one disease that has the potential to be cured by the use of stem cells.

Activity 1:

Case study

Sarah is a nineteen year-old girl who was diagnosed with having type 1 diabetes when she was seven years old. This means that cells in her body do not produce enough insulin in order to regulate sugar levels in her blood. In order to control this disease Sarah needs to take insulin injections daily and maintain her blood sugar levels at all times. Although this has become part of Sarah's daily life, a study undertaken in 2007 has shown that one day she may not have to depend on insulin injections.

This article was taken from The Times

Diabetics using stem-cell therapy have been able to stop taking insulin injections for the first time, after their bodies started to produce the hormone naturally again.

In a breakthrough trial, 15 young patients with newly diagnosed type 1 diabetes were given drugs to suppress their immune systems followed by transfusions of stem cells drawn from their own blood.

The results show that insulin-dependent diabetics can be freed from reliance on needles by an injection of their own stem cells. The therapy could signal a revolution in the treatment of the condition, which affects more than 300,000 Britons.

People with type 1 diabetes have to give themselves regular injections to control blood-sugar levels, as their ability to create the hormone naturally is destroyed by an immune disorder.

All but two of the volunteers in the trial, details of which are published today in the Journal of the American Medical Association (JAMA), do not need daily insulin injections up to three years after stopping their treatment regimes.

Stem cells are immature, unprogrammed cells that have the ability to grow into different kinds of tissue and can be sourced from people of all ages.

http://www.timesonline.co.uk/tol/life_and_style/health/article1637528.ece

Questions:

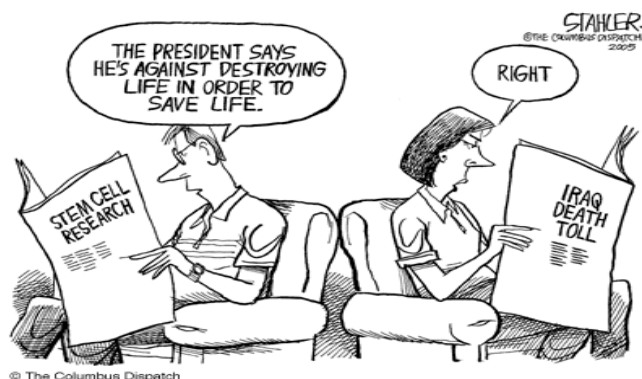
What type of stem cells were used in this study?

How could this one day prove to be of help to Sarah?

How effective was the treatment described?

Unit 3: Stem cells

Lesson 2: The debate in stem cell research (Double lesson)



Though it is true that stem cell research has the potential to be beneficial to many people, the ethical issues come to light when we examine the source of stem cells from embryonic stem cells. This raises questions about the status of an embryo and when human life begins.

When do you think life really begins for a human?

Why do you believe life begins at this stage?

Do you think science have a right to intervene with the natural process of life?

Activity:

In groups of four read the following article. It is then up to you in groups to list out the pros and cons of stem cell research and then answer the following questions.

<http://www.irishtimes.com/newspaper/sciencetoday/2008/0424/1208904387013.html>.

What in your opinion what are the main arguments against using embryonic stem cells?

What may be a solution to using embryonic stem cells?

Activity

In groups of four, read the following article about the use of stem cells and answer the questions underneath.

Umbilical cord stem cells repair woman's spine

Irish Examiner 29/11/2004

By Aung Jhi, Seoul

A SOUTH Korean woman paralysed for 20 years is walking again after scientists say they repaired her damaged spine using stem cells derived from umbilical cord blood. Hwang Mi-Soon, 37, had been bedridden since damaging her back in an accident two decades ago.

Last week her eyes glistened with tears as she walked again with the help of a walking frame at a press conference where South Korea researchers went public for the first time with the results of their stem-cell therapy.

They said it was the world's first published case in which a patient with spinal cord injuries had been successfully treated with stem cells from umbilical cord blood.

Though they cautioned that more research was needed and verification from international experts was required, the South Korean researchers said Hwang's case could signal a leap forward in the treatment of spinal cord injuries.

The use of stem cells from cord blood could also point to a way to side-step the ethical dispute over the controversial use of embryos in embryonic stem-cell research.

"We were all surprised at the fast improvements in the patient," said Song Chang-Hoon, a member of the research team and a professor at Chosun University's medical school in the Southwestern city of Kwangju.

Under TV lights and flashing cameras, Hwang stood up from her wheelchair and shuffled forward and back a few paces with the help of the frame at the press conference in Seoul on Thursday.

Medical research has shown stem cells can develop into replacement cells for damaged organs or body parts.

Unlocking that potential could see cures for diseases that are at present incurable, or even see the body generate new organs to replace damaged or failing ones.

So-called “multipotent” stem cells - those found in cord blood - are capable of forming a limited number of specialised cell types, unlike the more versatile “undifferentiated” cells that are derived from embryos.

However, these stem cells isolated from umbilical cord blood have emerged as an ethical and safe alternative to embryonic stem cells.

Clinical trials with embryonic stem cells are believed to be years away because of the risks and ethical problems involved in the production of embryos - regarded as living humans by some people - for scientific use.

In contrast, there is no ethical dimension when stem cells from umbilical cord blood are obtained.

Additionally, umbilical cord blood stem cells trigger little immune response in the recipient as embryonic stem cells have a tendency to form tumours when injected into animals or human beings.

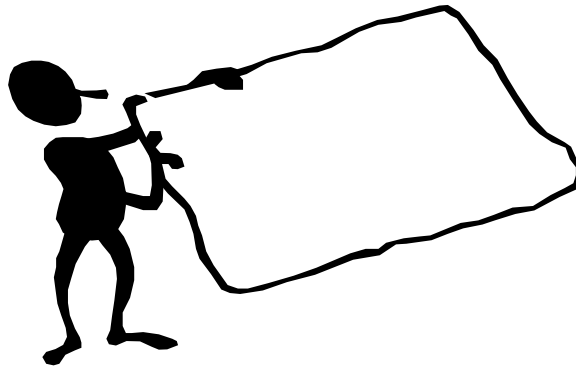
Meanwhile, Swiss voters yesterday overwhelmingly approved a new law permitting research on stem cells, rejecting a repeal initiative by an alliance of conservative Christian, left-wing and green groups.

The law, passed by the Swiss government last December, still sets stricter limits than in some places in Europe, allowing the use only of embryonic stem cells left over from in-vitro fertilisation.

<http://archives.tcm.ie/irishexaminer/2004/11/29/story359000786.asp>

What are the pros in your opinion on stem cell research?

Do you think that it is okay to use embryonic stem cells in order to save a human life?

Activity:

Create a short bullet point poster in your group listing the pros and cons of stem cell research.

Discuss with your group your views on stem cell research and the potential, if any, that they may hold to curing diseases.

What is your opinion now on stem cell research?

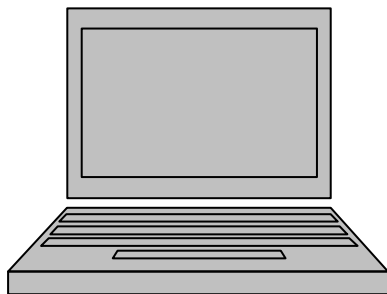
Unit 3: Stem cells

Lesson 3 ~ Future of stem cell research (single lesson)

Why is there so much research and interest in stem cells?

In this lesson you will learn how exactly stem cell research can help cure diseases!

Activity



In your groups chose one of the following diseases:

- Alzheimer's
- Parkinson's
- Diabetes
- Heart disease
- Cancer/ leukaemia

Your choice of disease: _____

Using the internet research the potential of stem cells for treating the disease you pick and answer the following questions, noting which type of stem cell was used in the treatment.

How many people suffer from this disease in the world?

What are the symptoms of this disease?

How can the disease affect peoples' daily lives?

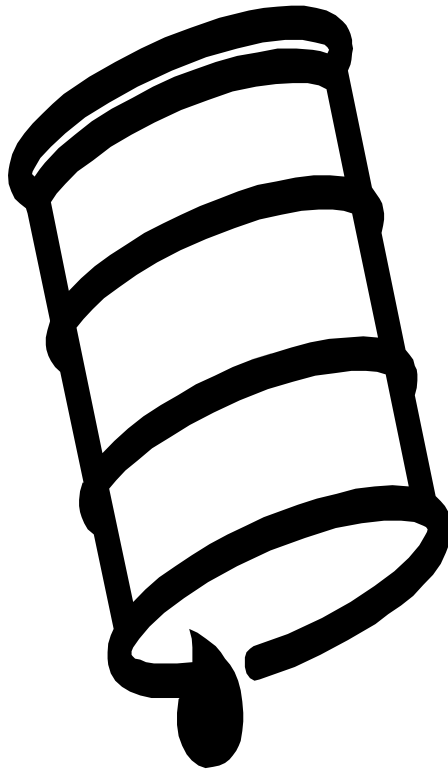
How can stem cell research help this disease?

Any other information you have come across:-

What is your opinion now on stem cell research?

Unit 4.

Biofuels



Unit 4. Biofuels

Lesson 1 ~ Understanding biofuels (Single lesson)

Scenario



Imagine that you have just won the opportunity to create your own dream car for a company and take it home to drive for good, not to mention that this car would be sold on a world-wide market.

Activity

Draw a schematic of your dream car; imagine what kind of colour and layout the car would take, and also think what kind of engine the car have and what type of fuel it would use.

Questions

How big is the engine that you chose for the car?

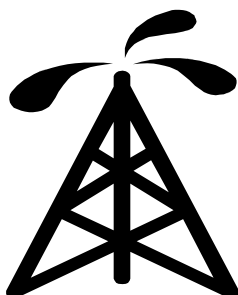
What fuel does your car run on?

Is this a renewable source of energy, explain why?

What will happen if this form of energy runs out?

Is there any other form of energy that your car could run on?

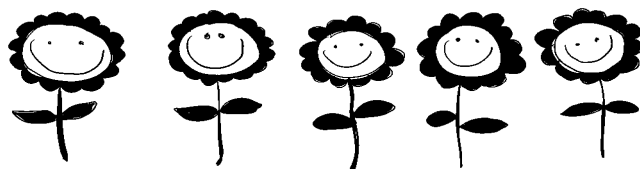
Did you know?



Scientists predict that by the year 2030 our oil supplies will be near to depletion. So what will you run your dream car on?

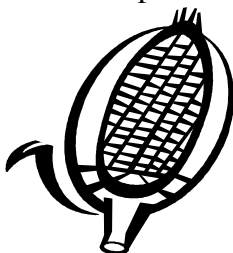
Can you think of any way that we can produce energy that is renewable and suitable to run cars?

In the energy-short world we are living in today it is important that we find ways of producing energy that are renewable and beneficial to us and to the environment. One example of this is the use of biofuels.



What do you know about biofuels?

A biofuel is a term used to describe a solid, liquid or gaseous fuel that has been derived from biological matter like plants.



Corn is an example

Why is converting plants to biofuels considered to be renewable energy?

What element is found in plants which allow them to produce energy?

What compound is it found in and what is the name of the process that traps solar energy in plants?

Compound: _____

Process: _____

Can you draw the atomic structure of this element?

As we mentioned earlier gasoline, which is made by the distillation of crude oil, is an example of a fuel that cars can run on. Oil is known as a fossil fuel and is non-renewable. But soon our oil and other fossil fuels supplies will run out so therefore we will look at biofuels for an alternative.

Bioethanol is a form of alcohol that is produced from the fermentation of the sugars in certain plants; **biodiesel** is also another form of biofuel which can be produced from vegetable oil or animal fat.

Did you know?

The rising prices of oil in the 1970's caused Brazil to undertake a major conversion from petroleum to bioethanol in order to run their cars. They used sugar from sugarcane as the raw material. So the use of biofuels has been around for quite a long time. In fact the first Ford car was designed to run on ethanol.

What benefits can you think of by using biofuels instead of petrol for cars?

Unit 4: Biofuels

Lesson 2 ~ The debate about biofuels (Double lesson)

In this lesson we will look at some of the pros and cons involved in using biofuels as a replacement for petrol and diesel. You will take part in a debate on the value of biofuels.

What do you think about the use of biofuels as a form of energy so far? Do you think they are a good thing or a bad thing?

The debate



Here is a list of the pros and cons to biofuels

Pros:

1. Biofuels are derived from agricultural crops such as corn and soy beans. This will promote local agricultural development.
2. Biofuels allow for a choice when choosing an energy source. Unlike fossil fuels and oil, it is a renewable source of energy.
3. Since biofuels are products of plants, there are safer to the environment when burned. The amount of carbon dioxide absorbed is released when burned so they are carbon neutral.
4. Biofuels do not pose a major problem for people and businesses to switch to as they can replace directly petrol or diesel.

Cons:

1. Growing crops to produce biofuels calls for large amounts of land to be cleared in order for the crops to be grown, releasing greenhouse gases.
2. The burning of bioethanol and biodiesel may lead to increased levels of nitrogen oxides in our environment.

3. Growing crops for biofuels could lead to an increased use of genetically modified crops.
4. Today there is already an increase in food prices so therefore buying of corn etc would come at a higher price. Biofuels may compete directly with food for crops like corn.

Activity:

In your group read through the pros and cons and then debate within the group and discuss whether you feel the arguments for biofuels outweigh those against or vice versa.

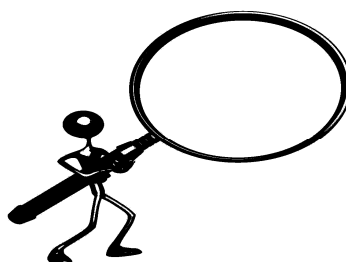
When this is completed look at the following headline.

'Replacing only five percent of the nation's diesel consumption with biodiesel would require diverting approximately sixty percent of today's soy crops to biodiesel production. That's bad news for tofu lovers!'

Matthew Brown, energy consultant.

Do you think it is right to replace our food supplies for the use of bio fuels?

What would happen to the third world countries that struggle in buying and growing crops if we used more biofuels?

Activity:**Scenario**

- Your group has just been asked by a multinational car company who are undecided to change their cars to biofuels to create an advertisement, aimed at the public who do not have a good grasp of the concept of biofuels.

- The advert created will be aired on national television so you better be well prepared!
- Remember to include such facts as the science, why it is considered as a renewable source etc and what benefits/negatives biofuels may have.
- It is up to you as the group to pick whether you are for or against biofuels
- The script to the commercial will be written by the group and acted out by the group.

Commercial brainstorm

What is your opinion on the use of biofuels now?

Do you think there is a bright future for this form of technology in our society or not?

Unit 4: Biofuels

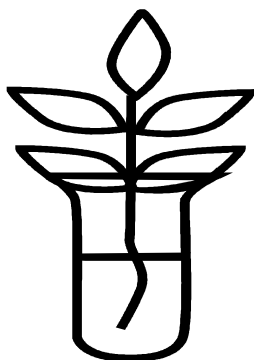
Lesson 3 ~ Producing energy from food (Single lesson)

In this lesson we will look at the science of biofuels and see if they have a future role in the world.

Fact:

Did you know that every food contains energy, including plants!!!!!!

Activity: To investigate the amount of energy produced by various food sources.



Safety: Lab glasses, gloves and coats to be worn at all times. Follow the safety rules at the front of this handbook.

Diagram: Draw a diagram of your experimental set-up

Materials needed:

Thermometer

Bag of marshmallows

Various bags (small) of dry beans — lima beans, etc.

Bag of dry-roasted nuts — peanuts, cashews, etc.

Small plastic cups (for seeds/nuts/foods)

Test tubes

Retort stand

Bunsen burner

Metal tongs and tin lid

Measuring cylinder

Procedure:

1. Measure out 30- 50 mL of water in the large test tube so it is about half-full, clamp to the retort stand, and place the thermometer in the test tube. Record the initial temperature.
2. Set the food source on fire using the Bunsen burner and place under the test tube for one minute. Put the food source on a piece of aluminium foil or tin lid or hold it in the tongs. Stir the water carefully using the thermometer and then take the final temperature of the water. (If the temperature rise is too small ($< 1^{\circ}\text{C}$) allow the sample to burn for longer than 1 minute. But use the same time for all samples.)
3. Calculate the heat given off. It takes 4.2 J to raise the temperature of 1 g of water by 1°C . So it would take $50 \times 4.2 = 210 \text{ J}$ to raise the temperature of 50 g (= 50 mL) of water by 1°C .
Heat given off = $50 \times 4.2 \times \text{temp. rise}/^{\circ}\text{C}$ (adjust if you used a different volume of water.)
4. Repeat for all of the food sources.

Results:

Food Type	Initial temperature	Final Temperature

Questions:

Which food source produced the greatest amount of energy when burned?

Which produced the lowest amount of energy?

Which food do you think would be the best to use as a source of fuel and why?

This is a very rough measurement - how could you make the experiment a fairer test and give better results?

Along with biofuels what other forms of renewable energy may be used to produce energy?

Unit 5.

DNA Identification



Unit 5: DNA identification

Lesson 1 ~ Understanding DNA identification (Single lesson)

Did you know that every person has their own unique DNA which sets them apart from everybody else? So how can this help scientists?

What is DNA?

Scenario



You arrive back from lunch to your classroom only to find that the class computer has been taken. The teacher corners off the crime scene with yellow tape! Suddenly you see and catch a man behind the desk holding the computer! But did he do it or was he just bringing back the computer. You have one clue - your teacher finds a strand of the culprit's hair!

How might we find out whether the man caught with the computer is innocent or guilty?

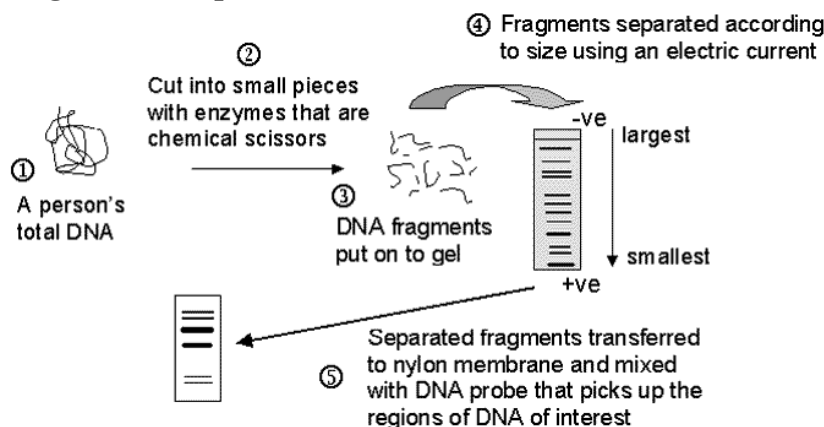
DNA profiling

DNA profiling is a method that scientists use to determine, for example, whether someone committed a crime or not by using the person's own unique DNA, often known as a DNA fingerprint. There are a number of steps involved in the method known as *gel electrophoresis*.

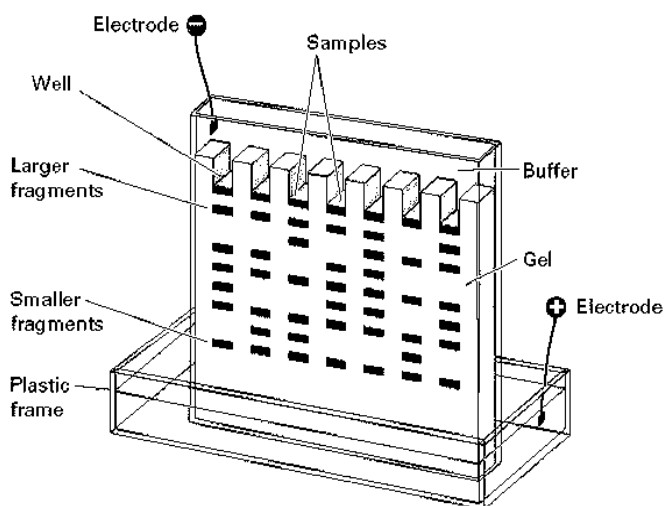
Activity:

So let assume that a hair of the culprit was found at the crime scene. Scientists then take this hair to the laboratory and follow a similar method to this.

- The cells are broken down in order to release the DNA.
- The DNA sample is cut into fragments, using special enzymes.
- The fragments of DNA are then separated to give a DNA profile using a process known as gel electrophoresis (similar in principle to paper chromatography, which you are familiar with).

Diagram of the process:

<http://www.dnaletters.com/img/19.gif>

So what is gel electrophoresis?**Diagram**

http://www.cbs.dtu.dk/staff/dave/roanoke/fig5_33.jpg

The picture above shows a gel electrophoresis chamber. So what happens?

- Gel electrophoresis involves placing DNA fragments at the top of a sheet of sugar-based gel, placed in a glass chamber, sitting in a buffer solution.

- An electric current is applied which draws the DNA towards the end of the chamber. The electric current is successful in drawing DNA towards the end, as the DNA fragments are negatively charged.
- Smaller fragments move faster down the chamber than the larger fragments, forming bands on the gel.
- When the bands are separated, UV light is applied which allows them to fluoresce and makes them visible.
- A photographic image is then obtained of the DNA profile.

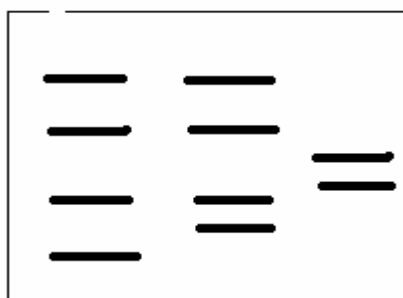
Why is a power source used in gel electrophoresis?

Which will move faster smaller fragments or bigger ones?

Why is UV light used at the end of the process?

Why is a picture taken at the end?

At the end of gel electrophoresis a picture of bands is obtained, for example:



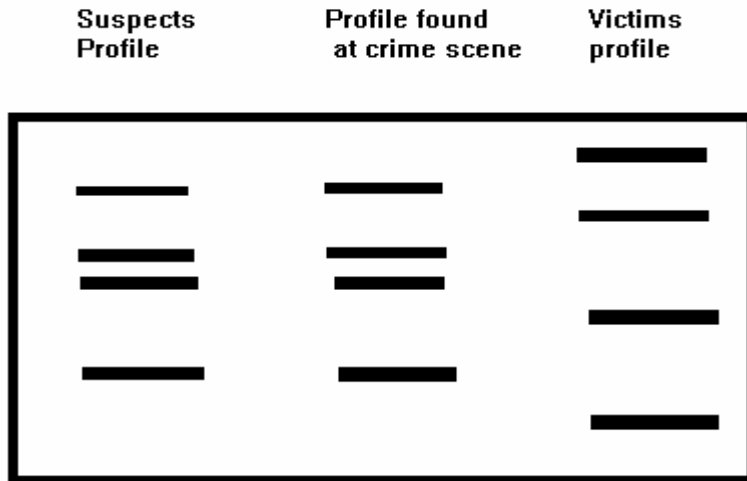
So how can these bands be helpful? Scientist can make what is known as DNA profile from these bands, which can be used to compare your DNA to another person's or to DNA that was found at a crime scene. Your DNA is your genetic fingerprint, which is unique, although it contains elements of your father's and mother's DNA.

How might this be useful?

Activity:

Here's an example of a DNA profile used by forensic scientists to determine whether a person was present at a crime scene or not.

Work in pairs to determine if you think this person was at the crime scene?



Look at the bands of DNA in the diagram:

Which of the suspects were present at the crime scene?

Explain your reasons for this answer

Should this DNA profile be used in court?

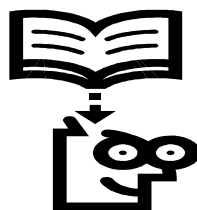
Unit 5: DNA identification

Lesson 2: The debate about DNA identification (Double lesson)

In the previous lesson you learned that a person's DNA can be made into a DNA profile using a technique called gel electrophoresis. In this lesson we will see what some of the benefits and negatives there are to DNA profiling, also called DNA fingerprinting.

What is your opinion on DNA finger printing so far?

Read the following extracts and determine how you feel about the benefits and negatives of DNA profiling.



Case A.

On the 11th of September 2001, 2,792 people lost their lives in the World Trade Centre in New York due to a terrorist attack. Many of the bodies found where so badly burned that they could not be identified using conventional means such as dental records. Forensic teams had to use DNA profiling, taking tissue samples from ground zero and running DNA profiles on the victims, for comparison with the DNA profiles of family members. Forensic scientists received more than 20,000 pieces of human tissue from ground zero and it was their job to profile them and enter the results into a database, a long and gruelling task. Out of the 2,972 people that died in the attacks, 1,585 of them have been identified. This allowed the families and friends of the victims to know that their loved ones have been found.

Case B

Not only can DNA profiles be used in criminal situations, but they can also be used in medical ones. For example genetic information such as the markers for diseases in a family can be obtained from DNA profiles. The disease may not yet have developed but may occur in the future. This may be seen as a benefit to the intermediate family, as it would tell a person if they were at risk. But what if this information was made public? For example, what if this information was given to insurance companies? If there were indications of a serious illness in a person's genetic makeup, would they be so willing to give life insurance to a person? Or what if this information was given to future employers, would it be so easy for a person with an illness to get a job? The

information might be used as a reason for abortion if a foetus were found to have a serious disease.

Answer the following questions, but try to think of other ways DNA profiling may be beneficial or negative.

What are the benefits of DNA profiling?

Can you think of any way in which DNA profiling may be negative?

Activity: Writing a newspaper article



In this activity you will work in groups of four to write your own newspaper article on the ethical issues involved in DNA profiling.

Background:

Statistics show that many people who commit crimes repeat their crimes after they are released from prison. All people arrested on suspicion of a crime have their DNA taken and kept on file. Many governments now require that their DNA profile be kept on a database so that they can be used for solving future crimes. However, many governments are now looking at having a nationwide database, which will contain the DNA fingerprints of newborns.

What do you think about this idea?

In the article

- Try to look at both sides of the argument - how DNA profiling may be both beneficial and negative.
- Think of the uses of DNA profiling in everyday life, and how it could affect you and your freedom.
- Discuss the issues that arise in your group before writing the article. Remember everybody may have a different opinion.

What is your opinion on DNA profiling now

Do you think that it should be used more in our society and not just for criminals?

Have you read of any 'cold cases' that have been solved using DNA profiles?

Unit 5: DNA identification

Lesson 3: Understanding DNA further (single lesson)

In this lesson you will be taking a further look into DNA and DNA profiling.

Look at the person sitting beside you



What colour hair do they have?

What colour eyes do they have?

There are so many characteristics that set us apart from the people sitting beside us. Unless there are identical twins in your class, no two people will look the same? So what makes us look so different from everybody else?

What are chromosomes and what are they made up of?

Where are chromosomes found in the body?

Draw a diagram of a chromosome.

How many chromosomes are found in the nucleus of a human cell?

DNA

DNA is often called the blueprint of life, as it contains within it the information which allows our body to function and allows us to have our own unique look.

What does DNA look like?

Draw a picture of a ladder with seven steps on it

DNA looks very like this!

Explanation:

- The two long sides of DNA are called side strands
- The steps in DNA are made up of pairs of bases.
- There are only four bases involved in DNA: they are adenine (A), Thymine (T), Guanine (G), and Cytosine (C)

So how do they pair up?

A----- T Adenine always joins with Thymine

G-----C Guanine always joins with Cytosine

There is also one more important factor. Picture the ladder you have just drawn. Now imagine twisting that ladder.

Why is DNA often called a double helix (hint look at your ladder)?

Activity: Making your own double helix - a model of DNA**Materials required**

Twizzlers

Tooth picks

Marshmallows / four different colours

Procedure:

1. Assign each colour of marshmallows a letter A,T,G or C.
2. Place two Twizzlers on the desk and cross them like an x
3. Place two different colour marshmallows on the toothpick, for example A and its complementary base pair T.
4. Set this tooth pick between the two Twizzlers
5. Continue this through out the length altering the base pairing in a random way.

Conclusion:



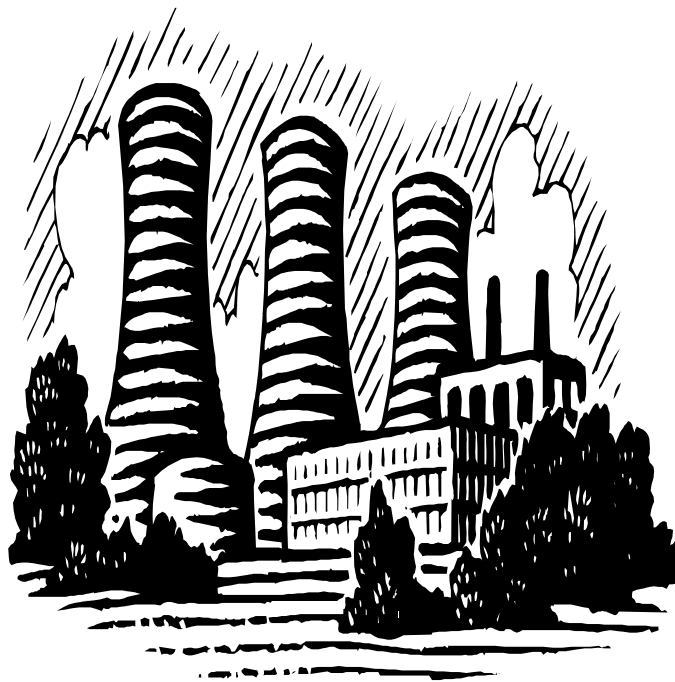
Is DNA found in every cell of the body?

Is it the same DNA in each cell in each person?

How might this help scientists in certain scenarios?

Unit 6.

Nuclear power



Unit 6: Nuclear power

Lesson 1: Understanding nuclear energy (single lesson)

The **Simpsons** are a cartoon family meant to represent the average American family. Some would argue that no family could ever really be as crazy and dysfunctional as them, and if it was a true representation we don't really believe that Homer would be a safety inspector at the Springfield nuclear power plant. Do we?



In this Unit you will be learning about nuclear energy and why in the future a plant, like the one Homer Simpson works in, may be located just a few miles from where you live! Don't worry I don't think he'll be the safety inspector!

Questions:

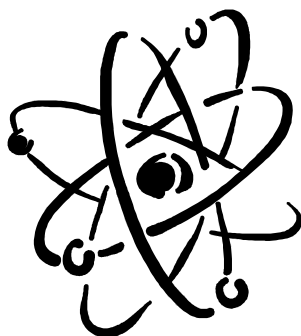
What is the difference between renewable and non-renewable energy?

List 3 types of renewable and 3 types of non-renewable energy.

	Renewable	Non-renewable
1.	_____	_____
2.	_____	_____
3.	_____	_____

Background

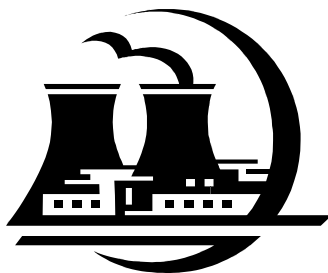
Nuclear energy is a form of non-renewable energy, as you will see later in future lessons. Nuclear power extracts usable energy from atomic nuclei when they undergo nuclear reactions, known as nuclear fission. Fission means splitting apart.



So how is nuclear power generated?

Nuclear power is generated using uranium atoms, which undergo fission reactions to produce energy. This occurs in nuclear power plants. Uranium is a metal mined in various parts of the world. Uranium is a radioactive element, which means that its nucleus is unstable and spontaneously splits up, releasing large amounts of energy and radiation. This is known as radioactive decay.

Can you find uranium on the Periodic Table?

Nuclear power plants

Do you know the location of the nearest nuclear power plant?

Fact: Over 70% of the electricity in France is generated in nuclear power stations.

So how is nuclear power generated in a power plant?

Activity:

All of these steps are jumbled up try to rearrange them in the correct order to explain what happens in nuclear power plants.

- Turbines turn generators to produce electricity
- Nuclear fission produces heat
- Electricity is sent around the country
- Water is heated to make steam
- Steam turns turbines

<u>1.</u>	
<u>2.</u>	
<u>3.</u>	
<u>4.</u>	
<u>5.</u>	

Did you know?

Currently over 15% of the world's electricity comes from nuclear power plants. The U.K., U.S, France and Germany are a few countries to name a few that have nuclear power stations. If you have travelled to Holyhead on the ferry to Wales, you were very close to a nuclear power station on Anglesey.

Questions

Why is nuclear energy a form of non-renewable energy? (Hint: uranium)

Why do you think Ireland has not built any nuclear power stations?

Why would we build nuclear power stations even though it is non-renewable energy?

Does nuclear energy produce air pollution?

What do you think happens to the radioactive waste produced by nuclear power stations?

Nuclear power under controlled conditions can be extremely beneficial, however there are risks associated with the use of nuclear power stations.

True story

In 1986 in Chernobyl in the Ukraine, a steam explosion in the nuclear power plant caused radioactive contamination to spread many miles from the power station. In fact the radioactivity reached Wales and Ireland. A total of 50 workers died from direct contact with the radioactive contamination. The true scale of the accident, however, is still being seen today with an increase in cancer cases and also an increase in the number of babies born with deformities. There is some disagreement about how many people have been affected by the explosion and in the area around the plant, wild life has flourished in the last 20+ years and they don't all have 2 heads!

Reading this article would you feel safe living close to a nuclear power station, why?

What if I told you that with today's technology new safety protocols have been set in place that make much safer than it ever was before? Newly built plants could now withstand the power of an earthquake or even a aeroplane crashing into the reactor. Many people in France live close to nuclear power stations and without them all the lights in France would go out!

Would you now feel safe living close to a nuclear power station, and why?

What benefits are there to nuclear power?

What are the negatives to using nuclear power?

Unit 6: Nuclear power

Lesson 2: Debating nuclear power (double lesson)

What is your opinion on nuclear energy so far?

Activity:

Scenario

You are part of a small local community consisting of a population of 1,000. The nearest city is an hour's drive away. A nuclear energy business has presented plans to build the first nuclear energy plant in your area. Currently there are other major renewable energy projects in your area, using wind power and solar power. It is up to you as the local community to vote on whether you accept or decline the nuclear power station. Some information is given below but each group should also do some research to add to the arguments for or against nuclear power.

People involved in the debate:

1. Public opposed to the building

This group should focus on:

- Deaths that could be caused in the incident of an explosion.
- The selling of the by-products produced for nuclear weapons.
- Vulnerability of the plant to attacks by terrorists.
- It uses a non-renewable energy source and we are only replacing the problem of oil with another.
- If it only supplies 15% of electricity worldwide, why would we bother?
- The problem with the disposal of radioactive waste. They take 10,000 years to decay and become harmless.

Two people will create a poster to show the cons of having a nuclear power station

2. Public in favour of nuclear power

This group should focus on

- The success of nuclear energy throughout the world e.g. France.
- The reduction of greenhouse emissions from using nuclear energy.
- The technology has improved over time so now safer methods are used, and an accident like Chernobyl is unlikely to happen again.
- Building such a station would create wealth and more jobs to the area.
- A nuclear power provides energy all the time unlike a wind farm.
- Supplies of uranium are more secure and will last longer than supplies of oil.

- Nuclear waste can be stored safely underground, as it came from underground in the first place.

Two people from this group will create a poster on the pros of having a nuclear power station.

3. Town council

The town council consist of ten members, the mayor and nine others. Upon hearing both arguments it will be the job of the town council to vote on the matter and decide whether or not to accept a nuclear plant.

4. Chairperson

The chairperson is responsible for the floor when the debate is taking place. If it happens that there is a tie during the voting process, the chairperson will have the final say.

After the debate:

What is your opinion on Nuclear energy now?

Do you see a future for nuclear power in Ireland, why or why not?

If it was a choice between nuclear power and biofuels, which would you like to see being utilised more, and why?

Unit 6: Nuclear Power

Lesson 3: Understanding nuclear power further (single lesson)

In this lesson you will look further into the science of nuclear reactions and how power can be generated from them.

Before you begin to understand nuclear energy let's revise the structure of the atom.

What charge does a proton, neutron and electron have?

Proton	
Neutron	
Electron	

Can you draw a diagram of the structure of a carbon atom, helium atom and an oxygen atom?

CARBON

HELIUM

OXYGEN

Activity:

Materials required:

Large pink and white marshmallows

Toothpicks

Sheet of paper

Adhesive tape

Procedure:

1. Get two toothpicks and make a cross. Use tape to bind the cross
2. Place the marshmallows on the toothpicks to make a model of the nucleus of a carbon atom. Use six pink marshmallows for the protons and six white marshmallows for the neutrons.
3. Repeat the steps to create a helium atom.
4. Now join the atoms together to form a new nucleus.

What new atom is now created?

5. Remove the helium atom, what atom is now created.

6. Add on two more white marshmallows to represent neutrons
What atom now have you created?

7. Replace one of the neutrons for a proton, what atom have you created now?

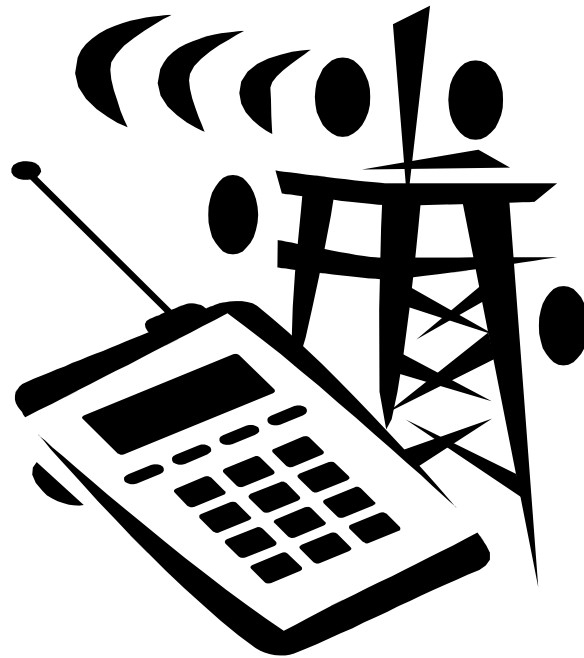
8. Now split the atom in two. In a nuclear reaction this liberates energy as a small amount of mass is converted into energy ($E = mc^2$). If a lot of atoms split simultaneously we have an atomic bomb.

Explanation

- A helium nucleus, when talking about nuclear energy, is also known as an alpha particle. It is a helium atom that has lost two electrons.
- When the helium and carbon atom were put together an oxygen atom was created.
- When the oxygen atom released the alpha particle this is called alpha decay.
- When two new neutrons are added, it was noticed that it was still a carbon atom but it did not have the same number of neutrons. This is called an isotope; *they have the same number of protons but different number of neutrons*.
- The carbon-14 atom now undergoes beta decay (losing an electron). This forms a nitrogen atom as a neutron is converted into a proton.
- To show nuclear fission split the nitrogen atom in two. Explain how this will release energy.

Unit 7.

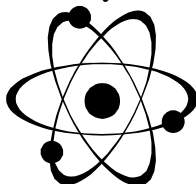
Electromagnetic Radiation



Unit 7: Electromagnetic Radiation

Lesson 1 ~ Understanding electromagnetic radiation (single lesson)

Not all radiation is due to radioactivity.



Waves

When most people think of waves they think of huge gushes of water crashing on the beach.



But ‘wave’ is also a term used in science!

Activity

Working in pairs, strike a tuning fork off your desk and hold it up to your ear.

What do you notice about the tuning fork when struck?

Do you hear a noise when you place the tuning fork to your ear?

What conclusion can you draw from this?

Can you give a definition of a wave?

When we hear something like a tuning fork then this is due to sound waves. We know that sounds have different pitches or frequencies, and they may be loud or quiet.

Electromagnetic waves

In this section we will focus on electromagnetic waves. Some might be wondering what they are?

There are seven different types of electromagnetic waves which make up what is known as the **electromagnetic spectrum**, which is the name given to the different types of radiation. Believe it or not you know about these types of waves! We met them in Unit 1 when we talked about the greenhouse effect.

Activity

In pairs try to figure out the name of the wave that matches the picture and pick a characteristic (following page) which you think applies to this wave!



1.



2.



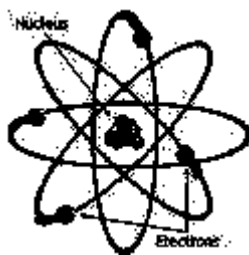
3.



4.



5.



6.

Characteristics:

- We listen to this wave every day when we listen to our favourite programmes.
- We use these waves to cook our dinner, but scientists also use these to learn about space.
- If we broke our ankle the doctor would use these waves to get a better look.
- The army uses these types of waves in order to see people in the dark, as their bodies emit heat.
- If we do not protect our skin these types of waves can damage it.
- The waves can be emitted from an unstable radioactive atom.

There is also one more type of radiation can you name it? (Hint: Rainbow colours)

7.

How do you think the different forms of radiation in the electromagnetic spectrum are produced?

As mentioned above all these types of radiation are part of the electromagnetic spectrum (which we met before). So what makes one type different from the other?

Recap:

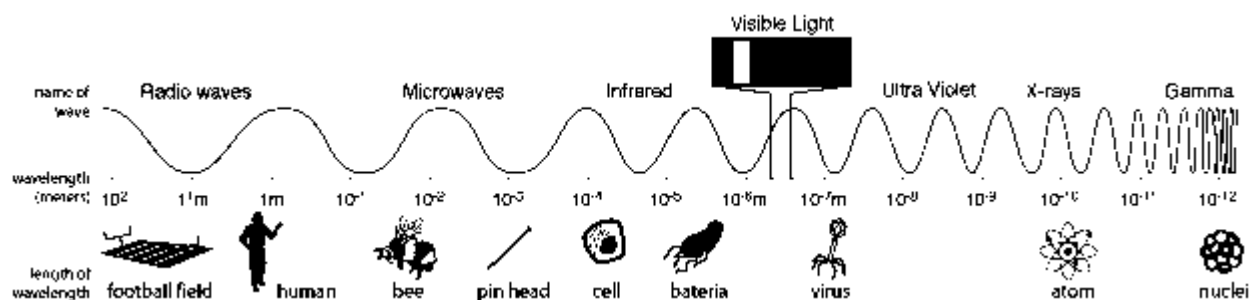
What is wavelength?

Draw a diagram to illustrate what you mean by wavelength.

Long wavelength means low energy; short wavelength means high energy.

How do radio waves differ from gamma waves?

The electromagnetic spectrum



<http://science.hq.nasa.gov/kids/imagers/ems/index.html>

Name a radiation with a long wavelength; does this have a lot of energy or a little?

Name a radiation with a short wavelength; does this have a lot of energy or a little?

What do X-rays, UV rays and gamma waves have in common?

Unit 7: Electromagnetic radiation

Lesson 2: The debate about electromagnetic radiation (double lesson)

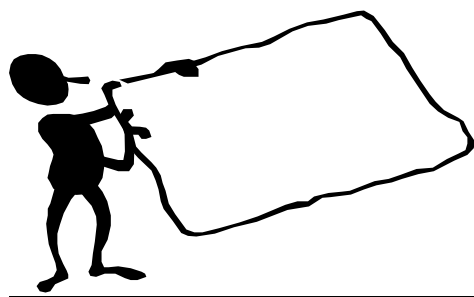
In the previous lesson you learned that there were many different types of electromagnetic radiation such as microwaves, X-rays etc found within the electromagnetic spectrum.

What in your opinion is the importance of the electromagnetic spectrum?

The electromagnetic spectrum is part of our everyday lives. Without it we would not be able to listen to the radio, watch television, call anyone on our mobile phones etc.



Activity:



You will be broken up into seven working groups, corresponding to the 7 types of radiation.

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7
Radio waves	Microwaves	Infra red Radiation	Visible Light	Ultraviolet light	X Rays	Gamma Rays

Each group will take one of the topics above and read the following!!!!

The electromagnetic spectrum is part of our everyday life and without it we would not be able to listen to the radio, watch television, call anyone on our mobile phones etc.

So which part of the electromagnetic spectrum is the most important in our lives, the part that we could not live without? It is up to your group to find out and argue your case to the rest of the class.

The only way of finding this information is to research your topic, through books, the internet etc.

As a Guideline you should answer the following questions

What part of the spectrum are you studying?

What wavelength range does it cover?

Is it a very energetic wave? (Remember shorter waves and longer waves)

Where does it lie in the electromagnetic spectrum?

How is this type of radiation produced or where is it found?

Give everyday examples of this type of radiation and its uses?

How does this type of electromagnetic radiation benefit us in our everyday lives?

How can this type of electromagnetic radiation have negative effects on our everyday lives?

Make a poster

Now that you have your information, it's time to make your poster to advertise your type of radiation!

Remember you are trying to influence the rest of the class to vote for this type of radiation, so make it as appealing as you can!

Note

As each person is advertising their form of radiation, write down your own conclusions in the following boxes. Try to weigh up both the positives and the negatives.

Micro waves	
Radio waves	
Infra red waves	
Visible waves	
Ultra violet waves	
X - Ray Waves	
Gamma Ray waves	

Which one do you believe is the best type of radiation, and why? (You do not have to vote for your own one!)

Which one do you believe to be the worst type of radiation, why?

What is your overall conclusion on electromagnetic radiation?

Fact: All types of electromagnetic radiation travel at the same speed - the speed of light, 301,000 km per sec!

Unit 7: Electromagnetic radiation

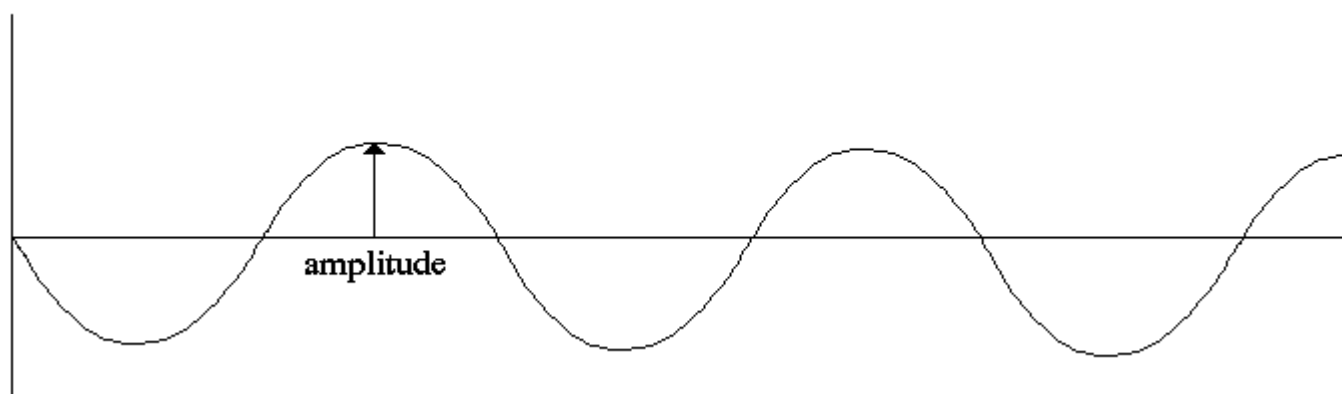
Lesson 3: Understanding Waves (single lesson)

In this lesson you will be learning about the science of electromagnetic waves, including their properties.

Describing a wave

Activity

Work in pairs to try to match the terms to the blank spaces in the diagram



<http://abyss.uoregon.edu/~js/images/wave.gif>

- The top of the wave is called a crest.
- The bottom of the wave is called a trough.
- The distance from one crest to another is called the wavelength and it is measured in meters.
- The distance from one crest to one trough is called 1 cycle.
- The number of cycles per second is called the frequency which is measured in hertz.
- The amplitude measures how high a crest is or how deep a trough is.

Very Important:

Waves can be described as vibrations moving through a medium, which may be a solid, liquid or gas. (Think of the waves rolling in from the sea. What is the medium there?)

Activity to show how waves transfer energy (Mexican wave)

1. In groups of eight stand in a straight line.
2. The pupil to the far left is the source of vibration (like a tuning fork).
3. The pupil to the far right is the acceptor of vibration (like an eardrum).
4. On the teacher's instructions, create a Mexican wave going from left to right.

Going from left to right when you sat down what did the person next to you do?

How can this be related to waves and energy?

Draw this wave that you created and follow the transfer of energy.

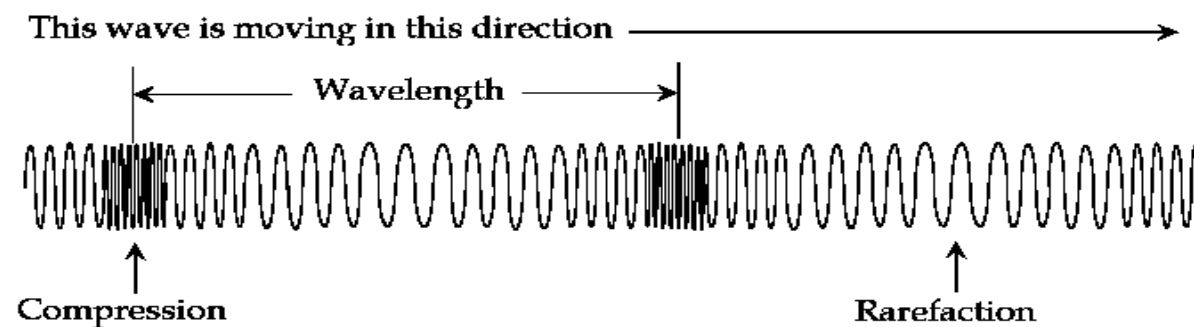
What kind of waves are there?

When we talk about waves there are two types of waves

Longitudinal waves

Longitudinal waves look very similar to compressions on a slinky.

Longitudinal waves need a medium to carry them in e.g. solid, liquid or gas



http://www.science-class.net/Notes/Images_8th_Notes/Longitudinal-Wave.gif

Scenario

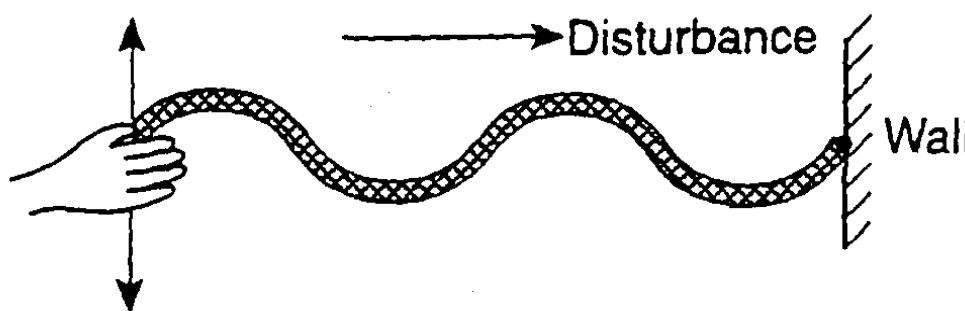
An alarm clock is ringing and is very loud, so you decide to place a bell jar over it.

Can you still hear the alarm ringing, why?

If you remove all the air, can you still hear the alarm ringing? If not, why not? (You may have ‘seen’ this experiment in Junior Science.)

Transverse Wave

The second type of wave is called transverse waves. These waves are similar to waves on a rope. These waves do not need a medium to travel in. Examples are electromagnetic waves.



<http://www.northrowan.com/sabo/30.gif>

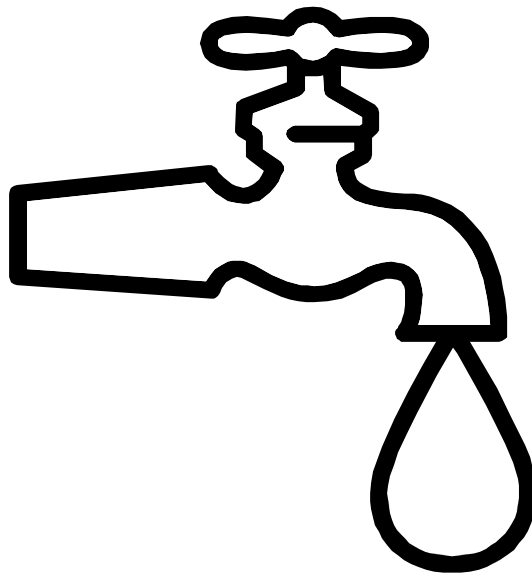
Can you think of any type of electromagnetic waves (Hint: Think space!)

Question:

Explain why you can see in space but you can't hear anything.

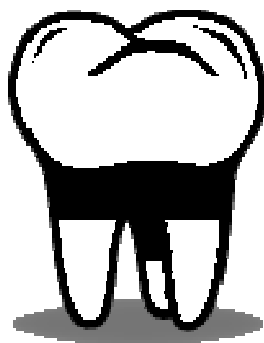
Unit 8

Fluoridation of water supplies



Unit 8. Fluoridation of water supplies

Lesson 1 ~ Understanding Fluoridation (single lesson)



People say that one of the most attractive things about a person is their smile. Every day we take care of our teeth - we brush, we floss and we rinse! Now what if I was to tell you that not only do we take care of our own teeth but so do the government of Ireland? They also take care of everyone's teeth in the country! How?

By adding a chemical called fluoride into the water! This is a compound of the element fluorine. Most would argue that this is a beneficial addition to our water supplies, after all it helps us maintain a beautiful smile, or is it?

The atom of fluorine

What is the number of the group in the Periodic Table that fluorine is located in? Locate fluorine in the Periodic Table.

What is the name of this group?

What characteristics does this group possess?

What is the mass number of fluorine?

What is its atomic number?

How many protons, neutrons and electrons does fluorine have?

1. Protons _____
2. Neutrons _____
3. Electrons _____

Can you draw the atomic structure of Fluorine?

Fluoride

Fluoride is an ion of fluorine formed by adding an electron to a fluorine atom and is found in salts, e.g. sodium fluoride! (The fluoride ion is like the chloride ion.)

Can you draw the structure of sodium fluoride? (Hint: Ionic Bonding)

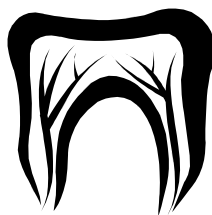
Did You Know?

Fluoride is a naturally occurring mineral in nature found in air and water. Some water supplies contain natural fluoride and you sometimes find it on the label of bottled water.

Fluoride is also considered a nutrient that is needed in the body in small amounts!

What is a nutrient?

Trip to the dentist



What are cavities in the tooth?

What causes cavities in your teeth?

Why do we need an intake of fluoride?

Besides helping protect the tooth against cavities, what else does fluoride protect against?

Name three places where we can get our intake of fluoride?

1.

2.

3.

True story

The effects of fluoride on teeth were noticed as far back as 1901, when two scientists - Dr McKay and Dr. Green Vardiman Black - worked together to find out why so many people living in Colorado Springs, USA had brown markings on their teeth. Both worked for many years to find reasons behind the mysterious browning of the teeth, which the aptly named 'the Colorado brown stain'. Eventually they realised that there must be something in the water supplies - high levels of fluoride were causing the teeth discolouration! However, the people also had fewer cavities.

This led scientists to question whether lowering the amount of fluoride added to water supplies would have a beneficial effect on maintaining the people's teeth, but without the browning.

From your knowledge of Junior Cert Science, explain what fluoridation is and when fluoride is added to water?

Note: Don't get fluorine (the element) and fluoride (the ion) mixed up, as many people do. This is the same mistake as mixing up chlorine and chloride. The element fluorine is very poisonous and dangerous; the fluoride ion in low concentrations is harmless and beneficial. The same is true of chlorine and chloride.

Unit 8: Fluoridation of water supplies

Lesson 2 ~ The effects of fluoridation (Double lesson)

In the last lesson you learned that fluoride is added to water supplies in order to maintain healthy teeth. However, too much fluoride in water can be bad. So how do the governments know how much to put in the water supplies?

Activity: To understand dose and response



Method one:

Materials required:

Three large beakers
Food dye

Procedure:

1. Label three large beakers A, B and C.
2. Place equal amounts of water into each of the beakers.
3. Add one drop of food colouring into A, note what you see.
4. Add three drops of food dye into beaker B, note what you see.
5. Add seven drops of food dye into beaker C, note you see.

Colour change

Beaker A	Beaker B	Beaker C

Questions:

Which beaker was the lighter colour, why?

Which Beaker was the darker colour, why?

Are chemicals at low doses more or less dangerous than chemicals at high doses, why?

If fluoride was to be added to water supplies which dose would be best?

True story

Too much of any chemical, even water, can be lethal to the human body. If the body receives too much water it can become over hydrated. The same goes for fluoride. If too much fluoride is added to water supplies it can lead to a case of browning of the teeth called *fluorosis*. However, at low doses it can help protect your teeth from decay and plaque.

The dose of fluoride usually added to water is one milligram to one litre of water (1 part per million), the Irish government however have reduced this from 1ppm to 0.8ppm

Method 2**Materials required:**

One larger beaker

One small beaker

Food dye

Method:

1. Fill the larger beaker with water and place four drops of the food dye in it.
2. Fill the small beaker with water and place four drops of food dye in it.

Result

Colour change in large beaker	Colour change in small beaker

Questions:

Which beaker turned the darkest colour?

What conclusions can you draw from this, in relation to dose and concentration?

How can this be applied to humans and adding fluoride to water supplies?

Part two of investigation.**To see the effects of fluoridation:****Materials required:**

Two large beakers
Two eggs hard boiled
Fluoride solution
Vinegar

Method:

1. Place water in a beaker and bring to the boil using a Bunsen burner or water bath.
2. Place the two eggs in and allow to cook for five minutes in order for them to be hard boiled.
3. When done allow to cool and carefully remove the hard boiled eggs.
4. Place one egg, label it C, in a large beaker; pour fluoride solution over the egg and allow it to stand for ten minutes.
5. Prepare a second beaker and label the second egg D; pour vinegar in but do **not** place in an egg - allow enough vinegar to cover two eggs.
6. After ten or fifteen minutes remove the egg C standing in the fluoride solution.
7. Label this egg with a black marker.
8. Place the labelled egg and the unlabelled egg into the vinegar and note the results.

Results:

What does the vinegar represent?

What is happening to the labelled egg when added to the vinegar? Note any bubbles formed on the surface.

What is happening to the unlabelled egg when added to the vinegar? Note any bubbles.

Why do you think the labelled egg is stronger than the unlabelled egg?

What conclusions can you draw from this?

Bring out the two beakers labelled A and B from the previous day

Your teacher prepared two hard boiled eggs and let them stand in fluoride solution (A) and vinegar (B).

What does the egg in Beaker A look like?

What does the egg in Beaker B look like?

What conclusions can you draw from this?

Question:

Why might it be a bad idea to drink fluoridated water, use fluoride toothpaste and a fluoride mouthwash?

Unit 8: Fluoridation of water supplies

Lesson 3 ~ The debate about fluoridation of water supplies (single lesson)

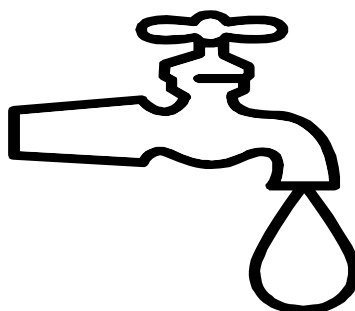
Debate about fluoridation

In the previous lesson you investigated one of the pros in relation to the fluoridation of water supplies debate.

What was the pro?

However, fluoridation of water is controversial and many people are against it. In this lesson we will debate the pros and cons of fluoridation.

Activity: the great community debate



Your community must take part in a debate in order to decide whether or not to allow the government to fluoridate your local town's water supplies. As a member of the public you will all be impartial and will hear both sides of the debate. It will then be up to you, the public, to vote for which side they feel have their town's best interest at heart and the welfare of its inhabitants.

For Fluoridation

Mr. Ryan, a respected member of the government, who has implemented the fluoridation of water supplies in several towns located around your area.

Against Fluoridation

Mrs. Lyons, a respected member of the town council, who has more than twenty years experience in dealing with town matters.

During the debate write notes on what you feel is important, and that stand out.

Remember their arguments should have scientific fact behind them, not just emotion.

Arguments for the fluoridation of water supplies	Arguments against the fluoridation of water supplies

Answer the following questions:

Which side do you feel got their point across showing clear scientific fact, why?

Which side did not get their point across, why?

What is your opinion on the fluoridation of water supplies?

As a member of the community would you vote in favour or against the fluoridation of water supplies, why?
