Science & Medicine!

TY Science Module

Teacher handout

Written by:
Karen Murphy
Series editor:
Peter E. Childs

Version 1.3, Oct. 2009

Table of Contents.

Introduction.

The Transition Year programme is designed to help pupils make the transition from dependent-type learning associated with the Junior Certificate to more independent type learning associated with the Leaving Certificate.
This guide is designed to provide specific information on how to introduce the Science and Medicine TY Science module into the classroom. It gives efficient teaching methodologies to sustain pupil's interests, to undertake active learning, while introducing some key scientific ideas. Each topic has useful information, which is easy to apply to everyday situations. Each unit is also designed to give the teacher scope to incorporate as much learning as possible.
This is an eight-week course which contains eight units. The units can be taught independently, but they are also designed to be sequenced so that one unit follows on from the previous one. These units should be informative, pupil-active, and will relate to pupils' everyday lives. Each unit consists of a single lesson, double lesson, and an optional lesson with extra information/ activities. The module will request pupils to develop their previous knowledge, enrich communication and IT skills, and they will experience many new science experiments and ideas. The module is not based on the Junior or Leaving Certificate courses.

The notes say '40 mins' for a single class and '79 mins' for a double class. These are nominal times and you should adjust for your own timetable.

Aims of the module:

1. Promote pupils interest in areas of Science that they have not encountered before.
2. Encourage pupils to enjoy Science and discuss issues relevant to their interests.
3. Give pupils an understanding of the relevance of Science topics in everyday life.
4. To help pupils see the importance of Science in the field of medicine.

Note: Request that pupils use a folder to keep all copies of their work. Read through each unit before beginning, as there may be activities which require pupil's preparation. Alternatively you can reproduce yourself or order the Student Handbook in bulk so that pupils have their own copy to use each week.

Unit 1: The action of antibiotics!

Unit 1: The action of antibiotics!

Pupils' previous knowledge:

Pupils will have been introduced to the concepts of bacteria, viruses, and antibiotics. The production of antibiotics will also have been briefly referred to in biotechnology. This topic appears in section 1C of the Junior Certificate syllabus: animals, plants, and microorganisms. The syllabus objectives are as follows:
OB65: investigate the presence of microorganisms in air and soil.
OB66: state two uses of biotechnology in industry and two uses of biotechnology in medicine.
OB67: list three common illnesses caused by viruses and three caused by bacteria.
This background information will be revised, and the foundation will be built on with more detailed information and activities.

Relevance to everyday life!
Pupils need to be informed about the dangers of misusing antibiotics. So many people, who nowadays get antibiotics for flu / cold symptoms, only take half of the prescribed course, and may finish the course at a later date when the symptoms re-occur. This is naïve behavior that has only caused more sickness to occur, and has resulted in the likes of the super bug. Also antibiotics are useless for viral diseases.

Lesson 1. Antibiotics – what are they? (Single lesson)

Class: Transition Year.
Duration: 40 minutes
Topic: Introduction to Antibiotics.

Aim: To introduce antibiotics and state how they work in the body.

Objectives:

- Pupils will understand how antibiotics were discovered in 1928.
- Pupils will be able to describe how antibiotics work in the human body.
- Pupils will observe that there are different types of antibiotics, which are used in different cases.

Resources;
Student workbook, Unit 1, lesson 1.
Leaflet from an antibiotic. [see page 78]

Assessment:
Pupils should be assessed throughout the lesson to determine their previous knowledge and capture pupils' attention.

- What are antibiotics?
- What are bacteria?
- Can you think of any names of antibiotics?
- Who invented antibiotics?

- Why is antibiotic resistance becoming a problem at the present? Link this to the superbug.
- What is the difference between aerobic and anaerobic bacteria?

Teaching ideas and tips.

- ✓ Get pupils to first suggest what antibiotics are.
- ✓ Break down the word antibiotic so that pupils can understand what it means.
  Anti = against / opposite of
  Biotic = life/ relating to living organisms
- ✓ Help pupils to come to their own conclusion as to what antibiotics are.
- ✓ Allow pupils to make a list of any antibiotic names that they have heard.
- ✓ Antibiotics are related to the immune system. Pupils are asked to recall the function of the white blood cells? Their function is to prevent / fight infection.

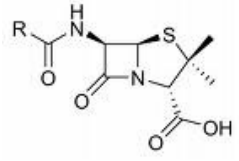
Make a clear distinction between:

1. **Bacteriostatic:** means that the antibiotics work by stopping bacteria from multiplying.
2. **Bactericidal:** mean that the antibiotics work by killing bacteria. They do this by interfering with the formation of the cell walls or cell contents of the bacteria. (Perhaps draw a cell when explaining how the antibiotic interferes with the cell wall)

   Any word ending with '-cidal' means to kill (as in suicidal). Pupils are asked to make a list of words ending in '-cidal'
   Some examples:
   Homicidal – a tendency towards killing another human being
   Suicidal – intentional killing of a person with his/her own hands
   Bactericidal – to kill bacteria
   Fungicidal – to kill / destroy fungus
   Germicidal – to kill germs, pathogenic organisms
   Pesticidal – to kill pests
   Viricidal – to kill viruses

   Stress the fact that antibiotics only cure bacterial infections.

   Question: What is the difference between anaerobic and aerobic bacteria?
   Aerobic bacteria need oxygen to survive; anaerobic bacteria do not need oxygen.
   Do not put too much emphasis on the chemical structure of an antibiotic – pupils do not have to learn this structure. It is here to show them that they are complex organic molecules.



Unit 1: The action of antibiotics!

Lesson 2. The Superbug. (Double lesson)

Duration: 70 minutes.
Topic: Antibiotics continued.
Aim: To introduce the concept of antibiotic resistance and to describe the production process of antibiotics.

Objectives:

- Pupils will understand what kinds of side-effects people taking antibiotics can suffer.
- Pupils will be able to state what antibiotic resistance means, and how it is affecting the world of medicine.
- Pupils will undertake an activity, which will require them to apply their knowledge to the situation in the story.
- Pupils will perform an activity to illustrate the fermentation process.

Resources:
Student workbook, Unit 1, lesson 2.

Teaching ideas and tips!

- ✓ Get pupils to suggest some side effects that they think may occur. Suggested examples are diarrhoea, feeling sick, being sick, fungal infections (thrush), more serious effects like formation of kidney stones, blood clotting, blood disorders.
- ✓ Ask pupils if they have any known allergies to antibiotics. Pupils are asked what types of side effects may occur if one was allergic to an antibiotic? Suggested answer is rash, swelling of the face and tongue, and difficulty breathing.
- ✓ Explain the importance of following the instructions when taking antibiotics. Some antibiotics should be taken with food; alcohol should not be taken with antibiotics containing metronidazole. Suggest that following the instructions is the best way to help prevent side-effects.
- ✓ Examine a label from an antibiotic packet (see p.78). Highlight what it is used for, ingredients, instructions, and side effects. Either photocopy the one included or get pupils to bring in their own label.
- ✓ Initiate a discussion with pupils about the MRSA. Ask pupils to suggest what MRSA is and how it has become a problem. Strive to get pupils to come up with the word **resistance**.
- ✓ Explain to pupils how resistant bacteria are affecting the world of medicine.

Information on the activity

This activity examines one process by which strains of antibiotic resistant bacteria can arise.

Aim: To show how populations of bacteria become resistant to antibiotics via the process of natural selection, and human misuse.

Duration: approximately 30 minutes.

Overview:
Pupils examine the story of a teenage girl who develops an infection related to injuries following an accident. Pupils will analyze the graphs and interpret the patterns. The graphs show that, over 6 days, the teen's population of bacteria becomes increasingly resistant to two antibiotics. Pupils should come to a conclusion that the teen picked up some bacteria resistant to the initial dose of antibiotics at the hospital. Those bacteria then grew to dangerous levels, and the teen's illness became more severe. Pupils conclude the activity by making a recommendation for further treatment.

In this lesson pupils are asked to give some examples of resistance and natural selection. These examples should include ideas like:

- Many insects have become resistant to insecticides
- Many weeds have become resistant to herbicides.

It may be a good idea to have pupils read the story prior to class. The concept of natural selection should also be briefly reviewed.
It may work better to put pupils working in pairs when answering the questions.

This activity should be organized to incorporate points discussed previously. Pupils should be encouraged to listen to each other's ideas, work together to analyze the graphs, and write individual thoughtful responses to the questions.

This section will now provide possible answers to the questions on the pupil's activity sheet:

Q1. Why do you think the first few antibiotics that Ann took at home did not work?
There were not enough antibiotics in the course, thus they only killed some of the bacteria.

Q2. Why do you think the antibiotics prescribed by the hospital did not work?
The few antibiotics that Ann took at home allowed the bacteria to become resistant to the antibiotics.

Q3. What information do the doctors need to find in order to treat the infection?
They would need to know what types of bacteria are present.

Q4. Explain how the graphs lines show how the number of bacteria changes over 24 hours.

No antibiotics: the number of bacteria increases quickly
Antibiotics and susceptible bacteria: the number of bacteria declines quickly as the antibiotics kill them.
Antibiotics and some resistant bacteria: first the number of bacteria falls as the antibiotic kills the susceptible bacteria. Because the resistant bacteria have been reproducing, a point is reached where the number of susceptible bacteria being killed

equals the increase of the resistant ones. As the population of resistant bacteria grows, the curve stops dropping and begins to rise.

Q5. There are three antibiotics suggested by the doctors for an infection like Ann's namely 'A', 'B', and 'C'.
Which antibiotic did Ann first become resistant to? A
Which antibiotics was she resistant to by Saturday? A and C

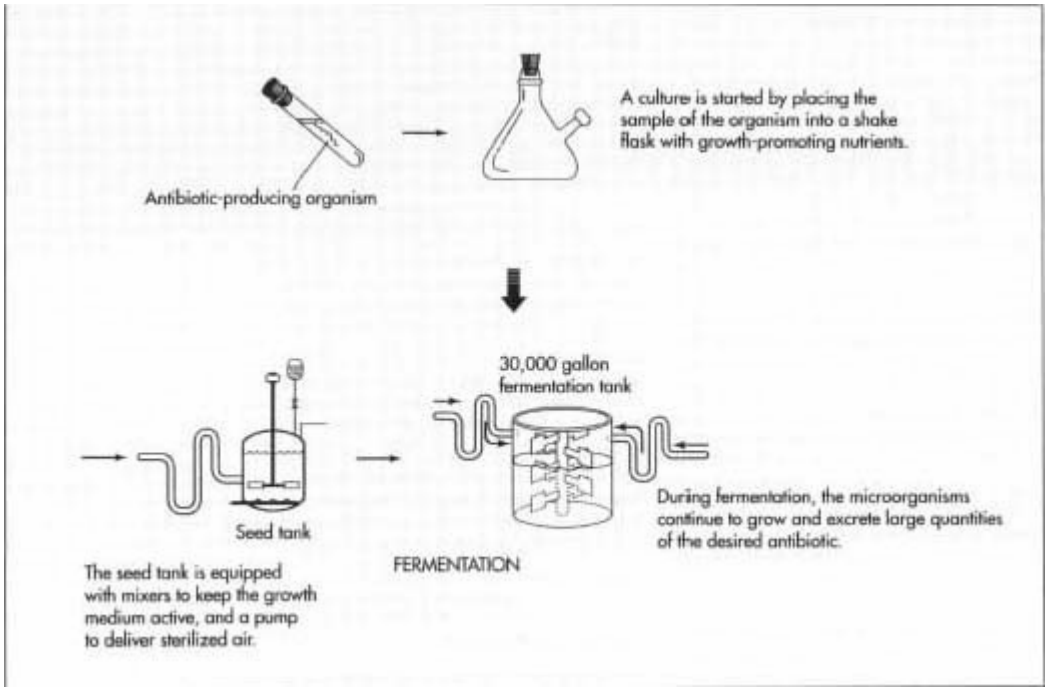
Q6. This question involves analyzing a graph in order to see that Ann is resistant to both antibiotics A and C. The best option for further treatment would be antibiotic B.

Assessment

Pupils are assessed throughout the class, and the activity provides stimulating questions, which require pupils to think and apply their knowledge. Some other suitable questions for end of topic assessment are:

- What is an antibiotic? What types of diseases do they treat?
- What do you think it means for a disease to be resistant to a drug, such as an antibiotic?
- How is the emergence of antibiotic–resistant bacteria an example of natural selection?
- Discuss what our lives would be like if most bacteria adapted to the presence of antibiotics and became resistant to them?
- Why are antibiotic resistant bacteria such a problem in hospitals? A suitable answer for this is: hospitals have a large number of disease causing microorganisms and thus they often use medicines that kill disease causing microorganisms, creating an environment that favors microbes resistant to these medicines. There are many open wounds in hospitals by which bacteria can enter the body.
- Discuss how human behavior helps resistant strains of bacteria arise. Why is the overuse and misuse of antibiotics risky, both for those who overuse/misuse and the overall health of the public?

The final part of this double lesson describes to pupils how antibiotics are made. Pupils should be able to list the main steps involved in the production. This will sustain pupil's interests, as it is something that applies to their everyday lives. The diagrams are useful aids for a summary.


Antibiotic-producing organism
A culture is started by placing the sample of the organism into a shake flask with growth-promoting nutrients.
30,000 gallon fermentation tank
Seed tank
During fermentation, the microorganisms continue to grow and excrete large quantities of the desired antibiotic.
The seed tank is equipped with mixers to keep the growth medium active, and a pump to deliver sterilized air.
FERMENTATION


ISOLATION, PURIFICATION, AND REFINING
Once the antibiotic is isolated from the fermentation broth and purified using either the ion-exchange or solvent extraction method, a purified powder form of the antibiotic is produced.
PACKAGING AND SHIPPING

Fermentation activity

Depending on time this can be done by the class or as a demonstration by the teacher or done as a home activity.

Get pupils to list some other products that fermentation is used for.

Ethanol – beers and wines
Acetone (nail varnish remover)
Yogurt
Drugs like interferon

Safety analysis

- Care should be taken when heating the milk to high temperatures.
- Laboratory coats and safety goggles should be worn throughout the experiment.
- Care should be taken when pouring the hot milk into the sterilized jars.
- Jars can be sterilized using a solution of sodium hydrogensulphite or by heating in an oven to ~ 100^{o}C.

Yogurt is a result of the bacterial fermentation of milk. The bacteria in yogurt are 'good' bacteria. It is the lactic acid they produce that causes the milk protein to thicken. The aim of this experiment is to investigate an optimal starter culture for making yogurt from whole milk.

Background information

Lactic acid is formed during the fermentation of lactose. The lactic acid lowers the pH and this causes the milk protein to thicken

For the yogurt making to be successful it is essential to have

1. Good sterile techniques
2. Proper incubation temperature
3. Protection of the starter from contamination.

Pupils are first asked what is probiotic yogurt?

Yogurt that contains bacteria or yeast

Resources:

- Milk
- Yogurt with live culture
- Beaker or jar with lid or a thermos flask
- Thermometer

Method

1. Heat the milk (approx 250 mL) to 85 – 90 degrees Celsius in the pot.
2. Remove from stove and place pot in container of water until milk is at 55 degrees Celsius.
3. Add one tablespoon of the yogurt to a sterilized jar (or Thermos flask).
4. Carefully pour the milk into the jar and cover with a lid.
5. Place the jar into a cooler with water of 50 degrees Celsius. (Not necessary if a thermos flask is used.)
6. Leave in the water bath for 3 hours.
7. Refrigerate over night.

Results:
Ask pupils to observe texture, smell, colour etc.
Please note that if this is made in the laboratory it cannot be eaten - it can if made in the home economics room or at home.

Explanation:
The milk was heated to kill any germs. Probiotic yogurt was added to the milk to make a starter culture. The milk had to be cooled first or the good bacteria would have been killed. Adding this yogurt added a type of bacteria called **acidophilus.** **Acidophilus** feed on lactose, a sugar found only in milk. They also produce a waste product called lactic acid. This acid gives the yogurt its distinctively sour taste and thick, custard like texture. Keeping the mixture warm optimizes the growth rate.

For more information:
http://www.sciencebuddies.org/science-fair-projects/project_ideas/MicroBio_p010.sht
http://biology.clc.uc.edu/Fankhauser/Cheese/yogurt_making/YOGURT2000.htm
http://chetday.com/howtomakeyogurt.htm

Unit 1: The action of antibiotics!

Lesson 3. A look further (Single lesson)

Duration: 40 minutes.
Topic: Antibiotics.

Aim: To extend on the knowledge previously discussed.

Objectives:

- Pupils will undertake research and will present their findings in this class. This research should be done before the class so most of the class time can be used for final preparation and presentations.

Resources:
Student workbook, Unit 1, lesson 3.
The Internet.

Pupils will be divided into groups for this activity. Each group will have been asked to research one of the tasks on the list as homework. They will be required to give a brief presentation to the class on their findings. The purpose of this is to develop their communication skills.

Ensure that it is clear to the class that they are not to repeat information already given. New facts/ stories / information must be researched.
Divide presentation time appropriately among the groups.

List of tasks:
Topic 1: Extend on the history of antibiotics.

Topic 2: The production process of antibiotics. Research one company that produces antibiotics.

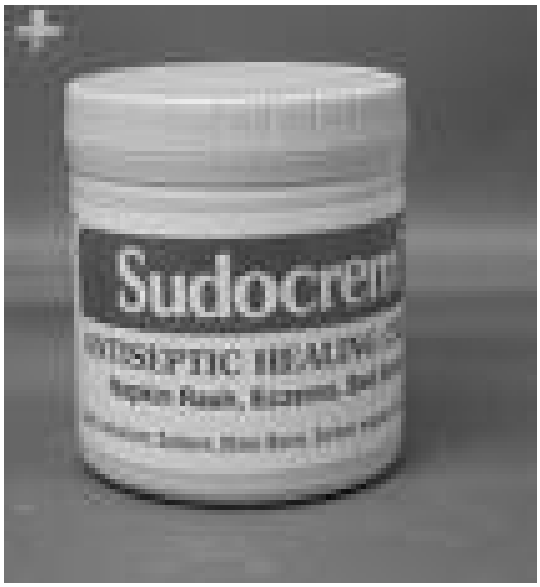
Topic 3: The difference between antibiotics. Compare three antibiotics, their uses, structure and side-effects.
Augmentin, Distaclor, Klaricid.

Topic 4: How are new antibiotics discovered? (Synthetic versus natural)

Topic 5: The fermentation process. Extend on what we already have discussed.
(For example the process of making beer/ wine or drugs like interferon)

Information for topic 3

Augmentin	Distaclor	Klaricid
• Co–amoxiclav • Use: bacterial infections • Active ingredients: amoxicillin and clavulanic acid • Penicillin type antibiotic • Works by interfering with the ability of bacteria to form cell walls • Broad spectrum • Absorbed better if taken at the start of a meal • Side effects: diarrhoea, indigestion, nausea, vomiting, thrush, and many more.	• Belongs to cephalosporins • Interfere with the ability of bacteria to form cell walls • Use: bacterial infections • Active ingredient, cefaclor • Side effects: headache, rash, itching, diarrhoea, vomiting and more • May reduce effectiveness of contraceptive pill	• Use: bacterial infections • Active ingredient: clarithromycin • Prevents bacteria from producing essential proteins • Does not directly kill bacteria • Broad spectrum • Side effects: disturbance of the gut, sore mouth, oral thrush, headache, disturbance of taste/ smell and more



Unit 2: Antiseptics

Unit 2: Antiseptics

Pupils' previous knowledge.
Pupils will most likely have heard of antiseptics, and will probably have used one or more throughout their lives. This topic will sustain pupils' interest, as it is very relevant to their everyday lives.

Lesson 1. Why use antiseptics (Single lesson)

Class: Transition Year.
Duration: 40 minutes.
Topic: Antiseptics.

Aim: To introduce antiseptics, their history and uses.

Objectives:

- Pupils will be able to distinguish the difference between antiseptics, antibiotics, and disinfectants.
- Pupils will understand how antiseptics were first introduced.
- Pupils will be able to list some common antiseptics and describe how to use them.

Resources:
Student handbook Unit 2, lesson 1.
Labels from some antiseptic products to examine their composition.

Preparation for this class:
Pupils will have been asked to check what antiseptics they have at home. They will also be required to bring a label from an antiseptic product.

Background information.
Tips!
Ensure to make a clear distinction between

1. Antibiotics: which destroy bacteria within the body.
2. Antiseptics: medicines that slow or stop the growth of germs and help prevent infections. (Used on living skin)
3. Disinfectants: destroy microorganisms found on non- living objects. Usually more powerful than antiseptics.

Ensure that it is clear that disinfectants are **not** used on the human body.

Get pupils thinking by asking them to make a list of any antiseptic products they can think of or perhaps list a few examples and get pupils to come up with the word antiseptic.

Activities
Get pupils to come up with the word antiseptic by asking them what they would do if they wounded/ cut their skin.

1. Wash the cut to clean it.
2. Put on some antiseptic.
3. Bandage the cut to prevent any more dirt from entering.

What does the word antiseptic mean?
Anti = against or opposite of
Septic = infected

Pupils are asked to make a list of the antiseptic products they have in their homes. It may be good to draw a pie chart or bar chart to show which is the most / least popular. This practices graphing techniques.

Get pupils to examine an antiseptic label. Get pupils to write down the main ingredients and compare different products.

Activity: To prove that some antiseptics are oxidizing agents.

Pupils are first asked what an oxidizing agent is? **An oxidizing agent is a chemical that removes 1 or more electrons from another agent. It gains electrons itself.**

Materials required:

- 0.02M potassium iodide
- Hydrogen peroxide solution (dilute - 6-10%)
- Starch indicator

Safety note:
Only use a few drops of hydrogen peroxide and potassium iodide together as this can give a very vigorous rection, which gives off heat and can be dangerous if conc. hydrogen peroxide is used. If dilute hydrogen peroxide is used this is safe for pupils to use.

Using an antiseptic, which contains hydrogen peroxide, can prove this. Potassium iodide is added to the solution. Iodide is oxidized to iodine.

	I^-	→	I_2
O.S.	-1		0

An electron has been removed by the hydrogen peroxide, which is converted to water and oxygen gas.

Add some starch to the solution of hydrogen peroxide and potassium iodide. If the iodide has been oxidized to iodine, the starch will turn the solution a dark blue. If it turns blue, it indicates that it is an oxidizing agent. This is known as the potassium iodide starch test. They will have met the use of iodine as a test for carbohydrate. Ask pupils to write down their observations.

An antiseptic like hydrogen peroxide works by oxidizing bacteria and germs and destroying the chemicals that make them up. You might want to try some other antiseptics to see how many of them are oxidizing agents.

Unit 2: Antiseptics

Lesson 2. Effects of antiseptics (Double lesson)

Duration: 70 minutes.
Topic: Antiseptics.

Aim: To examine the effect of antiseptics on microbial growth.

Objectives:
- Pupils will be able to describe how antiseptics interact with our cells when applied.
- Pupils will perform an experiment to examine the effect of antiseptics on microbial growth.
- Pupils will learn some key concepts such as: sterilization, autoclaving, aseptic techniques, and zone of inhibition.

Resources:
Student handbook. Unit 2, lesson 2.

Experiment information.

Title: The effect of disinfectants and antiseptics on microbial growth.

Resources:
- 4 disinfectants/ antiseptics
- Broth cultures of *E coli* and *Staphyloccus aureus*.
- Sterile cotton swabs (2)
- Sterile nutrient agar plates (2)
- Sterile filter paper disks (paper punch tailings will do)

Safety analysis
Individual microbes are microscopic and cannot be seen directly. They are grown as a culture on agar plates to make them visible with the naked eye.
- Wash your hands before and after this experiment with soap and water.
- No eating or drinking in the laboratory.
- Do not touch your eyes, mouth or face during the experiment.
- Use aseptic techniques to avoid contamination.
- Laboratory coat, plastic gloves and goggles must be worn throughout the experiment.
- Open petri dishes as little as possible.

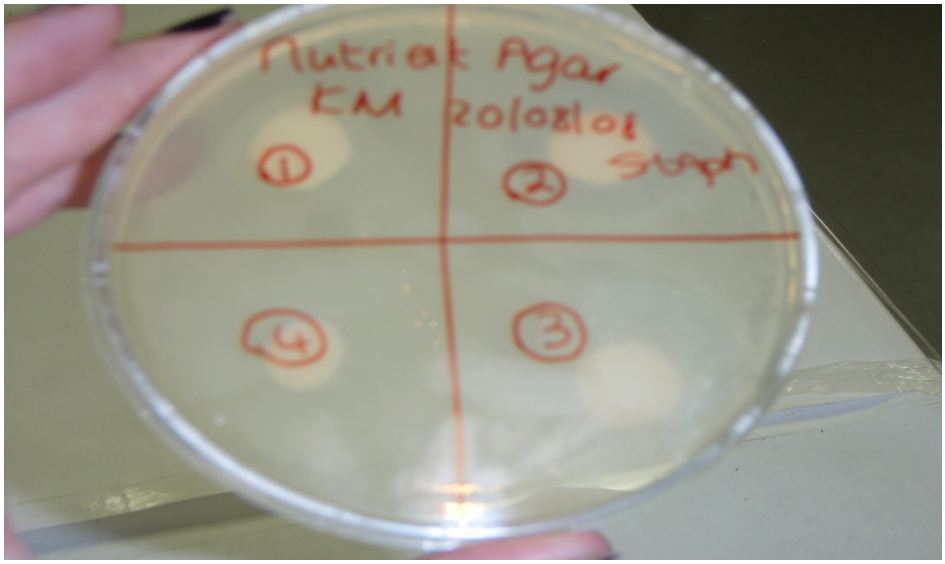
Method.

1. Using a sterile swab dipped into the broth culture of *Escherchia coli*, inoculate the surface of one nutrient agar plate heavily to obtain confluent growth after incubation.

2. Do the same with the other agar plate, using the broth culture of *Staphylococcus aureus* and a second sterile swab.
3. Label the bottom of each plate with the name of the organism.
4. Number the four antiseptic or disinfectant bottles that you will be testing 1, 2, 3, and 4.
5. On the *bottom* of the agar plates, mark four sectors using a marker pen. Label the sectors 1, 2, 3, and 4. These numbered sectors correspond to the numbers you put on the antiseptic or disinfectant containers.
6. Sterilise the tip of your forceps by passing it through the flame of your Bunsen burner two or three times.
7. Aseptically pick up a sterile filter paper disk with your sterile forceps and dip the disk into the disinfectant or antiseptic numbered 1. Ensure that the excess liquid has drained off.
8. Place the disk in the centre of Sector 1 of the *S. aureus*-inoculated plate.
9. Using the same disinfectant, place another disk in Sector 1 of the *E. coli*-inoculated plate. You are comparing the effectiveness of each disinfectant or antiseptic on both organisms.
10. Repeat steps 8 and 9, placing the other disinfectants in the other sectors.
11. Gently press the disks down with the tip of your flamed forceps to ensure contact with the nutrient agar.
12. When all four disinfectant-soaked disks have been placed in all four sectors of both plates, seal them with parafilm, invert the plates and incubate them at 37^{o}C for 48 hours.

Sample results:
Disinfectants
1 = Milton
2 = Zoflora
3 = Dettol
4 = Virkon 1%

On the *E coli* plate, Milton worked the best and Virkon was the poorest.
On the *staph* plate, Dettol worked the best and Virkon was the poorest.



Teaching tips

- ✓ **It is important to ensure that pupils understand the purpose of this experiment and can relate it to their own experiences!**
  - ✓ Explain all background information before beginning the experiment. Ensure that pupils understand the concepts of sterilization, autoclaving, aseptic techniques, and zone of inhibition.
  - ✓ It would be advantageous to have all equipment prepared for pupils to get to work. However, you may want to take time to get pupils to prepare agar plates themselves.
  - ✓ Put pupils working in teams of two to test the effectiveness of the 4 antiseptic agents.
  - ✓ Perhaps, have the agar plates incubated with *E coli* and *Staphylococcus aureus*, and just carry out a demonstration to show how it is done.
  - ✓ Show pupils how to undertake an experiment aseptically.
  - ✓ Leave pupils working in pairs for the true/ false activity and ensure that they can give an explanation for their answer.
  - ✓ For the results, ensure that pupils observe, measure, and compare the diameters of zones of inhibited growth around each disk to determine the relative effectiveness of each agent.

Background information

Bacteria: are ubiquitous, and are either beneficial or benign to human, and some are even pathogenic. Remind pupils of common food germs. If ingested, it can cause serious intestinal disorders or even death, which is the reason that they need to thoroughly clean their hands and their kitchen counters after they have handled raw, uncooked meat. Staphylococcus and streptococcus are also frequent, unwelcome guests in our homes. Remind the pupils of the importance of maintaining good aseptic techniques. Also extreme care must be taken in the laboratory to ensure that the cultures bacteria stay in the sealed petri dishes.

In our struggle to control the microbes responsible for decay and disease, humans have discovered and invented chemicals that are toxic to microorganisms. Some of these antibacterial agents simply inhibit microbial growth and activity, while others kill the microorganisms.

Antiseptics: are described as inhibitory chemicals and are bacteriostatic. They are used to cleanse skin and wounds as they stop bacterial growth without killing the underlying tissue skin that the bacteria are trying to grow.

Disinfectants: are bacteriocidal. They also kill living cells therefore should not be applied to living tissue.

Antiseptics	Disinfectants
Savlon Iodine Dettol Mouthwash TCP Antibacterial handwash Iodine	Milton Toilet duck Dettol surface spray

Assessment

Ensure that pupils thoroughly explain their results. Get pupils to explain the data in terms of effectiveness of each chemical.

Possible questions to ask.

1. Rank each agent that you tested in order from most effective to least.
2. Why wouldn't you want to treat a wound with a disinfectant, even if it showed a greater ability to kill germs?
3. Were any microorganisms growing within the zone of inhibition of any of the agents? If so, why do you think this occurred?
4. What factors, other than the inhibition of growth by the chemicals, might affect the size of the zone of inhibition? Answer: The amount of disinfectant that the filter paper absorbed. The amount of diffusion into the medium surrounding the disk.
5. From your research, propose three different ways that chemicals caused the results. Answer: By penetrating the cells, stopping the growth, killing the bacteria.

It would be best to get pupils to undertake the experiment at the beginning of the class as it takes quite a bit of time.

After the experiment, discuss mechanisms of action that antiseptics perform. Focus on one antiseptic e.g. iodine, and get pupils to decide what it is a rapid killer of:

Bactericidal	**Kill bacteria**
Fungicidal	**Kill fungus**
Virucidal	**Kill viruses**
Sporicidal	**Kill spores**

Activity- True / False!

1. **Disinfectants always remove all bacteria and fungal spores from an object.**

   False. There are variation in biocides and how they work.

2. **Antiseptic is another term for disinfectant.**

   False. Antiseptics are medicines that slow or stop growth of germs and help prevent infection on living skin, whereas disinfectants destroy microorganisms found on non-living objects.

3. **The presence of blood serum, skin tissue and other body fluids would interfere with the antimicrobial action of disinfectants.**

   True. It may affect their ability to work.

4. **Disinfectants are used as mouth / throat gargles.**
   False. They are too strong for living tissue.

5. **The zone of inhibition is the clear zone around an antimicrobial agent in which no bacteria are growing.**

   True.

6. **All disinfectants are equally effective against most microbes.**

   False. There is variation in their ability to work – depends on concentration, time etc.

7. **Cutting instruments, thermometers, and plastic materials are best sterilized by autoclaving.**
   False. Autoclaving involves very high temperatures. Plastics would melt and thermometers may shatter. In this case we would have to use chemical sterilization.

Unit 2: Antiseptics

Lesson 3. Writing a report (Single lesson)

Topic: Antiseptics.
Duration: 40 minutes.
Aim: To critically observe and understand the results of the experiment.

Objectives:

- Pupils will undertake the activity of making observations and recording their results, measuring the zone of inhibition areas, and will decide which agent was most effective and least effective.
- Pupils will individually write a concise report of their procedure, results, and conclusions.
- Pupils will undertake an activity as a means of assessment.

Resources: Student Handbook. Unit 2, lesson 3.

Tips
Get pupils to fill out the title, aim, and method prior to the class.
Pupils should observe results carefully and make critical conclusions.

Assessment

Optional activity.
Write a summary paragraph explaining:

a. What you have learned.
b. Why the knowledge is important
c. What you liked best about the experiment
d. How the activity could be improved.

Final Assessment Activity
Pupils will be given an envelope with many questions and answers to be matched. The questions and corresponding answers are on the following page. It would be best to photocopy this page, and cut out each questions and answer. Put pupils working in teams of two, and give each group an envelope with the same set of questions and answers. This activity will test that pupils understand the key concepts of the unit.

What are antiseptics?

Medicines that slow or stop the growth of germs and help prevent infections in minor cuts, scrapes, and burns.

An example of an antiseptic is

Savlon cream

An example of a disinfectant is

Toilet duck

Antibiotics

Destroy bacteria within the body.

Disinfectants

Destroy microorganisms found on non- living objects.

Bacteriocidal means

Capable of killing microbes

Bacteriostatic means

To prevent or inhibit bacterial growth

Ignaz Semmelweis

First recognized the importance of hand cleanliness

Biocides

The chemical agents found in antiseptic products

Sterilization

A physical/ chemical process that completely destroys all microbial life, including spores

E coli

Rod shaped bacteria

Staph

Spherical bacterium

Unit 3: Blocking sensations!

Unit 3: Blocking sensations!

Pupils' previous knowledge:
Although this topic in not covered on the Junior Certificate course, it is expected that pupils will be familiar with the word anaesthetic. Many pupils may have experienced an anaesthetic at the dentist and will be able to share their experiences in this class. Pupils may also be familiar with the fact that anaesthetics block pain. This knowledge will be built on in this section. (Anesthetic is the American spelling.)

Lesson 1. Types of anaesthesia (Single lesson)

Class: Transition Year.
Duration: 40 minutes.
Topic: Anaesthetics.

Aim: To introduce pupils to anaesthetics and what they are.

Objectives:

- Pupils will be able to define anaesthesia.
- Pupils will be able to state the difference between local, general, and regional anaesthetics.
- Pupils will understand how anaesthetics were used in the past and have evolved.

Resources:
Unit 3, lesson 1 (student handbook)
Ice
Cloth

Lesson one begins with many questions to help capture pupils' attention and to get them thinking.

If you were to twist your ankle and you felt pain – what action would you take?
Pupils will most likely suggest putting ice on the ankle.

What is pain?
Give pupils a chance to suggest their own definitions.
Pain: a sensory experience. An unpleasant awareness of noxious stimulus/ bodily harm / tissue damage.

If you hold some ice to your skin, what feeling would you experience after a few minutes?
Give pupils some ice wrapped in a cloth and ask them to hold it against their skin for a few minutes. What feeling does it cause? Encourage pupils to come up with the word numbness. Explain that ice only has limited uses; it is not effective enough for most pain.

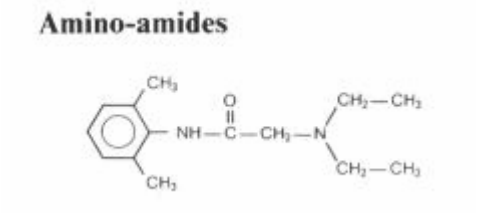
What other methods are used to achieve this feeling?
Anaesthetics or painkillers (covered in a later unit).

What do you know about anaesthetics? Have you ever had an anaesthetic?
Give pupils a chance to explore their ideas on anaesthetics and share them with the class.

Anesthesia involves the loss of sensation – particularly pain – in all or part of the body.

What does the word anaesthetic mean?
This will help pupils to understand what the word means.
An = without
Aesthetic = sensation

Structure of a local anaesthetic:



All local anaesthetics are weak bases. They contain an aromatic group, an ester or amide, and an amine group.
Note: pupils are not required to learn the structure of a local anaesthetic.

Differences between the three types of anaesthetics.
Get pupils to suggest some differences and together make a list, which they will fill into the table.

Local

- ✓ Effect on smaller or localized area of the body.
- ✓ Used for dentistry and minor surgery, ex, receiving stitches.
- ✓ Loss of pain sensation in that area.
- ✓ This type of anaesthetic usually 'wears off' in a couple of hours depending on the dose.
- ✓ Some common local anaesthetics – cocaine, procaine.
- ✓ Block conduction in the nerves.
- ✓ Types: drops, sprays, ointments, or injections.

General

- ✓ Loss of consciousness.
- ✓ Used for major surgery in hospitals.
- ✓ High doses.
- ✓ Blocks pain impulses in the nervous system reaching the brain.
- ✓ Some common general anaesthetics – nitrous oxide, isoflurane.
- ✓ Types: inhaled gases, injected into vein, or swallowed.

Regional.

- ✓ Used for operations of the lower body.
- ✓ Injected into a bundle of nerves.
- ✓ Patient will remain conscious but free from pain.
- ✓ Example: epidural may be used when giving birth. It involves receiving an injection into the lower spine area. This will remove any feeling from below the waist.
- ✓ **Web link: http://www.youtube.com/watch?v=69s7NScxd1k&feature=fvsr**

Unit 3: Blocking sensations!

Lesson 2. Blocking the pain (Double lesson)

Duration: 70 minutes.
Topic: Anaesthetics.

Aim: To explain how anaesthetics work
.
Objectives:

- Pupils will observe a typical form that one is required to fill out before receiving an anaesthetic.
- Pupils will be able to explain the process an anaesthetic takes to block pain.
- Pupils will be able to draw the structure of a nerve and list the functions of each part.

Resources:
Unit 3, lesson 2 (student handbook)
Labeled diagram of a nerve.

This lesson begins by focusing on dentistry, as it will most likely be familiar to pupils. A dentist administers an anaesthetic by injection.

Ask pupils to observe the form and questions. Pupils should not write answers to these questions.

Pupils are asked to observe a picture of a man being prepared for surgery. Compare this to how people prepare for surgery nowadays – fasting, waiting in hospital, removing jewellery, sterile conditions, receiving an anaesthetic, recovering with necessary medication.

Pupils are asked why it was necessary for people to hold down the patient, as in the picture?
Surgery was so painful in the past that patients would try to escape.

There was often a priest present when a person was having surgery- why was this necessary?
A priest was often present as few people survived surgery and they could administer the last rites.

Pupils will then examine a table which highlights the main differences between anaesthetics in the past and nowadays.

The use of anaesthetics can be linked to the *nervous system.*

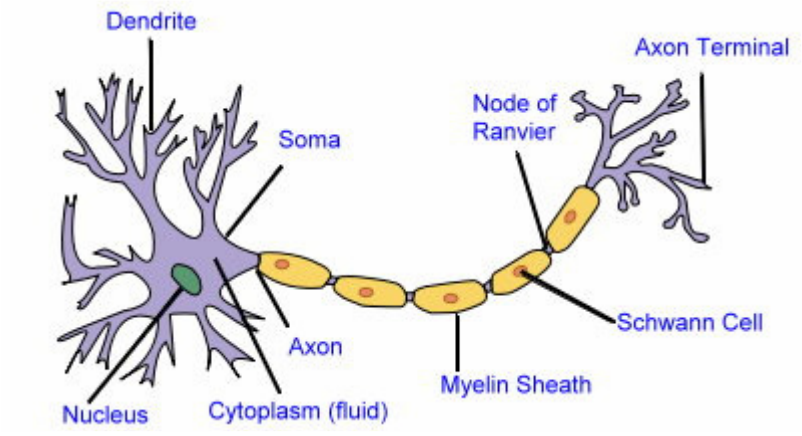
What part of our bodies would the anaesthetic have to affect to prevent us from sensing pain?
Nerves/ senses/ nervous system.

Can you recall the function of the 2 types of neurons (nerves)? Pupils will have covered this on the Junior Certificate course.
Sensory neurons: carry signals from the senses to the central nervous system (spine and brain)
Motor neurons: carry signals from the central nervous system to the muscles.

Explanation for pupils:
It is these nerves/ neurons that enable us to sense pain. When we receive a local anaesthetic, it is absorbed into the nerves. It blocks the nerves from conducting messages, thus a message cannot be passed to the central nervous system to inform the brain that there is pain occurring. The nerve will regenerate itself after a few hours depending on the dose, and it will begin conducting again. This occurs when we feel the numbness 'wearing off', and we start to feel normal sensations again.

Background for teacher:
The connective tissue that wraps each neuron is composed of myelin sheath, which itself is made up of Schwann cells. The myelin sheath is almost continuous along the axon. However, there are tiny breaks in the myelin sheath called nodes of Ranvier. These nodes are very important to speed up the conduction of an impulse.
The axon contains potassium ions and sodium ions which are present outside the membrane. The sodium ions must enter the nerve cytoplasm and the potassium ions leave. This is called depolarization. It is this process that causes an impulse to be conducted.
Anaesthetics reduce the ability of the sodium ions to enter nerve cytoplasm. Inhibiting depolarization inhibits the ability of a nerve to conduct an impulse.

Structure of a nerve.
(Pupils are required to draw a simple labeled diagram of a nerve)



Functions:

Axons: carry impulses

Myelin sheath: insulation around the axon

Schwann cells: cells that make up the myelin sheath.

Nodes of Ranvier: speed up the impulse.

Dendrites: receive impulses from other cells.

Axon terminals: release the impulse to a muscle.

Unit 3: Blocking sensations!

Lesson 3. More about the nervous system! (Single lesson)

Activity

This activity will require pupils to research more information on the nervous system and how it works. Allocate this activity to pupils before you begin the unit in order to give them time to research it appropriately.

How do you think the nervous system could be compared to a modern security system?
In groups of 2, you will design a brochure, which will advertise the nervous system as a security system. This involves you explaining the overall purpose and functions of the nervous system. You have to make it sound like a security system, which lets the body know when there is something wrong. You must use your imagination for this task! You may use drawings, magazine cuttings, computer graphics, etc in your brochure.
However your brochure must contain the following vocabulary: cell body, dendrites, neuron, axon, impulse, central nervous system, cerebellum, spinal cord, and peripheral nervous system. You may need to look up some of the functions of these parts.
Give your brochure a catchy title, and you will present this to your class.

Vocabulary to be included:

Cell body: holds all general parts of the cell.
Neuron: electrically excitable cells in the nervous system.
Central nervous system: brain and spinal cord.
Cerebellum: region of the brain that plays an important role in the integration of senses, coordination, and motor control.
Brain stem: lower part of brain, adjoining and structuring continuous with spinal cord.
Spinal cord: long thin tubular bundle of nerves, extension of the CNS, enclosed and protected by the bony column.

Unit 4: Antacids

Unit 4: Antacids

Pupils' previous knowledge.
This concept is briefly covered on the Junior Certificate course in the chapter on acids and bases. Pupils should be able to recall what an acid and base is and how to test for them. They will also have encountered the word 'antacid' and know what they are used for. Pupils will revise this material and will build on it with the use of experiments to test the efficiency of different antacids.

Lesson 1. What is indigestion? (Single lesson)

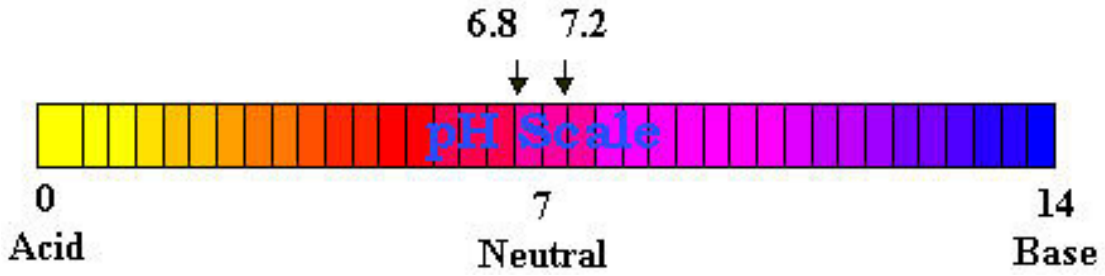
Class: Transition Year.
Duration: 40 minutes.
Topic: Antacids.

Aim: To introduce pupils to antacids and discuss what they are used for.

Objectives:
- Pupils will revise the concept of acids and bases, and will form a definition for antacids.
- Pupils will draw a labeled diagram of the pH scale.
- Pupils will undertake an activity to observe antacid labels and list their active ingredients.

Resources:
Unit 4, lesson 1 of Student Handbook.
Labels from antacid products.

Teaching tips and ideas!
- ✓ To begin the lesson pupils are asked what the symptoms of heartburn, belching and regurgitation suggest. Encourage pupils to come up with the word indigestion.
- ✓ Ask pupils what they would take to relieve these symptoms and get them to make a list of any products they can think of. Examples: Gavascon, Rennies, Maalox, Rolaids, Tums, Alka-seltzer, Pepcid.
- ✓ Ask pupils what the word antacid means.
- ✓ Ant = anti = against/ opposite of
  Acid = turns litmus from blue to red. Has a pH less than 7.
- ✓ Pupils should then make a list of acids: Lemons, Vinegar, Hydrochloric acid, Fizzy drinks, etc.
- ✓ Pupils are asked to draw a labeled diagram of the pH scale.
- ✓ They should mark on the pH of the stomach - usually between pH 1-2.



- ✓ When explaining about the history of antacids, pupils are asked where calcium carbonate can be found. Answer: limestone.
- ✓ The final activity of this lesson involves pupils observing antacid product labels. Pass labels around the class and ask them to make a list of the active ingredients. Pupils could also have been asked to bring the labels in themselves.

Typical ingredients on antacid labels include compounds containing calcium, magnesium, and aluminum.
Some examples:
Magnesium hydroxide (Milk of Magnesia)
Aluminum hydroxide and magnesium hydroxide (Maalox, Mylanta)
Calcium carbonate (Tums, Rennie, Rolaids, Quick-eze)
Sodium bicarbonate (Alka – Seltzer)

They should recognize that all these ingredients are bases and will thus neutralize acids.

Unit 4: Antacids

Lesson 2. Neutralization reactions (Double lesson)

Duration: 70 minutes.
Topic: Antacids.

Aim: To investigate the efficiency of different antacids in neutralizing acid.

Objectives:

- Pupils will understand what a neutralization reaction is and will write an equation:
  ACID + BASE = SALT + WATER.
- They are asked to re- write the equation in relation to antacids:
  ACID + ANTACID = SALT + WATER

Info!

- The acid present in our stomach is Hydrochloric Acid. The pH range of 1-2 indicates it is between 0.1 (pH 1) and 0.01 M (pH 2).
- Antacids differ in how quickly they neutralize acid and how long they provide relief. Those that contain magnesium hydroxide and sodium bicarbonate appear to give the fastest relief. Those that contain calcium carbonate or aluminum hydroxide tend to take longer to begin working. Why do you think this may be the case? Answer: they take longer to dissolve as they are less soluble.

Information on experiment

To investigate which antacid can neutralize the most stomach acid.

Safety analysis

It is essential that pupils wear safety goggles and disposable gloves when undertaking this experiment, as HCl can burn their skin on contact, depending on the concentration used.
Do not allow pupils to participate in this experiment unless they have a laboratory coat or apron.

Resources:

- 500 mL HCL (1M)
- water
- Latex gloves
- 4 different antacids
- Four 200 mL beakers
- Burette
- Hot water bath
- Mortar and pestle
- pH paper or pH meter

Method:

1. Collect four 200 mL beakers.
2. Place 50 mL of hot water in each beaker.
3. Using a bowl and pestle, crush one dosage of each antacid.
4. Put each crushed antacid into a separate beaker of water.
5. Mix the contents of each beaker until the antacids are fully dissolved.
6. Place the beakers in a hot water bath for a few minutes.
7. Test the initial pH of each beaker.
8. Fill a burette with 1M HCl.
9. Allow one drop of HCl into beaker 1 and test the pH. Continue to add drops of HCl until the pH = 7 (using pH paper or a pH meter).
10. Count the number of drops needed to bring the solution to pH 7.
11. Repeat this for each beaker.
12. Record the amount of drops used by each beaker.

Results:
Make it clear to pupils that they are to measure and record their results accurately. If there is time they should repeat the experiments to check their results.

Sample results:
Antacid 1 = Bisodol (can be bought in Tesco or any chemist)
Antacid 2 = Gavascon.

Antacid	1	2
Initial pH	8.75	8.69
Number of drops	4	6

This indicates that Gavascon was the best antacid to neutralize HCl as it used up **more** acid per dose of antacid.

Conclusion:
The pH of HCl in the stomach is between 1 and 2, depending on the type of food we eat. The antacid that needed the greatest number of drops is best. Get pupils to write a conclusion that explains which antacid appeared to neutralize the most acid and which antacid neutralised the least acid.

Activity:
Pupils are asked to make a poster, which depicts the main points of the experiment. The information must include:
Title
Materials
Procedure (very brief - use bullet points)
Safety
Results
Graph, get pupils to draw a bar graph of the results.
Conclusion

When explaining antacids further, refer to the advertisements on TV for antacids. For example in the Gavascon advertisement, the antacid is portrayed as firemen putting out a fire, as indigestion is a burning feeling felt in the chest.

Unit 4: Antacids

Lesson 3. Investigation of antacids (Single lesson)

Duration: 40 minutes
Topic: Antacids

Aim: To examine an alternative way to test the efficiency of antacids.

Objectives;

- Pupils will perform an activity to make cabbage juice indicator.
- Pupils will use the indicator to undertake an experiment to compare the efficiency of two antacids.
- Pupils will observe the colour change and make their own conclusions.

Note! This is a simple yet very enjoyable experiment for pupils to undertake.

Resources:

- Measuring cups or small beakers
- ¼ head of red cabbage for each group
- 3 test tubes for each group
- Ammonia **(2M) /** Sodium bicarbonate
- Strainer or sieve
- Saucepan or large beaker
- Knife
- Water
- 4 glasses
- Pipette
- Vinegar **(acetic acid)**
- 2 different antacid tablets for each group
- Glass bottles
- Stirrers

Safety:
Ensure that pupils wear safety goggles and disposable gloves when using ammonia and vinegar. In the case of ammonia making contact with skin rinse with plenty cold water.

Method:

To make an indicator.

1. Cut up the piece of red cabbage and place into a large beaker with approx 350 mL of water and heat to the boil and then simmer for a few minutes.
2. Pour the cabbage juice through a strainer or sieve into a pot or beaker, and then through a funnel into a bottle. Label the bottle.

Test the cabbage juice indicator.

5. Get 3 test tubes. Place ~10 mL of water and ~10 mL of indicator into each test tube.
4. Add a few drops of vinegar to the 1st test tube, ammonia or sodium bicarbonate to the 2nd test tube and water to the third (as a blank). Compare the colour in each test tube.

Observations

A: When vinegar was added. Purple to red.
B: When ammonia was added. Purple to green.
C: When water was added. It remained purple.

Next…

5. Add 50 mL of indicator to 250 mL of water in a large beaker. Add a few drops of vinegar to obtain a reddish colour.
6. Half fill each of three small (100 mL) beakers with this solution.
7. Crush 2 tablets of each antacid. Place the 1st antacid powder into glass 1 and the 2nd powder into glass 2. Do not put anything into glass 3. This is the **control.**
8. Stir each glass every 5 minutes for approximately 20 minutes, and compare the colours.

Note:

The vinegar caused the cabbage juice to turn red. When the antacid tablets dissolved, they neutralized some acid. This caused a colour change. **The solution with the greatest colour change is the stronger antacid.** Help pupils to come to a conclusion using this information.

Sample results:

Antacid 1 = Bisodol
Antacid 2 = Andrews

BEAKER 1: Bisodol. Changes to a light purple colour almost immediately. This means that it neutralized the acid (vinegar), and the solution returned to the purple colour of the indicator.

BEAKER 2: Andrews. After a few minutes, the colour changed from red to a pinkish colour. This indicated that Andrews neutralized some acid but not all.

BEAKER3: Control. The control remained a red colour. This beaker is used to compare the colour changes.

Conclusion: Bisodol is the stronger antacid as it had the greatest colour change!

Unit 5: Analgesics and Pain

Unit 5. Analgesics & Pain

Pupils' previous knowledge.
Pupils will not have encountered this topic on the Junior Certificate course. However, even though pupils may not be familiar with the word analgesic, they will be familiar with products such as Panadol, Nurofen, Lemsip etc. used as painkillers. There is also a link back to the unit on anaesthetics.

Lesson 1. What are analgesics? (Single lesson)

Class: Transition Year.
Duration: 40 minutes.
Topic: Analgesics.

Aim: To educate pupils about the use of analgesics.

Objectives:
- Pupils will be able to define analgesic.
- Pupils will compare different analgesic products and examine what they are used for.
- Pupils will undertake an activity, which will make them aware of how to use analgesics for different people and different symptoms.

Resources:
Unit 5, lesson 1. (Student handbook)
Information leaflets from different analgesic products.

This class will begin by getting pupils to think about what pain is and why it occurs.
Pain: an unpleasant awareness of bodily harm / tissue damage.
Why does it occur? Pain occurs to inform us that something is wrong in our bodies.
What can people do to relieve pain? Take medication.

Pupils are asked to list some of these products.
Panadol, Nurofen, Uniflu, aspirin, Lemsip, morphine etc.

Explain to pupils that many of these medicines are sold over the counter. That means they are safe to use and do not need a doctor's prescription.

Pupils are asked to break up the word analgesic in order to gain a better understanding of the word.
An = without
Algesia = pain

Pupils should now be able to devise a definition for an analgesic.

An analgesic is a drug used to relieve pain.

Activity 1:
Ask pupils to collect labels from painkiller products prior to this class, and pupils can then share their resources. Pupils should examine leaflets carefully to determine the differences between analgesic products, and in what cases they should be taken and the recommended dosage.

Pupils should compare original Panadol with Panadol Actifast and note the differences.

Put great emphasis on the fact that people should not take more than one product containing Paracetamol. Pupils are asked to think about why this may be dangerous.

Suggested answer: this could lead to an overdose of Paracetamol. This may / may not lead to immediate sickness but will lead to serious and irreversible liver damage, which can be fatal. This is why the number of paracetamol tablets/packet is limited.

Activity 2:
The next activity involves pupils using their knowledge obtained from examining the analgesic leaflets and applying it to make recommendations.

There may be more than one correct answer to this activity.

Pain sufferers	***Recommended drug***
A person with a simple headache	Paracetamol product
A person who suffers from arthritis	Ibuprofen product
A pregnant woman with back pain	Consult doctor
A person who is allergic to aspirin	Paracetamol product
A child of 3 years with high fever and body aches	Calpol

Unit 5. Analgesics & Pain

Lesson 2. Aspirin synthesis (Double lesson)

Duration: 70 minutes.
Topic: Analgesics.

Aim: To synthesize aspirin.

Objectives:

- Pupils will understand what an esterification reaction is and how it works.
- Pupils will perform an experiment to synthesize aspirin, and will record their results.
- Pupils will learn the chemical structure of aspirin (and paracetamol) by means of colour coding the elements and drawing a diagram or making a model.

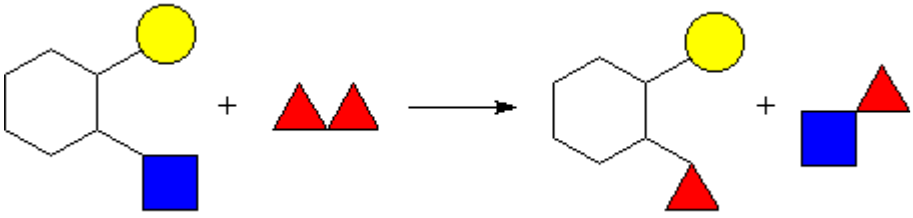
Resources:
Unit 5, lesson 2 (student handbook)
Material for experiment
Black, red, blue, and white colouring materials
Set of molecular models e.g. Molymod

This class begins with assessment on the previous class.
It was **Felix Hoffmann** who synthesized aspirin from salicylic acid. Aspirin is an ester of salicyclic acid.

Background on esterification reaction
An esterification reaction is a naturally occurring process. Living things store much of their energy as esters, also known as fats or oils. Many flavours and odours in fruits are esters.
Aspirin can be made using an esterification reaction. Esterification occurs when a carboxylic acid and an alcohol combine in a reaction to produce an ester. The carboxylic acid alcohol mixture is heated in the presence of H_2SO_4, which acts as a catalyst. During the reaction, a molecule of water splits off and the remaining carboxylic acid and alcohol fragments bond producing an ester.

Uses of esters: aspirin, anti–wormer, maxicaine (local anaesthetic), artificial flavours

Explain using the symbolic equation how an esterification reaction works.



SALICYLIC ACID + ACETIC ANHYDRIDE = ACETYLSALICYLIC ACID + ACETIC ACID

Experiment: To make aspirin.

Safety analysis:

- **Acetic anhydride:** a colourless liquid with a very strong acetic odour can cause eye, nose, and throat irritation; causes skin burns, and is flammable. Avoid inhalation and wash thoroughly if contact with skin or eyes occurs. Keep away from flames. Should be used and handled in a fume cupboard wearing gloves.
- **Conc. sulphuric acid:** colourless liquid, reacts violently with water, causes severe burns; avoid contact with eyes, skin, and clothes. Wash thoroughly if eye or skin contact occurs.
- The teacher must place the drops of both these chemicals into the test tubes to minimize pupils having contact with the chemicals. This should be done in a fume cupboard.
- Pupils should be put working in pairs. While one pupil is collecting the chemicals, the other pupils must remain with the boiling water.

Materials (per group):

- 8-10 drops of acetic anhydride
- 0.05 – 0.10g of salicylic acid
- 3-4 drops of concentrated sulphuric acid
- 1 test tube
- Stopper
- Plastic pipette
- 2 beakers (250 mL)
- Ice
- Hot plate
- Filter paper
- Watch glass

Procedure:

1. Half fill a beaker with water and heat the beaker to boiling point on a hot plate.
2. Fill the second beaker with ice and add water until the beaker is approximately 2/3 full.
3. Measure the mass of a clean, dry test tube. Record this mass.
4. Measure an amount of salicylic acid about the size of a match head into the clean dry test tube.
5. Measure and record the mass of the test tube and salicylic acid. **The mass of salicylic acid should be between 0.05 and 0.10 grams.**
6. The teacher will place 8 –10 drops of acetic anhydride and 3 –4 drops of sulphuric acid into the test tube. **As pupils should be working in pairs of two, one pupil should collect the salicylic acid and sulphuric acid, and one pupil should remain with the water bath.**
7. Heat the test tube and its contents in the hot water bath for approximately 3 minutes.
8. Remove the test tube from the hot water bath using tongs and using a plastic pipette, add 10 drops of water.
9. Stopper and shake the test tube.
10. Place the test tube in the ice bath for at least 5 minutes.

11. Observe and record your observations.
12. Use a pipette to remove any liquid from the crystals.
13. Place the crystals on a piece of filter paper and place on a watch glass overnight. **Use a vacuum pump to dry the aspirin if available.**

Results:
Ensure the pupils record the mass of:
1. The dry test tube
2. Test tube and salicylic acid
3. Dry crystals

Sample results.
Mass of test-tube = 15.51g
Mass of test-tube and salicylic acid = 15.56g
Crystals will form after the solution is cooled. This is the main ingredient in aspirin.

Allow aspirin to dry and get pupils to weight their results. Make a list of pupil's results on the board.

Identification test for aspirin

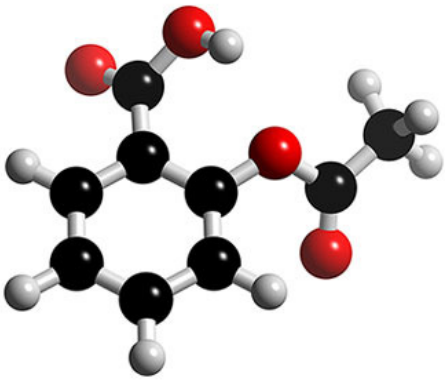
The iron(III) (ferric) chloride test!
Draw the chemical structures for both salicylic acid and aspirin on the board. Show pupils that salicylic acid has a phenolic -OH group whereas aspirin does not. A phenol is an aromatic alcohol. Therefore if salicylic acid has been changed to aspirin it should not contain a phenol group. To test for a phenol group carry out the following procedure.

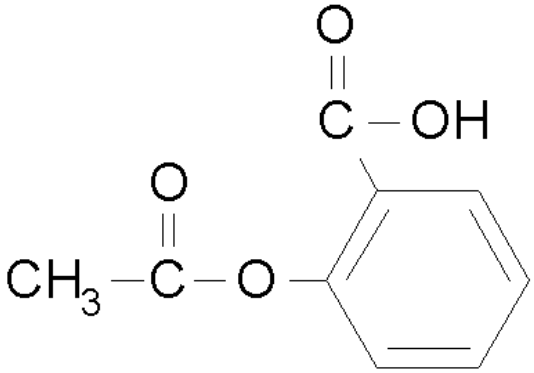
Method:
- In separate test tubes, dissolve a few crystals of salicylic acid and a few crystals of your aspirin and a sample of commercial aspirin in 1 mL of methanol.
- Add 1-2 drops of iron(III) ferric chloride solution to each test tube and shake.
- Observe the colours in each test tube.

Results:
When the iron(III) (ferric) chloride is added to the test tube containing salicylic acid, a purple complex will result; this shows the phenol group ispresent.
When iron(III) (ferric) chloride is added to the test tubes containing aspirin, no purple colour will form; showing that no phenol group present.

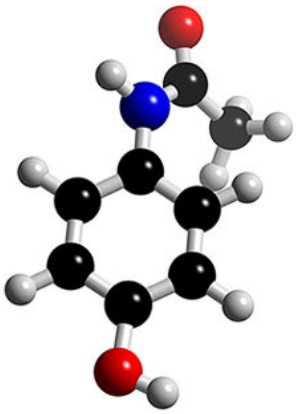
Activity:
The final activity involves pupils learning the chemical structure by drawing it in 3D with colour coding or making a molecular model. They should make the model first and then draw it to try and show its 3D shape. Molymod model sets are ideal for this.This will help pupils to imagine how the molecule is structured. They should do the same thing for paracetamol and observe the similarities and differences between the two molecules.

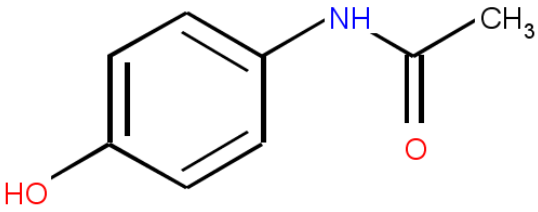
3D structure of aspirin and molecular structure:





3D structure of paracetamol and molecular structure:





Unit 5. Analgesics & Pain

Lesson 3 Finding out more about analgesics (Single lesson)

Pupils should be allocated groups previous to this class and be given a topic to research.

Tip: Pupils could be asked to produce a poster of pictures only, which they will use when presenting their topic to the class. The poster should contain no words. This will require pupils to think more about the topic rather than copying information from the Internet. This lesson will develop their research and presentation skills.

Depending on the size of the class, you may use some or all of the following topics:

1. The history of analgesics. (Extend on information already given)
2. How does aspirin work biologically to reduce the risk of heart attack.
3. Addiction to analgesics (how they affect the liver)
4. What is the 'doctrine of signatures' and what role did it play in the development of aspirin.
   Teacher information: developed during the European Renaissance, it suggested that plants shaped like certain organs could treat diseases of that organ.
5. How do analgesics (for example, Aspirin) help to reduce fevers.
   Teacher information: aspirin expands blood vessels thus increasing blood flow, which allows heat to be dissipated better.
6. What is the relationship between aspirin and cancer?
   Teacher information: there has been some evidence that women who take aspirin everyday may reduce the risk of developing breast cancer.
7. How does a migraine differ from a headache? What medicines are used to treat migraines?
   Teacher information: Headache: pain in the head located above eyes / ears/ behind the head/ back / upper neck. Migraine headache: a type of vascular headache. Caused by enlargement of blood vessels and a release of chemicals. Reoccurring and usually on one side of the head.
8. Research the company that produces Panadol. (GlaxoSmithkline)
9. What is Reye's syndrome?
   Teacher information: a potentially fatal disease that affects the organs, in particular the brain and liver. There is a strong association between aspirin consumption for viral illnesses and the development of Reye's syndrome.

Unit 6: Importance of medicines

Unit 6. Importance of medicines

Pupils' previous knowledge.
Pupils will not have covered this topic on the Junior Certificate course, and it will not be covered on the Leaving Certificate courses. This topic can be applied to pupils' everyday lives. They may have seen articles in the newspapers or coverage on the television about new and upcoming drugs. This topic will give pupils an awareness of how pharmaceutical companies work and an insight into the importance of the industry in Ireland.

Lesson 1. Upcoming new drugs (Single lesson)

Class: Transition Year.
Duration: 40 minutes.
Topic: Importance of medicine.
Aim: To make a connection between medical headlines in the media and what is happening in reality.

Objectives:
- Pupils will be aware of the cost and time involved in developing new drugs.
- Pupils will gain a full understanding about the trials that drugs must undergo before receiving a licence.
- Pupils will examine Alzheimer's disease, which is currently under research.

Resources:
Recent newspaper headlines.
Unit 6, lesson 1 (student handbook)

Tips!

- ✓ It is a good idea to link newspaper headlines that pupils may see to this topic at the beginning of the class in order to grasp pupils' attention.
- ✓ Allow pupils to discuss the headlines and share any information they may have.
- ✓ Pupils are asked to list some illnesses / diseases which have no cure. Examples: Cancer, Alzheimer's disease, Crohn's disease, Parkinson's disease, Huntington's disease.

- ✓ **Stress this fact:** it is pharmaceutical companies that make it possible for new drugs to be introduced. These are chemical companies devoted to developing new chemicals as medicines, manufacturing the chemical and then turning them into medicines for sale. Ireland is a major centre for pharmaceutical companies and they play a very important part in Ireland's exports, even through the recession.
- ✓ Pupils are asked what they think would be the most important things to consider before introducing a new drug? Pupils may share their ideas, and it would be useful to make a list of their suggestions on the board before moving onto the sequence of events.

The following is the typical sequence of events that occurs when scientists develop a new drug:

1. Will there be a large market?
2. Run many tests to find out how the drug behaves in the body; check the drug in animal studies for signs of toxicity.
3. Scientists assess how the drug is metabolized, how long it stays in the body, and where it goes.
4. **Phase I** (approx 18 months): Clinical trials. Firstly, the drug must get approval from the Medicines and Healthcare products regulatory agency (MHRA). Six healthy volunteers are then given doses of the drug much lower than have proved safe in animals; and are monitored carefully.
5. **Phase II** (approx 12 – 24 months): this stage involves a small group of patients. The drug is tested to ensure that it is safe in people with the disease, and that it does have beneficial effects.
6. **Phase III** (several years): almost 5000 patient volunteers take part in this stage. The drug is named and gets a license by MHRA. Phase III is the most expensive stage and failure can waste millions of pounds. The company must have great confidence in the drug before proceeding from phase II to phase III.

Pupils are given a chance to share their thoughts on what they know about Alzheimer's disease. They may well know someone with the disease and will relaise how important a cure would be. They will observe briefly how the brain functions, and will compare a healthy brain to one which has been affected by Alzheimer's disease. **A healthy brain weighs about 3 pounds.**

Pupils may read the article in their own time.

Unit 6. Importance of medicines

Lesson 2. Role of pharmaceutical companies (Double lesson)

Class: Transition Year.
Duration: 70 minutes.
Topic: Importance of medicine.
Aim: To examine the role of pharmaceutical companies.

Objectives:

- Pupils will perform an activity whereby they have to research, prepare, and become actively involved in a role-play.
- Pupils will gain an insight into why different committees disagree.
- Pupils will understand the pressures on pharmaceutical companies and the great importance of the industry.

Resources:
Unit 6, lesson 2 (student handbook)
Projector or PowerPoint
Flash cards.

Preparation for class:
It would save time to have pupils read the background information prior to this class. Also allocate the roles listed to pupils as you see fit. The CEO should be allocated to a strong character!

Tips!

- ✓ The role-play should be explained thoroughly to pupils. This activity needs to be planned well. **Remember, failing to plan is planning to fail!**
- ✓ Encourage pupils to speak as the character and to believe in their views. This will help them to argue their cases more strongly.
- ✓ During the role-play, ensure that all characters get the chance to speak their views. Allow characters to debate with each other.

A large pharmaceutical company is now planning their future expenditure. In the past five years, they have had three fails at phase III that has cost the company millions. The company now has to be very careful about proceeding with the next drug, as they cannot afford to have another fail. The company has three proposed drugs that have all passed phase II. A meeting will now be held with a senior committee of executives to decide which drug A, B, or C should be put forward to phase III.

Roles to play.

- **The Chief Executive Officer:** you are the boss. You would not normally attend this type of meeting, but are making an exception for this difficult decision. You will conduct the meeting. At the beginning of the meeting, welcome everyone and emphasize the importance of this decision. Call each development head in turn to present their case, and then allow your colleagues to do the questioning. Conduct a voting procedure and announce the result. At the end of the meeting thank everyone for his or her cooperation.
- **Head of Research and Development:** You agree that all 3 drugs have good potential but you need convincing that they will be good in the long term. Ask detailed questions about the long-term effects of the drugs. Argue strongly against the need for cost cutting, as you do not believe in cutting corners.
- **Chief Financial Officer:** you are concerned about income and expenditure. You want to reduce the costs of the trials by planning shorter smaller phase III trials. You also ask for clear statements of how much each one will cost - do not accept approximations.
- **Head of Commercial Operations:** You feel that the company is falling way behind its competitors. Question the development heads on estimated sales figures – how sure are they of these figures? The success of the drug will depend on the price it is sold at.
- **Development leaders:** 3 development leaders will present a case on each of the proposed drugs – A, B, and C. each case will be discussed individually.
- **All members will vote.**

Extra roles: a patient with AIDS/HIV, a representative from the Irish Heart Foundation etc.

Background information

Drug A: treatment for AIDS

40 million people in the world are affected by AIDS / HIV. There is no known cure. It is a virus, which infects and destroys white blood cells, which are required for our

immune system. Each of our cells has receptors to which the virus attaches. In this case scientists have discovered a drug, which will block any virus from attaching to the cell. Cost $500 million.
Phase I: approved.
Phase II: patients affected by HIV took the new drug A, and it proved successful, as their viral count was reduced and no toxic effects observed.
Phase III: 6000 volunteers required.
Benefits – it will sell cheaply for developing countries that may not be able to afford medication. Results appear promising.
Risks – may cause long-term liver damage. Costs will be large. Also many volunteers' from different countries must be recruited to ensure that it suits people worldwide.

Drug B: treatment for heart disease
Heart disease is the leading cause of death in the UK, England, Canada, and Wales. Heart disease is also Ireland's No 1 killer! There are many different types of heart disease, the most common when arteries become clogged with fat and cholesterol. Also about 2000 people die after suffering strokes each year. In this case, scientists developed a drug, which would increase levels of good cholesterol which in turn reduces levels of bad cholesterol. Cost $600 million.
Phase I: approved.
Phase II: Many people were already on medication for this problem so it was difficult to obtain true results of the new drug. However, all patients did have an increase in good cholesterol, but 2 patients also had an increase in blood pressure, which may only be coincidence.
Phase III:
Benefits – if this drug were to be successful, it would greatly reduce- even eliminate this deadly disease. It would be a big selling drug for the company, which would make up for the previous losses.
Risks – there is the risk that this drug may cause high blood pressure in patients, in which case millions would be lost for the company.

Drug C: Treatment for obesity
Obesity is a disease whereby excess body fat contributes to high blood pressure, high blood fat levels, high cholesterol, diabetes etc. It is the most common nutritional disorder in the world. 1 in 5 Irish adults are obese! In this case, scientists have developed a drug, which will relieve people of cravings for food. It is observed that people who smoke cannabis get cravings for food so the challenge was to do the opposite. Cost $400 million.
Phase I: approved.
Phase II: Obese volunteers, who would be susceptible to the above-mentioned symptoms, were treated with the new drug. Weight was generally lost from the abdomen.
Phase III:
Benefits – side effects minor. This could greatly help patients with a problem that will not respond to diet or exercise. There is also a huge potential market for this drug. Cost lower than other two proposed drugs.
Risks – as this was only a short-term study, there is no guarantee that this is a long-term solution for patients. It may be said that pharmaceutical companies should focus

on serious illnesses with no cures; as obesity can be helped with diet and regular exercise.

The time scale of the lesson should be accurately planned to ensure that the role-play is successful.

SUGGESTED TIMESCALE.

5 minutes	Review previous lesson, introduce a definition for a pharmaceutical company
5 minutes	Explain clearly to pupils the purpose of this activity. Ensure each pupil has been given a role and that they are clear about their character.
5 minutes	The pupil acting CEO will begin the meeting by introducing him/her self and will explain the importance of the situation.
30 minutes	Three development leaders will give their presentations on drugs A, B, and C; and time will be allocated for questions after each presentation. Allow each pupil to use PowerPoint, acetates, or flash cards for their presentation.
10 minutes	Once the presentations are completed, pupils are invited to question the committee. You may provide pupils with questions to ask if required.
10 minutes	The CEO will ask everyone to make his or her vote. If time permits, the characters may discuss their views on the outcome and what the next step should be.

Questions:

Request that each pupil make a list of questions suitable to his/her own character. Depending on the class ability, you may want to provide pupils with guidelines on questions to ask.

Suggested questions:

- Obesity is curable through a correct diet and exercise. Why would we waste millions on this drug when heart disease and AIDS are bigger issues?
- There are already drugs available for obesity; will we really make any profits if we go ahead with drug C?
- I think it is too much of a risk to go with drug B for heart disease. If it turns out it increases patient's blood pressure, we will loose out on too much.
- I am a member of the British Heart Foundation. There is no doubt that heart disease is the no 1 killer so it has to be worth pursuing. If it works this drug could save so many people!

- I think we should carry out another phase II. It may take a few years but if this fails at phase III it will cost the company too much.
- I don't think there are much profit to be made from drug A's treatment for AIDS. It will have to be sold cheaply for developing countries so what is the point when the company really needs to make money?
- I am a sufferer of AIDS. It shouldn't all be about the money. A drug like A could change our lives – surely it is worth a try.

Websites for more info!
www.bbc.co.uk/health/conditions/heart/treatment_index1.shtml
www.bbc.co.uk/science/hottopics/obesity/index.shtml
www.bbc.co.uk/relationships/sex_and_sexual_health/stis_hivaids.shetml

Unit 6. Importance of medicines

Lesson 3. Fieldtrip- industrial visit (Single lesson)

Class: Transition. Year.
Duration: 40 minutes.
Topic: Importance of Medicine.
Aim: To further pupils' knowledge on the importance of pharmaceutical companies.

If you want to understand how modern medicines are made you need to visit a company that makes pharmaceuticals in bulk and makes the finished medicines. There are many companies to choose from in Ireland. Pharmachemical Ireland has a list of companies in Ireland. Alternatively someone from a pharmaceutical company might visit your school.

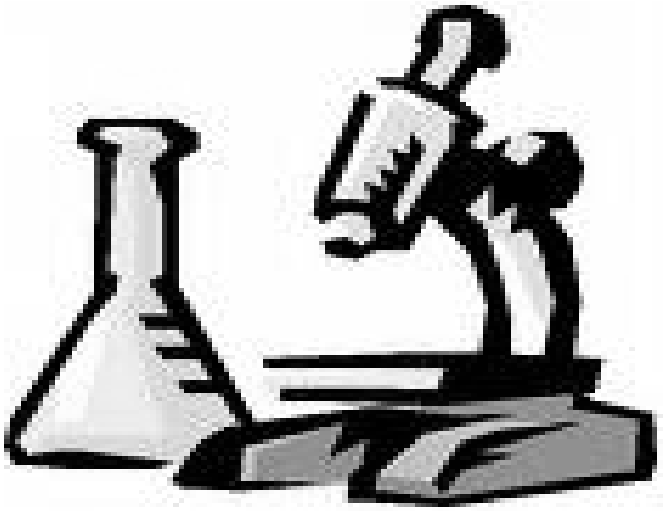
Some suggested companies to visit:
Allmarket Ltd (Co Meath)
Clonmel Healthcare (Tipperary)
Roche, Clarecastle, (Co Clare).
Pfizer, (Cork).
Rice Steele, (Dublin)

Or. . .

Working in groups select one of the Irish companies and produce an A4 poster on the company. Find out what they make, how many people they employ, what sort of jobs there are in the company. Use the information to create a large map of Ireland showing the location of the chemical companies and what they make.

Consult the website for Pharmachemical Ireland:
http://www.pharmachemicalireland.ie/Sectors/IPCMF/webipcmf.nsf/wHome?OpenForm

They sent out a booklet to schools listing companies that could be visited or contact their Education Officer: Siobhan.murphy@ibec.ie



Unit 7: Science & Technology in Medicine

Unit 7: Science and technology in medicine

NOTE! There is a powerpoint presentation to accommodate this unit. If you do not have it email peter,childs@ul.ie to get a copy.

Lesson 1. Electromagnetic waves (Single lesson)

Class: Transition Year.
Duration: 40 minutes
Topic: Medical Technology
Aim: To introduce pupils to Electromagnetic Radiation.

Objectives:

- Pupils will be able to define an energy wave, and give examples of everyday uses.
- Pupils will be able to draw the electromagnetic spectrum, and differentiate between different types of radiation.
- Pupils will be able to list some uses for X–rays.

Resources:
Unit 7, lesson 1 (student handbook)

There are many different types of waves – the waves you see at the beach, the waves the wind may create in a flag, and there are also energy waves.

What is an energy wave?
Waves transfer energy without transferring matter.

Waves can transmit electromagnetic energy, which can be used for many medical procedures.

What is electromagnetic energy?

Light, microwaves, X- rays, TV, and radio transmissions are all electromagnetic waves. When you cook food in a microwave you are using electromagnetic waves!

What is radiology?

Radiology is the use of electromagnetic energy to obtain visual images of different parts of the body.

Can you think of any examples that may use electromagnetic energy for medical purposes?

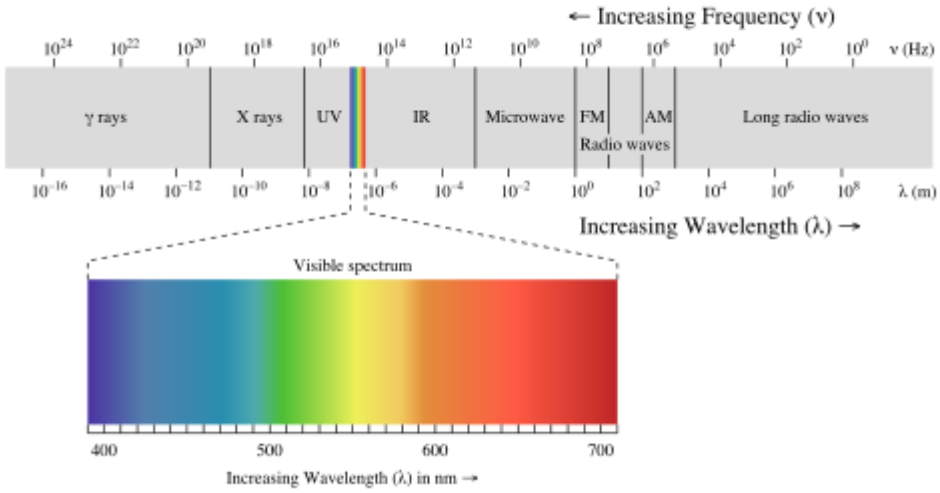
- X - rays
- CT scans

(Ultrasound does not use electromagnetic radiation.)

The electromagnetic spectrum.

Use the following box to draw the electromagnetic spectrum:

Draw the following diagram as a simpler version of the board and allow pupils to draw it into their workbooks.



The visible part of the electromagnetic spectrum consists of the colours that we see in a rainbow.

Gamma rays can only be stopped by several centimeters of lead. Lead can absorb all types of radiation, which is why this metal is used in radiography equipment.

Chemical symbol for lead = Pb

Radiography involves exposing a part of the body to a small dose of ionizing radiation (usually X-rays), to produce pictures of the inside of the body.

What is an X – ray?
A painless medical test used in radiology and dentistry. Using a beam of X-rays to take a picture inside the body.

List some uses of X – rays.

- To determine whether a bone is fractured or joint dislocated.
- Ensure that a fracture is healing properly.
- Detection of cancer.
- Location foreign objects.

Examine the images below. One hand is healthy and the other has poor circulation. Can you tell which one is which?

(a) Poor circulation

(b) Healthy hand

Can you recall the three types of blood vessels, which circulate blood in the body?

- Arteries
- Veins
- Capillaries

Unit 7: Science and technology in medicine

Lesson 2. X- rays and Ultrasound (Double lesson)

Duration: 70 minutes
Topic: Medical Technology
Aim: To describe the process of taking an X–ray.

Objectives:

- Pupils will be able to describe how to read an X-ray.
- Pupils will be able to list the benefits and disadvantages of X–rays
- Pupils will be able to describe how an X–ray machine works in 4 steps.
- Pupils will understand how a CT scan uses X-rays to give a 3D picture inside the body.

Resources:
Unit 7, lesson 2. (Student handbook)

Bone X- rays.

An X–ray machine produces a small burst of radiation that passes through the body, recording an image on photographic film. Different parts of the body absorb different amounts of radiation. Dense bone absorbs most radiation.

- Bone appears white on the X- ray.
- Soft tissue appears in shades of grey.
- Air appears black.

What about the patient?

If you have had an X–ray before, you will be familiar with this procedure.
The person receiving the X–ray must hold very still and may be asked to hold their breath for a few seconds to prevent any movement and blurring. At least two images are taken. The process of a bone X–ray usually takes 5-10 minutes.

Chest x – rays.

These X–rays make images of the heart, lungs, airway, blood vessels, and the bones of the spine and chest.
Chest X– rays are used to help diagnose patients with symptoms such as:

- Shortness of breath
- Bad / persistent cough
- Chest pain / injury
- Fever

Physicians often diagnose conditions such as

- ✓ Pneumonia
- ✓ Heart problems
- ✓ Emphysema
- ✓ Lung cancer

On a chest X – ray, the ribs and spine will absorb most radiation. Lung tissue absorbs little radiation and will appear dark.

X – rays:

Benefits	Disadvantages
Fast Easy Inexpensive Usually no side effects	All ionising radiations are harmful to the human body. This is why there must be little radiation emitted into the patients body and the procedure must be quick

What differences can you see between the two X – ray images?

#1

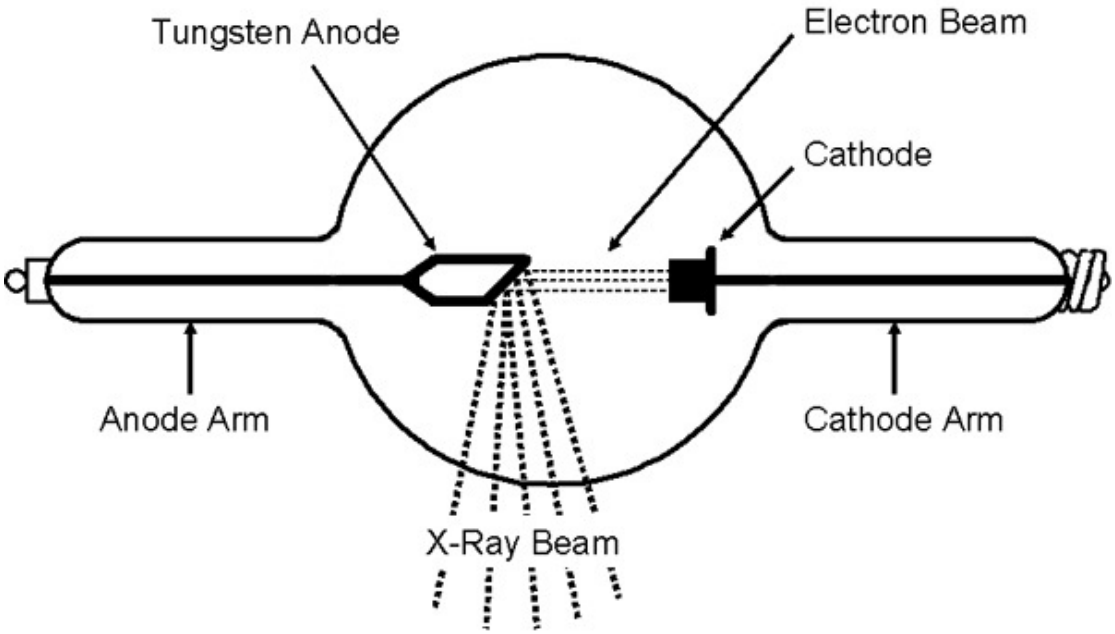
#2

X-ray #2 gives a more detailed image of the bones in the hand.

What year was the first X – ray taken?
1895. When Roentgen photographed his wife's hand.

X - ray equipment

X - rays are very high frequency electromagnetic radiation produced when high-speed electrons in a cathode ray tube strike a metal target.



What is the CATHODE and ANODE?

Cathode: positive electrode. Positively charged ions move towards the cathode.

Anode: negative electrode. Negatively charged ions move towards the anode.

How does it work?

1. A beam of electrons are produced at the cathode.
2. The electrons accelerate at very high speed towards the anode.
3. The high energy electrons strike a metal target at the anode, and they are converted into X – rays.
4. The tube is surrounded with a lead shield. X–rays cannot penetrate through lead. It only has a small window for X–rays to escape.

What is a CT scan?

This is another type of non- invasive, painless medical test, which uses X-rays. This type of scan uses special X– ray equipment to produce multiple images, and a computer to join the images in cross sectional views.

What do you think is the difference between an X-ray and a CT scan?
CT scans provide greater clarity than X- rays when required and provide a 3D not a 2D picture of the inside of the body.

During a computerized tomography (CT) scan, a thin x-ray beam rotates around an area of the body, generating a 3-D image of the internal structures

Uses

- ✓ Chest and abdomen.
- ✓ Diagnosing cancers. It allows physicians to confirm the presence of a tumour, measure its size, location, and involvement with other nearby tissue.
- ✓ Diagnosing spinal problems. Can clearly show small bones.
- ✓ Often used to plan surgery.

A CT scanner is a large machine with a tunnel in the centre. The patient lies on a table, which can slide in and out of this tunnel. The X- ray tube and electronic X – ray detectors rotate around the patient. At the same time, the examination table moves. CT scans provide very detailed images of lungs, bones, and blood vessels.

What is an ultrasound?

An ultrasound machine involves high frequency sound waves (not electromagnetic radiation) to make images of soft tissue structures in the body. Ultrasound machines do not use ionising radiation, thus it is considered safer. Ultrasound scans are often used to analyse the development of foetal anatomy and will show any abnormalities that the baby may have. An ultrasound scan is a painless test. Ultrasound travels freely through fluid and soft tissues but is reflected back when it hits a more solid surface. This is like using sonar to look at objects under the sea or in an echo sounder to determine depth.

The operator places a probe on the skin over the part of the body to be examined. Lubricating jelly is put on the skin so that the probe can make good contact with your body. Pulses of ultrasound are sent from the probe through the skin into your body. The ultrasound waves then echo back. Echoes are then detected by the probe and are displaced as a picture. The picture can show movement as well as structure. An ultrasound can take from 15 – 45 minutes.

Other uses of ultrasounds.

- Heart imaging.
- Blood flow in arteries.
- Detecting flaws in manufacturing.
- Looking at soft tissue and organs.

Unit 7: Science and technology in medicine

Lesson 3. Using technology to treat disease (Single lesson)

Duration: 40 minutes
Topic: Medical technology.
Aim: To discuss an alternative way of using electromagnetic radiation.

Objectives:
- Pupils will be able to define radiotherapy, and describe how it works.

Resources:
Unit 7, lesson 3. (Student handbook)

Radiotherapy is the use of radiation to treat cancer.

The radiotherapy is targeted at the point of your body where the cancer is found. It works by attacking cells that are dividing rapidly, such as cancer cells.
This procedure can be used:
- ✓ To destroy cancer cells
- ✓ To reduce the size of some cancers

To find the exact position of the cancer, your doctor will use X – ray scans and CT scans.

A machine is used to give a dose of energy, such as X-rays or gamma rays, to attack the cancer cells. The energy beam is directed accurately at the cancer. This is a painless procedure. However, there may be some side effects such as tiredness, scaring of the skin, hair loss etc. Cobalt-60 is often used in radiotherapy.
http://www.cancer.gov/CANCERTOPICS/FACTSHEET/THERAPY/RADIATION

PET scans

Another type of scan used in hospitals is called a PET scan. Research what this is and how it works. What is it used for in medicine? All these scanners are very expensive and are not available in every hospital.

PET stands for positron emission tomography. The patient is given a drink containing a radioactive element which makes its way to the brain. The patient is then scanned and the 3D scan shows activity going on in the brain.

A PET scan measures important body functions, such as blood flow, oxygen use, and sugar (glucose) metabolism help doctors evaluate how well organs and tissues are functioning.
http://www.radiologyinfo.org/en/info.cfm?pg=PET
http://en.wikipedia.org/wiki/Positron_emission_tomography

MRI scans using nuclear magnetic resonance imaging using powerful magnets to image what is going on inside the body.

Fill in the gaps!

X – rays and other radiation can damage the **DNA** in cells and kill them. Cells which are **dividing** rapidly are more likely to be killed, so we use x- rays to **kill** the rapidly dividing **cancerous** cells. We must make sure that **healthy** tissue is undamaged. A linear accelerator generates **x-rays.** It rotates around the body, **irradiating** the tumour from all directions. This means the **tumour** receives a higher **dose** than the healthy tissue.

Notes on presentation.

CT scan = Computed Tomography

MRI scan = Magnetic Resonance Imaging

PET scan = Positron Emission Tomography

Unit 8:

Why not take the alternative route?

Unit 8. Why not take the alternative route?

Pupils previous knowledge: Pupils will not have covered this topic in school. It is more focused as a topic of interest rather than something required for exams. Pupils will have experienced many home remedies throughout their lives and pupils get a chance to share their experiences. Pupils will know of some alternative medicines through using them or through family members. Pupils will unlikely have heard of the placebo effect.

Lesson 1. Ways to look after our health (Single lesson)

Class: Transition Year.
Duration: 40 minutes
Topic: Alternative Medicine

Aim: To differentiate between conventional medicine and CAM.

Objectives:

- Pupils will be able to define alternative medicine, complementary medicine, and a holistic approach.
- Pupils will learn some key concepts about different alternative medicines
- Pupils will understand what the placebo effect is and read about an example.

Resources:
Unit 6, student handbook.

The meaning of health… What is health, how would you define it?
Some definitions:
Being sound or whole in body, mind, and soul.
Being free from physical disease or pain

What are alternative medicines? Alternative to what?
Write alternative medicine on the board and write a list of pupils' suggestions.

Complementary and alternative medicine [known as CAM], can also be referred to as holistic.

Define the three underlined terms:
Alternative medicine: medicine which is used instead of conventional treatment.

Complementary medicine: alternative techniques used in conjunction with conventional medicine.

Holistic: an approach to healing which emphasizes the emotional, mental, spiritual, and physical elements of the patient, and thus claims to treat the whole person.

Pupils are then asked about home remedies that they may have used. Make a list of home remedies.
Some examples:

Colds	Vitamin C, chicken soup, garlic
Indigestion	Peppermint tea
Nettle sting	Dock leaf
Hiccups	Hold breath, gargle with water
Sunburn	Aloe Vera
Sty	Used teabag

Add to this list.

Can you think of any **examples** of alternative methods used instead of conventional medicine?
The following is a list of alternative therapies:

- Folk medicine
- Herbal medicine
- Dietary supplements
- Homeopathy
- Faith healing
- Chiropractic
- Acupuncture
- Naturopathy
- Massage
- Music therapy
- Meditation
- Yoga
- Reflexology
- Aromatherapy
- Osteopathy
- Traditional Chinese medicine
- Hypnosis

Allow pupils to share information about any alternative methods they may be familiar with.

Activity:
CAM shopping!
Each pupil/ group will be allocated a particular alternative therapy. For the next class, your job is to research the therapy and design an eye-catching poster which makes the therapy attractive. Hint! Use pictures and you may include the following:

Who invented the therapy?
Where it originates?

Key principles, how does it work?
What conditions does it treat [perhaps include a diagram of the human body to highlight where it is effective]
Any scientific evidence?
Any other interesting facts.

Inform pupils that they will have to present their poster in the next class.

The placebo effect.
After reading about an example pupils are asked to try and define the word placebo.

Placebo: a 'non – treatment' but the person taking this is unaware of this and believe that they are taking real treatment.

Unit 8. Why not take the alternative route?

Lesson 2. Alternative therapies (Double lesson)

Class: Transition Year.
Duration: 70 minutes.
Topic: Alternative Medicine

Aim: To introduce pupils to different alternative therapies.

Objectives:

- Pupils will learn about many different alternative therapies, and will perform an activity, which requires application of their knowledge.
- Pupils will discuss 5 specific alternative medical treatments

Resources:
Unit 8, student handbook – lesson 2.
Alternative medicine products
Leaflets from an alternative medicine shop

Pupils will already have their posters prepared and researched for this class. Posters should be placed around the classroom for everyone to see. Pupils should act as if they are trying to advertise and sell their therapy.

Activity:
Pupils will undertake an activity, which requires them to use the information on each alternative therapy. You should photocopy the following sheet and cut the boxes. Place each one into an envelope and hand an envelop to each group. Each group has to try and match the alternative therapy with its description.

Folk medicine	Herbal medicine, acupuncture etc
Herbal medicine	Use of plants and plant extracts. Sometimes use fungi and bee products
Dietary supplements	Believed to improve health by diets and eating patterns
Homeopathy	An ill person can be treated using a substance that can produce, in a healthy person, symptoms similar to the illness
Faith healing	An attempt to use religious or spiritual means such as prayer to prevent illness, cure disease or improve health
Chiropractic	Focuses on diagnosis, treatment, and prevention of mechanical disorders of the muscoskeletal system and nervous system with special emphasis on the spine
Acupuncture	Inserting thin needles into specific body points to improve health and well being. Also known to relieve pain.
Naturopathy	Using herbs and food to help the bodys innate ability to heal and maintain itself.
Massage	The treatment and practice of manipulation of the soft body tissues with physical, functional, and sometimes psychological purposes
Music therapy	The use of music to achieve therapeutic goals. Used for pain relief, anxiety and stress reduction.
Meditation	A mental discipline where one tries to get into a deep state of relaxation or awareness
Yoga	The practice of physical postures or poses in an attempt to unite mind, body, and spirit.
Reflexology	Massaging, squeezing, or pushing on parts of the feet, with a goal of improving general health
Aromatherapy	Uses volatile liquid plant materials, known as essential oils for the purpose of affecting a persons mood or health
Osteopathy	Emphasizes the role of the muscoskeletal system in health and disease
Traditional Chinese medicine	Includes herbal medicine, acupuncture, and massage, also qigong
Hypnosis	A trance like state that resembles sleep

Take a look further!

Hypnosis.
This is a trance like state of mind. It can help to manage pain to kicking bad habits like smoking. It is not clear how hypnosis works. While hypnotised you are deeply relaxed, can concentrate on something specific, and become more open to suggestions.

Dietary supplements.
An example would be the dandelion, a perennial herb. It was commonly used in Native American medicine. They prepared the root and herb to treat kidney disease, upset stomach, and heartburn. Dandelion root and leaf are widely used in Europe for gastrointestinal ailments.

Eucalyptus oil.
Commonly used as a decongestant for upper respiratory tract infections / inflammations. It is also often used in mouthwashes.

Echinacea.
Commonly called purple coneflower. Some of these plants are used in herbal medicines. Studies undertaken showed that when taken at first signs of a cold, it reduces cold symptoms. People take Echinacea to help the immune system and fight infections.

St Johns Wort. (Hypericum)
This is a yellow flowering perennial herb. Most popular use in herbal medicine for the treatment of major depression. However, a prescription is required for its use.

Rescue remedy.
Known for its calming effect. This alternative medicine contains 4 flower essentials:
Rock rose- for terror and panic
Impatiens – for irritation and impatience
Clematis – for inattentiveness

Star of Bethlehem – for shock
It is mostly used in emergency situations to help people cope with stressful situations. It is also good for relaxing students for exams!

What's the evidence?

Modern medicine is evidence-based. What do you think this means?
This means that it is based on scientific investigation, clinical trials, toxicity testing etc. to provide a basis of evidence for using the remedy or procedure.

A remedy like aspirin is used to relieve pain or reduce fever because many clinical trials have shown it to be effective. We also now know how it works in the body, because scientists have investigated its effects on the body. As we saw earlier a new drug is not allowed on the market until it has passed a series of trials and has been shown to have no serious side-effects and has significant benefits over a placebo.

Would you recommend a drug that had no better effect or even a worse effect than a placebo? Why?
If a drug was the same as or worse than a placebo then there is no point taking it as it has no effect.

Many alternative medicines are not evidence-based - they are based on anecdotal evidence ("My Gran swears by it", "Since I started taking it, I've never felt better!").

Discuss in your group the difference between scientific evidence and anecdotal evidence and summarize your discussion in a table.

Scientific evidence	Anecdotal evidence
Based on scientific investigation by many people	Based on a few people's personal experience
Should be reproducible in order to be acceptable	Personal experience often accepted as true
Has to demonstrate effectiveness in carefully designed double-blind clinical trials	No need to test effectiveness in this way
Test for toxicity needed before a medicine can be introduced	Many alternative remedies have not been tested for toxicity

Taking cod liver oil is supposed to increase your IQ and make you more intelligent. Discuss how you would design a trial in your school to test whether this claim was true or not. Try to identify the main things you would have to do to provide scientific

evidence for or against this claim. Summarise the main points of your discussion below.

Points to include:
A large sample to give statistical reliability
A control group and an experimental group
Two groups need to be matched to be similar in age, health etc.
Double-blind trial using the cod liver oil and a placebo which looks and tastes similar - patients and those giving the test do not know who has the cod liver oil
Suitable tests of intelligence given before and after the course of treatment

It is important to bring out the importance of evidence is deciding whether a medicine works or is safe to use. Many alternative remedies and herbal medicines have not been properly tested and people have died as result. If products are in the marketplace they should be subjected to the same tests as scientific medicines in order to protect the public.

Donal O'Mathuna has an interesting series of articles in the Tuesday Health Supplement in the *Irish Times*, where he looks at the evidence for the effectiveness of alternative medicines, herbal remedies and vitamins. You could collect some of these and use them in this unit.

Unit 8. Why not take the alternative route?

Lesson 3. Agree or disagree??? (Single lesson)

This lesson is devised to allow pupils to debate alternative versus conventional medicine, based on ideas in the previous lessons.
Pupils are asked to express their feelings on the placebo effect, whether they think public money should be used to fund alternative medicine, and whether they would consider using alternative medicine.
A good idea to get pupils to express their opinions is to use the agree/ disagree game.

Method.

Make space in the classroom for pupils to stand.

The class will stand in the middle of the space.

Pick one side of the room for disagree, and the opposite side of the room for agree.

Pupils who are not sure should remain in the middle.

People from the agree / disagree sides have to try and convince the unsure party to join their side.

Ask pupils why they

- Agree?
- Disagree?
- Are not sure?

The three main questions to focus on are

1. Do you agree / disagree with the placebo effect?
2. Do you think public money should be used to fund CAM therapies?
3. Would you ever use these methods?

Ask them to answer the questions in their handout after this discussion, to summarise their own views on the topic.

PATIENT INFORMATION LEAFLET

ON

KLACID LA tablets

(Clarithromycin)

100-335-201

Please read this leaflet carefully before you take these tablets. It gives a summary of the information available on your medicine. If you have any questions or are not sure about anything, ask your doctor or pharmacist.

What's in Klacid LA tablets?

Klacid LA tablets are modified release tablets which means that the active ingredient is released slowly from the tablet so that you only have to take them once a day. Each Klacid LA tablet contains 500 mg of clarithromycin as the active ingredient. Other ingredients include: citric acid, sodium alginate, sodium calcium alginate, povidone, talc, stearic acid, magnesium stearate, methyl hydroxypropyl cellulose, polyethylene glycol, titanium dioxide (E171), sorbic acid, quinoline yellow dye (E104) and lactose.

Klacid LA tablets are available in blister packs or bottles containing 1, 2, 7 or 14 tablets. The 2 and 14 tablet pack sizes are presented in a double (2) tablet blister pocket presentation for use where 2 tablets are to be taken as a single dose. Your doctor will advise you if this applies to you.

Klacid LA is an antibiotic belonging to a group called the macrolides. Antibiotics stop the growth of bacteria (bugs) which cause infections. Its use is described below.

Marketing Authorisation Holder and Manufacturer's Name and Address

Irish Product Authorisation Holder:
Abbott Laboratories (Ireland) Ltd., 1 Broomhill Business Park, Broomhill Road, Tallaght, Dublin 24, Ireland.

Manufacturer:
Abbott Laboratories Ltd., Queenborough, Kent, UK, ME11 5EL.

What are Klacid LA tablets used for?

They are used to treat infections such as:

1. Chest infections such as bronchitis and pneumonia
2. Throat and sinus infections
3. Skin and tissue infections such as cellulitis, folliculitis or erysipelas.

Before taking Klacid LA tablets

Do not take Klacid LA tablets if you know that you are allergic to clarithromycin or other macrolide antibiotics such as erythromycin or azithromycin.

Do not take ergotamine or dihydroergotamine tablets or use ergotamine inhalers for migraine while taking Klacid LA tablets.

Do not take terfenadine or astemizole (widely taken for hay fever or allergies) or cisapride or pimozide tablets while taking Klacid LA as combining these drugs can sometimes cause serious disturbances in heart rhythm. Consult your doctor for advice on alternative medicines.

If you have any liver or kidney problems consult your doctor before taking these tablets.

If you develop severe or prolonged diarrhoea during or after taking Klacid LA tablets, consult your doctor immediately.

If you are pregnant or breast feeding do not take Klacid LA tablets without consulting your doctor first, as the safety of Klacid LA tablets in pregnancy and breast feeding is not known.

Consult your doctor if you are taking any of the following drugs: digoxin (heart drug), warfarin (blood thinner), ergotamine or dihydroergotamine (for migraine), carbamazepine or phenytoin (drugs for epilepsy), theophylline (helps breathing), terfenadine or astemizole (for hay fever or allergy), triazolam or midazolam (sedatives), disopyramide (heart drug), drugs for high cholestrol (such as lovastatin or simvastatin), cisapride (for stomach disorders), cyclosporin, hexobarbital, alfentanil, pimozide, zidovudine, ritonavir (an anti-viral [anti-HIV] drug), rifabutin (an antibiotic effective against some infections) any ß-lactam antibiotics and tacrolimus (for organ transplants).

Klacid may sometimes cause dizziness in some people. If this happens to you, it may affect your ability to drive or use machinery.

These tablets contain lactose but at a level which should not produce symptoms of intolerance.

Taking Klacid LA tablets

You may be given a pack containing a single dose of Klacid LA so that you can start your treatment straight away. **This one dose is not a full course of treatment.** You should also receive a prescription for the rest of the tablets that you need.

Klacid LA should be taken with food and must be swallowed whole and not chewed. You should take each dose at the same time each day throughout your course of treatment.

The usual dose of Klacid LA for adults and children over 12 years is 500 mg once daily for 6 to 14 days. Your doctor may increase the dose to two 500 mg tablets in severe infections. You should take both of these tablets at the same time. You may receive a pack with 2 tablets in each blister pocket to make it easier for you to do this.

These tablets are not suitable for children under 12 years as liquid medicines are generally preferable. Your doctor will prescribe another suitable medicine for your child.

Do not stop taking Klacid LA tablets because you feel better. It is important to take the tablets for as long as the doctor has told you to, otherwise the problem might come back.

If you forget to take a Klacid LA tablet, take one as soon as you remember. Do not take more tablets in one day than your doctor has told you to.

If you accidentally take more than two Klacid LA tablets in one day or if a child accidentally swallows some tablets, seek medical advice urgently. An overdose of Klacid LA tablets is likely to cause vomiting and stomach pains and there is a possibility of allergic reactions.

What problems can Klacid LA cause?

Klacid LA tablets can sometimes cause stomach problems such as feeling sick, vomiting, stomach pain or diarrhoea. Headache has also been reported. If you develop severe or prolonged diarrhoea during or after taking Klacid LA tablets, consult your doctor immediately.

If you have a blood test while taking Klacid LA it may show raised liver enzymes. These levels usually return to normal and it is unlikely that you will show any symptoms. However, Klacid LA can rarely cause jaundice and other liver disorders which can be severe or even fatal in extremely rare circumstances. If you feel generally unwell or develop yellow skin and/or eyes, consult your doctor immediately. There have been reports of a rise in the levels of protein normally excreted by the kidneys. Occasionally, a blood test may show low levels of white blood cells.

Allergic reactions including rashes have been reported with Klacid LA. In very rare cases, difficulty in breathing, fainting and swelling of the face and throat can occur which may need emergency treatment. Allergic rashes may range in severity from mild itchy skin eruptions to a rarer, more serious condition called Stevens-Johnson syndrome (which may cause ulceration of the mouth, lips and skin) or toxic epidermal necrolysis (which causes severe illness and sloughing of the skin).

Some people taking Klacid LA notice a funny taste in their mouth or a change in their sense of taste and smell. However these are only temporary effects and you should not stop taking the tablets because of them. Very rarely the teeth become discoloured, but in most cases this can be removed by professional dental cleaning. There have also been reports of Klacid LA causing the tongue to swell or darken, sore mouth and 'thrush' in the mouth.

There have also been some reports of dizziness, ringing in the ears (tinnitis), difficulty sleeping, hallucinations (seeing things), bad dreams, confusion, aggressive and unstable behaviour, feelings of unreality, loss of bearings (disorientation) and panicking. These effects are usually short-lived and soon disappear. Very rarely, fainting due to low blood sugar, and mood and behavioural disorders have been reported, which in severe cases have required hospitalisation. Very rarely some patients may experience unexpected bruising and their blood may take longer to clot after a cut to the skin. Consult your doctor immediately if you develop any of these problems or have any other unexpected or unusual symptoms. Changes in heart rhythm have also been reported rarely.

There have been reports of hearing loss with clarithromycin which is a temporary effect and is usually reversible on stopping treatment.

In the unlikely event that your infection has been caused by a bug which Klacid cannot treat, your symptoms may get worse. If this happens, you should consult your doctor.

How should Klacid LA tablets be stored?

Do not use these tablets after their use-by (exp) date which is imprinted on the blister pack. If the tablets are out of date, return them to your pharmacist and, if necessary, get a new prescription from your doctor.

Keep these tablets protected from light at a temperature between 15°C and 30°C, in a safe place where children cannot reach them. If your doctor decides to stop your treatment with Klacid LA tablets return any remaining tablets to a pharmacist.

REMEMBER these tablets are for **you**. **NEVER** give them to someone else. The tablets may harm them, even if their symptoms are the same as yours.

If you have any questions about your treatment which are not answered by this leaflet, ask your doctor or pharmacist.

This leaflet applies only to Klacid LA tablets and was prepared in April 2001.

100-335-201