Food Science

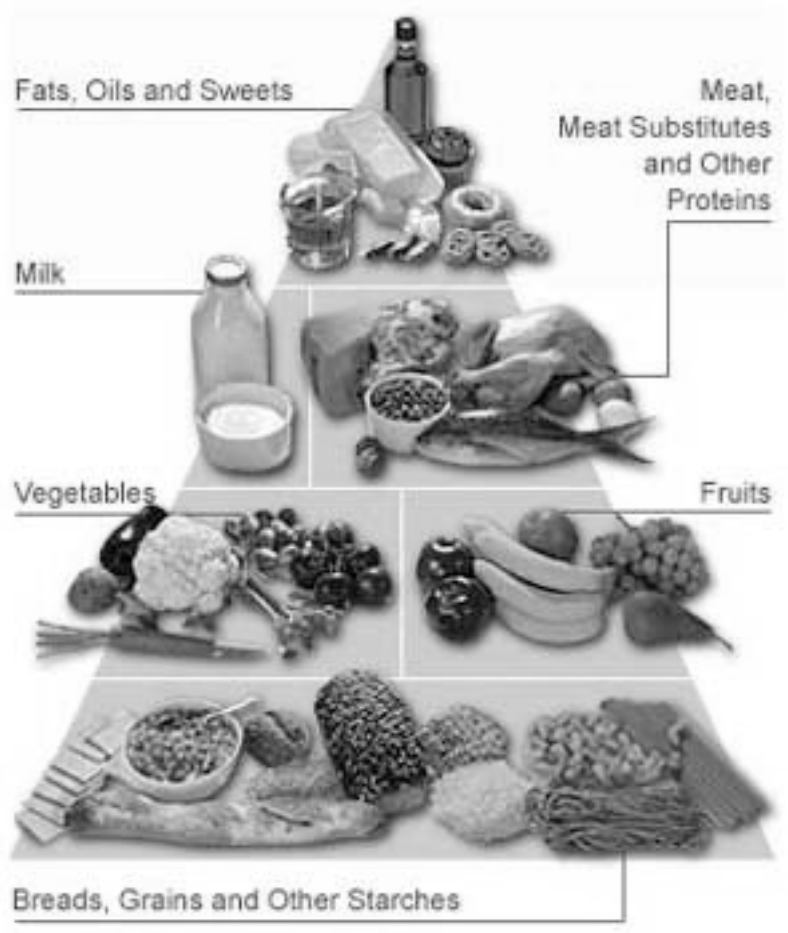

Image Sourced: http://www.diabetes.org/ueimages/Food-Pyramid.jpg

Transition Year Science Module

Teacher Handbook

Written By: Anne O' Dwyer

Version 2.1

Table of Contents

Introduction

This Food Science Module is made up of eight seperate Units. However, these units are presented in order that one leads into and provides the background knowledge for the following.
Each unit provides as opportunity for pupils to be able to use the skills and knowledge that they have learned at Junior Certificate Science level. Pupils will also be able to adapt knowledge and skills learned in the early units of the module to solv investigations and problems in the final units.

Each unit is composed of an introductory single lesson, a main double lesson and a final (optional) single lesson.
The concluding single lesson in each unit challenges different aspects of the pupils' capabilities. These activities will help the pupils to recognise the importance of Science in many aspects of the everyday world.

The activities in these lessons include:

- Planning a Diet for an athlete and an elderly person
- Researching articles about Dietary Supplements
- Investigating special Dietary requirements
- Debating topical food issues e.g. G.M. Foods
- Reading and comprehension of Scientific articles and graphs
- Organising a class visit to a local Factory

Safety in the Laboratory!

Image sourced: http://nobel.scas.bcit.ca/debeck_pt/science/images/labsafety.jpg

Please note the following:

- Personal Protection must be worn at all times during experimentation i.e. white laboratory coat, laboratory goggles, gloves etc.
- All long hair must be ties back away from the face and the working area.
- No eating or drinking is allowed in the laboratory. All food tastings must take place outside of the lab e.g. Home Economics Kitchen.
- Any food prepared or used in an experiment in the laboratory should not be consumed afterwards.
- All accidents (no matter how small) and breakages should be reported to the teacher immediately.
- Clean up spills immediately and in the appropriate and safe manner.
- Wash hands before leaving the laboratory
- Follow all safety instructions carefully for each individual experiment!

Unit 1- A taste for more…

This is the first of eight units through which the science of food, its' uses, its' properties, its' dangers etc. will all be explored. In this first unit, we look at our own diets, the types of food we eat and the nutritional value we are gaining from these foods.
We will investigate the different nutrients as well as the functions and importance of each.
The final lessonin this unit will explore the different dietary requirements of different people and why these dietary requirements change.

Lesson 1

Looking into food

Single Lesson

Introduction:
This is the first lesson of the first unit, so the aim is to make pupils more aware of what they eat, their own eating habits and that there are many different ingredients in the food we eat. The reference to the Food Pyrmamid makes pupils aware of eating guidelines and what quantities of each food should be consumed.

Link to Syllabus:
This lesson links to Junior Certificate Home Economics as it outlines "factors affecting eating habits, awareness of current dietary advice and issues" (Department of Education, 2001) This lesson also revises density as covered in the Junior Certificate Science; Section 3A1, "measurement in science" as well as the Law of the Lever "force and movements" Section 3A3 (Department of Education, 2003). The introduction of Boyle's Law is part of Section 3.2 "Gas Laws" of the Leaving Certificate Chemistry syllabus (Department of Education, 1999)

Background Information:
Food Pyramid

The pyramid shape explains the different proportions of foods to one another, i.e. foods, which make up the base should provide the largest part of the diet (the bulky foods). The quantities of requirements become smaller as the pyramid becomes thinner. The number of servings is also provided, but their size depends on the following factors; age, gender, health, lifestyle / occupation and pregnancy.

Bread, Grain, Cereal and Pasta Form the Base: These foods provide complex carbohydrates, which are an important source of energy, especially for a low-fat meal plan. You can make many low-fat choices from foods in this group. You'll need 6 to 11 servings of these foods in a day. Try to eat whole-grain breads, cereal and pasta for most of your servings from this group. Whole-grain foods (which are made with whole wheat flour) are less processed and retain more valuable vitamins, minerals and fiber than foods made with white flour. When you purchase whole-grain foods, look for breads and pastas with "stone-ground whole wheat flour" as the first ingredient, because some "wheat" breads may be white breads with only caramel coloring added.
Fruits and Vegetables: Fruits and vegetables are rich in nutrients. Many are excellent sources of vitamin A, vitamin C, folate or potassium. They are low in fat and sodium and high in fiber. The Food Pyramid suggests 3 to 5 servings of vegetables each day.
The Food Pyramid suggests 2 to 4 servings of fruit each day.
Count only 100% fruit juice as a fruit, and limit juice consumption. Many commercial bottled juices come in containers that hold more than 2 servings, which can add lots of sugar and calories to your daily diet.
Beans, Eggs, Lean Meat and Fish: Meat, poultry and fish supply protein, iron and zinc. Non-meat foods such as dried peas and beans also provide many of these nutrients. The Food Pyramid suggests 2 to 3 servings of cooked meat, fish or poultry. Each serving should be between 2 and 3 ounces.

Choose lean meat, fish and dry beans and peas often because these are the lowest in fat. Remove skin from poultry and trim away visible fat on meat. Avoid frying these foods. Moderation is the watchword when it comes to nuts because they are high in fat.
Dairy Products: Products made with milk provide protein and vitamins and minerals, especially calcium. The Food Pyramid suggests 2 to 3 servings each day. If you are breastfeeding, pregnant, a teenager or a young adult age 24 or under, try to have 3 servings. Most other people should have 2 servings daily. Interestingly, cottage cheese is lower in calcium that most other cheeses - one cup counts as only 1/2 serving of milk. Go easy on high-fat cheese and ice cream. Choose non-fat milk and yogurt and cheeses made from skim milk because they are lowest in fat.
Fats and Sweets: A food pyramid's tip is the smallest part, so the fats and sweets in the top of the Food Pyramid should comprise the smallest percentage of your daily diet. The foods at the top of the food pyramid should be eaten sparingly because they provide calories but not much in the way of nutrition. These foods include salad dressings, oils, cream, butter, margarine, sugars, soft drinks, candies and sweet desserts.
These guidelines were adapted from:
Life Clinic, Health Management Systems. More information can be accessed at:
http://www.lifeclinic.com/focus/nutrition/food-pyramid.asp#Top

Investigation of what makes Fizzy Drinks different:
This experiment was adapted from Sanger, M.J., "Whatever floats or sinks your can" Journal of Chemical Education, 83(11) , November, 2006.

Safety Issues and Considerations:
All laboratory safety guidelines should be adhered to throughout the class. It is important to remember that the fizzy drinks cannot be consumed in the Science Lab.

This investigation lends itself well to class cooperation. The practice of recording results in a table and sharing these with the class will be useful for later experiments in the module.

Each group tests the buoyancy of one or two cans and shares the results. Each can should be tested by more than one group and any contradictory results addressed. If students use a container where the water level is not much taller than the cans, they may have difficulty distinguishing between floating and sinking cans. While most of the carbonated diet soda cans float very well, some of the sweetened carbonated soda cans have densities rather close to the density of water. This means they may sink very slowly, or appear to float. To be sure that students see that the sweetened soda cans sink, they are told to quickly push downward on any floating cans. Diet soda cans should quickly rebound and remain floating; any "floating" sweetened soda cans should remain submerged.

The sugar content is responsible for whether a can sinks or floats in water. Direct comparisons between cans can be used to identify the relevant factor. For example, since Pepsi and Caffeine-Free Pepsi sink, you can rule out the effect of caffeine; and since Diet Pepsi and Diet 7-Up float, you can rule out the effect of color. The effect of sugar can be seen since Pepsi sinks but Diet Pepsi floats.
It important that all cans used are of the same volume to ensure the results are

reliable.

Possible variations
You could open the cans and test the liquids themselves. If a few drops of a sweetened fizzy drink (like Coke of Orange) were added to water, the fizzy drink would sink as it mixes with the water. When a few drops of a diet fizzy drink are added to water, it floats on top as it mixes with the water. Dark fizzy drinks work best for these tests as the observations are more easily seen (e.g. coke)

This investigation could also be set up to illustrate the Law of the Lever. A cup of a Diet drink and a regular drink could be balanced on a meter stick. This exercise would help pupils to recognise the difference in the densities of the drinks as well as the Law of the lever to help the system to balance. The diet drink would have to be topped up with spoons of sugar until it is balanced. This would help the pupils to understand the quantity of sugar in the drinks.

Why does a shaken fizzy drink over-spill when opened? – Boyle's Law

For best results and to facilitate the observation of the bubbles, a bottle should be used instead of a can, and a clear drink e.g. Sprite or 7-Up make the bubbles easier to be seen than in Orange or Coke.
Flicking the side of the can / bottle in this experiment dislodges the bubbles attached to the side of the can and they float to the top. When the can is opened, the gas simply escapes. As you will soon discover, tapping the top of the can does nothing. Shaking the unopened can/ bottle of fizzy drink causes bubbles of carbon dioxide to line the inside walls of the can. When you open the can/bottle, the pressure in the can goes down and the volume of each bubble goes up (Boyle's Law). The quickly expanding bubbles force the liquid that rests above it out of the can.
Many pupils may have learned to tap the top of the can before opening it. This does nothing. However, tapping the side of the can knocks bubbles off the bottom and sides of the can, at which point they rise to the top. The trick is to dislodge the bubbles from the sidewalls and bottom of the can so they can float to the top of the can (because gas is lighter than liquid) and there is only a small amount of liquid blocking their escape when you open the can. Remember, SNAP the SIDE instead of tapping the top.

Suggested Activities:
Another activity for the pupils to introduce them to this food module could be to examine the information (nutritional information and ingredient listings) on different types of foods. This will help the pupils to become more aware of what is in food, and how the ingredients and nutritional value of different types of food vary.

Helpful Sources of Information:
Bord Bia:
http://www.bordbia.ie/Consumers/About_Food/Nutrition/Healthy-Eating/
VHI Health:
http://www2.vhihealthe.com/topic/eatingtips
Food Guide Pyramid:
http://www.lifeclinic.com/focus/nutrition/food-pyramid.asp#To
Making Science Fun:
http://www.stevespanglerscience.com/experiment/00000024

Lesson 2

Our source of Energy

Double Lesson

Introduction

The main focus of this lesson is to aid the pupils' understanding of food as a source of energy, and to understand that different foods contain different nutrients and therefor provide us with different amounts of energy.

Links with Syllabus

The investigation in this lesson to show that food provides us with energy facilitates a more mature understanding of "the conversion of chemical energy in food to heat energy" (Depatment of Education,2003) as outlined in Section 1A of the Junior Certificate Science Syllabus.

This lesson also has a cross-curricular link to Section 1.1.2 of the Leaving Certificate Home Economincs Scientific and Social Syllabus; "energy values " and "energy requirements" (Department of Education, 2001).

The creation of the lemon-powered cell revises the Junior Certificate Science, Section 3C4 'Electic Circuits' (Department of Education, 2003) and also introduces elements of Leaving Certificate Physics.

Background

Making a single cell Battery using fruit:

When you put the two different metals in the fruit a chemical reaction will try to take place. If Zinc metal can dissolve to from Zinc Ions it will release energy, but it also has to loose electrons. If the zinc is connected to the copper by an electric circuit these electrons can flow around the circuit and neutralise copper ions in the lemon. This process releases energy, which you can use to charge an I-pod. (Up to 12 lemons may be needed to charge an I-pod)

Why are there copper ions in the lemon?

There will be a few there naturally, but most of them will be created by the tarnish on the copper dissolving in the acid (see the cleaning coppers experiment) releasing all the copper ions in the copper oxide tarnish.

If a zinc atom is to dissolve it must from Zn2+ ions, this involves loosing 2 negatively charged electrons. If these electrons can't go anywhere the Zinc object will become so negatively charged it will attract as many positively charged Zinc ions back as are dissolving, so the reaction will stop.

Electrons can flow around the circuit to the copper electrode, here copper ions are attracted to the negative electrons and when they meet they are neutralised forming copper metal. Because Zinc is more reactive than copper, this whole process releases energy, about 1 joule of energy for every coulomb of charge that is moved, which is the same as saying the battery produces about 1 volt. This voltage is related to the difference in reactivity between the two metals you are using, so if you change the metals you will change the voltage.

To produce a large current both chemical reactions have to be able to take place fast, so the larger the surface area and the more reactants there are in the solution the faster

the reaction will occur. There is a very low concentration of Cu2+ ions so the reaction is likely to be quite slow, limiting the current that can be produced.

The other limiting factor is that if it is difficult for ions to move around in the fruit, as after a while the region around the Zinc will get positively charged and the region around the Copper will get negative. This will mean that there is less difference in voltage between the Zinc and Copper Nails, so instead of giving out 1 V the cell may only produce 0.5V. But if you wait for a while ions will flow through the fruit to cancel out this effect.

After a while the region around the Zinc will become positive due to all the extra Zinc ions and the region around the copper will become negative, reducing the voltage of the battery.

But if you wait for a while, without drawing a current, the ions in the fruit will redistribute themselves and the voltage will build up again.

This is why we needed to use 12 1V cells to produce the 5V to charge the I-pod; each cell was actually producing less than half a volt. This is also why commercial batteries when they are almost flat can produce a good voltage, right up until you draw a current.
To function, the human body must have nutrients. The nutrients known to be essential for human beings are proteins, carbohydrates, fats and oils, minerals, vitamins, and water.

Proteins: Proteins are made of amino acids, small units necessary for growth and tissue repair. Protein is the body's most plentiful substance except for water and, possibly, fat. Animal foods such as meat, fish, poultry, milk, and eggs are rich in protein. Good plant sources of protein are beans, peas, nuts, bread, and cereals.

Combining plant sources, such as peanut butter with whole-grain bread or rice with beans, provides excellent protein. So does combining plant and animal sources such as cereal and milk or beans on toast.

Carbohydrates: Starches and sugars are carbohydrates, the main source of the body's energy. Carbohydrates account for about half of the calorie intake for most Americans and up to four fifths of the calories in diets of African and Asian peoples. Carbohydrate-rich foods are also the main sources of protein for most of the world. Rice, wheat, corn, and potatoes are common rich sources of carbohydrates.

Sugars are not essential foods. They provide energy (calories) but no nutrients. For that reason sugar is called an "empty calorie" food. Occasional sweets are not harmful to a healthy, active person, but excessive sugar can lead to tooth decay when eaten between meals, especially in sticky snack foods that cling to the teeth.

Fats and oils: (which are liquid fats) are a concentrated source of energy. Fats in the diet are necessary for good health. They make certain vitamins available for use in the body, they cushion vital organs, they make up part of all body cells, and they help to maintain body temperature. Fats also delay pangs of hunger because a food mixture

containing fat remains longer in the stomach.

Nutritionists distinguish between different types of dietary fats, or fats in food. Saturated fats usually are solid in form and of animal origin. In many typical diets, meat fat is the main source. It is known that saturated fats can raise the level of cholesterol in the blood. Cholesterol is a natural waxy substance made by the body. It helps to form digestive juices and does other important work. It is present in the body no matter what is eaten. When the body cells cannot absorb any more cholesterol, any excess begins to accumulate in the walls of the blood vessels and gradually narrows them. This condition may lead to a heart attack or stroke. Unsaturated fats are usually n liquid form and from plant sources e.g. sunflower oil, nuts etc.

Minerals: Minerals are neither animal nor vegetable; they are inorganic. Almost all foods contribute to a varied intake of essential minerals. Most minerals are easy to obtain in quantities required by the body. A major exception is iron for children under age 4 and adolescent girls and women in the childbearing years. These groups need more iron than a normal diet may provide. Iron helps to build red blood cells. It also helps the blood carry oxygen from the lungs to each body cell through haemoglobin. Rich sources of iron are meat, especially liver; egg yolks; and dark green vegetables.

Everyone at every age needs calcium. This mineral builds bones and teeth, and it is necessary for blood clotting. The best sources are milk and hard cheese. Others are leafy greens, nuts, and small fishes--such as sardines--with bones that can be eaten.

Phosphorus works with calcium to make strong bones and teeth. A diet that furnishes enough protein and calcium also provides enough phosphorus. Other important minerals are sodium, potassium, iodine, magnesium, zinc, and copper.

Vitamins: The discovery of vitamins began early in the 20th century. It is likely that some still are undiscovered. Eating a wide variety of foods ensures getting enough vitamins whether or not they are identified. All living things need vitamins for growth and health. The body either cannot manufacture them at all or cannot normally manufacture them in sufficient amounts, and so must absorb them from food. Each vitamin has specific roles to play. Many reactions in the body require several vitamins, and the lack or excess of any one can interfere with the function of another.

Fat-soluble vitamins: Four vitamins--A, D, E, and K--are known as the fat-soluble vitamins. They are digested and absorbed with the help of fats that are in the diet.

Vitamin A is needed for strong bones, good vision, and healthy skin. It is found both in dark green and yellow fruits and vegetables. Vitamin D is essential for children because it helps calcium and phosphorus to form straight, strong bones and teeth. With direct sunlight on the skin, the body can manufacture its own vitamin D. Infants and young children often need a vitamin D supplement. Vitamin D is added routinely to most milk during processing. Vitamin E helps to protect vitamin A and red blood cells. It is found in a wide variety of foods, and almost everyone gets enough. Vitamin K is one vitamin that is made within the human body by bacteria that live in the intestinal tract. Small amounts are found as well in the green leaves of spinach, kale, cabbage, and cauliflower and also in pork liver. Fat-soluble vitamins can be stored in

the body for long periods. They are stored mostly in the fatty tissue and in the liver.

Water-soluble vitamins: The vitamin B group of several vitamins helps to maintain healthy skin and a well-functioning nervous system. B vitamins also help to convert carbohydrates into energy. Vitamin C, or ascorbic acid, is needed for building the connective tissue that holds body cells together. Vitamin C is essential for healthy teeth, gums, and blood vessels. It also helps the body to absorb iron. These water-soluble vitamins are not stored in the body for long. Good sources should be eaten every day.

Water: In order to live, every cell in the body must be bathed in water. Water takes an active part in many chemical reactions and is needed to carry other nutrients, to regulate body temperature, and to help eliminate wastes. Water makes up about 60 percent of an adult's body weight. Requirements for water are met in many ways. Most fruits are more than 90 percent water.

More information can be gained about the nutrients at:
http://www.linksnorth.com/nutrition/nutrients.html

D.R.I. – Dietary Reference Intake
R.D.A. – Recommended Daily Allowance
G.D.A. – Guideline Daily Amount

Is food an actual energy source?

This experiment was adapted from "JCE Classroom Activities" Journal of Chemical Education, 81(10) October, 2004.

Safety Issues and Considerations:
The Activity uses a nonflammable device to hold burning food samples. However lab glasses should be worn at all times and long hair tied back. All laboratory guidelines should be adhered to.
Cashews take longer to light, but burn steadily. Marshmallows are easier to light, but tend to need relighting to burn completely.

If time allows in this activity, pupils will determine the quantity of energy in two different foods by measuring the increase in temperature of a volume of water heated by a burning sample of each food, and then compare the energy released.
Pupils determine how many calories are released per gram when marshmallows and cashews burn and then compare the quantity of energy available from carbohydrates versus fats. Students burn the food items beneath a metal soft drink can containing water and measure the resulting change in temperature of the water. More energy is available from fats than carbohydrates because the carbon in carbohydrates is already partially oxidized. The carbon in fats is largely un-oxidized. Oxidation takes place as fats and carbohydrates are converted to carbon dioxide and water. A fat also contains more carbon atoms per gram; therefore combustion of a gram of fat releases more than twice as much energy as a gram of carbohydrate. One gram of fat provides 9 calories while one gram of carbohydrate and protein each provide 4 calories.
Calculations should show that the number of calories released by burning a gram of cashews is much larger than for marshmallows; marshmallows contain mainly carbohydrates (sugar), while cashews contain a large fraction of fat. The combustion energy calculated from Activity data will be lower than the actual combustion energy of

the food, mainly because the experimental setup allows for energy transfer to more than just the water.

Suggested Activity:
After pupils have used the given example to calculate the number of calories in one serving., give pupils other food packages, (where the Nutritional Values are clearly outlined) to work out calorific values. The pupils can invvestigate if the stated calorific value is the same as calculated by themselves.

Helpful Sources of Information:
Nutrients:
http://www.linksnorth.com/nutrition/nutrients.html

Food Labelling Legislation:
http://www.citizensinformation.ie/categories/health/environmental-health/food_labelling

Lemon-powered Battery:
http://www.thenakedscientists.com/HTML/content/kitchenscience/exp/charging-ipods-with-lemons/

Lesson 3

Who's Diet?

Single Lesson

Introduction
This lesson aims to make the pupils more aware of their own dietary habits and how dietary requirements vary for different people due to their age, gender, occupation, climate, lifestyle etc.

Background
Breakfast is the most important meals of the day. It means, "to break the fast." The verb is from 1679. The English word derives from the concept that sleep prevents eating, thus an involuntary fast occurs during sleep; this fast is broken by the first meal - called *breakfast*.

In addition to the nutritional claims, there is concern that students who do not eat breakfast perform worse in school. Research has suggested that eating a meal before noon, consisting of standard breakfast-style foods is positively correlated with improved functioning of school-aged children. Skipping breakfast is also connected with being overweight.

Pupils can keep a record of their own food intake for a week. This will make them more aware of what they are eating and whether they are eating the correct foods or not.

Pupils can work together to apply what they have learned about the different nutrients to plan a day's meals for an Olympic Athlete and an elderly person.

Helpful Sources of Information:
The Nutrition Notebook – The Athlete's Diet
http://www.springboard4health.com/notebook/diet_athlete.html

Nutrition of the Elderly

http://www.danone-institute.be/communication/pdf/mono04/mono4-part5.pdf

Michael Phelps Diet:
http://blogs.wsj.com/health/2008/08/13/the-michael-phelps-diet-dont-try-it-at-home/

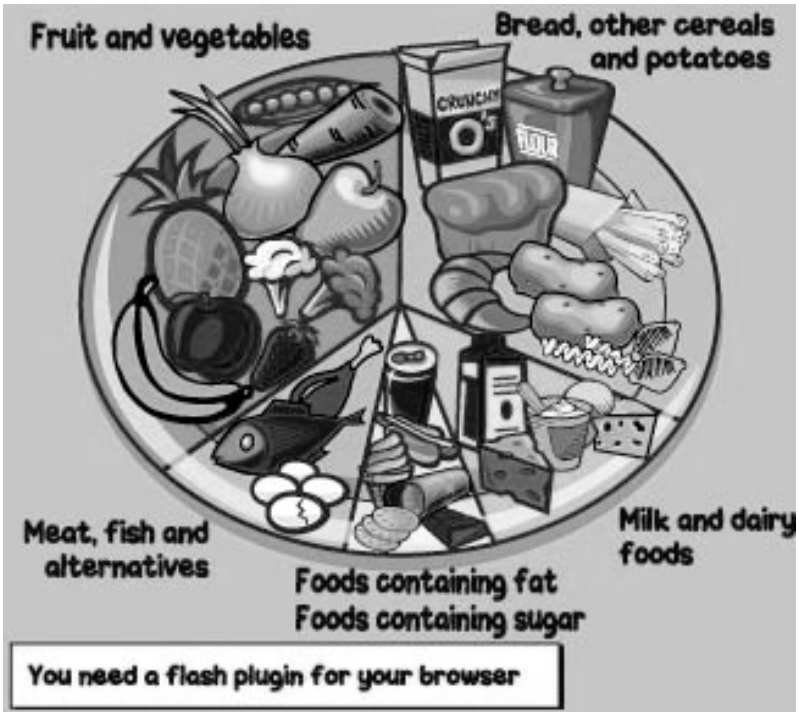

Image sourced: http://www.bbc.co.uk/northernireland/schools/4_11/uptoyou/images/flash_plate.jpg

Unit 2 - The nutrients

In this unit, we will take a closer look at the different food groups and in particular the different nutrients that make up the different foods. We will identify the fuction and source of the different nutrients and also how to identify them in unlabelled food!
We will investigate the use of food supplements by athletes and others. Have you ever taken any type of a fod supplement? why ?

Lesson 1

The Nutrients

Single Lesson

Introduction
The pupils have already had an introduction to the nutrients in the previous lesson. The beginning of this lesson asks the pupils to recall what they have learned about the function and source of the different nutrients. The scenario at the end of the lesson encourages the pupils to work together as a class to test the 'mysterious' food samples using known food tests from their Biology in Junior Certificate Science to determine which nutrient these foods contained to help understand why the players were eating this food.

Links to the Syllabus
The food tests are an aspect of Section 1A1 of the Biology section of the Junior Certificate Science syllabus. This lesson is also linked to Section 1.1.3 of the Leaving Certificate Home Economics Scientific and Social syllabus "Carbohydrates-Composition and Structure" (Department of Education and Science 2001)

Scenario
"These scraps of food were found in the dressing room after a football game. Which nutrient do you think the team may have needed before the game? Since no packaging was left behind, how can we investigate the ingredients in these foods?"
For this activity, the teacher can bring in a few banana skins and apple cores to the lab as found in the dressing room.

Recommendations
This investigation lends itself well to classroom co-operation between all of the pupils. The class may be divided into two groups A and B. Group A can test for sugar, while group B test for starch. Before giving the testing reagents to the pupils, ask if they can recall these food tests from the Junior Certificate Science.

Safety Issues and Considerations
Ensure that all pupils wear lab jackets, glasses and gloves for both experiments. All regular Laboratory Safety Guidelines should be adhered to throughout the class.

Guidelines
There is no standard test for carbohydrates. However simple (reducing) sugars can be identified using Benedict's Reagent as the colour changes from blue to red.

The commercial ready-made reagent should be available in the school lab, but to make it from scratch, first dissolve 100 g sodium carbonate and 173 g sodium citrate dihydrate in a final volume of 850 ml water. Slowly, with stirring, add a solution of 17.3 g copper sulfate pentahydrate in 100 ml of water. Bring the final volume to one liter. The commercial reagent, at least, seems to be stable for years.

When 1 ml of reagent is heated with 5 drops of sample in a boiling water bath, a positive test for reducing sugars is formation of a precipitate within five minutes. The colour ranges from green to yellow to orange to brick-red depending on the amount of reducing sugar in the sample; with a sample containing 1% glucose, the precipitate is usually brick-red.

Starch can be identified using Iodine as it changes from brown to a blue-black colour in the presence of starch. Povidone-Iodine Solution is recommended for use in this experiment. It is available in the First Aid sections of Chemists or in a supermarket (it is often used as an antiseptic wash). It is a 1% iodine solution in which povidone, a vinylpyrrolidone polymer, forms a water-soluble complex with iodine. When a few drops of the solution are added to the mysterious food sample, the brown color of Povidone-Iodine Solution turns to purple.
This investigation will help the pupils to understand that there can be more than one type of carbohydrate.
It is important that the pupils can identify the fruit from the scraps left and that they hypothesise whether starch or sugar will be present in the foods.
These food tests should be carries on both samples if time allows. The pupils should be able to identify sugar in the apple (fructose) and starch in the banana.
The pupils should then be able to reach the conclusion that the nutrient present in the 'mysterious food scraps' was carbohydrates and understand that the football team would need carbohydrates before a big game to provide them with energy.

<u>Suggested Activities</u>
Dietary fibre is also an important carbohydrate. It is found in whole cereals and in the outer skins of fruit and vegetables. In refined foods dietary fibre is removed during processing. This simple demonstration could be used to show pupils why it is important to drink plenty of water with a high fibre diet.

1. Measure the volume of a cup of All-Bran in a measuring jug
2. Record the volume
3. Pour 150ml of hot water onto the All-Bran in the jug.
4. Leave to soak for 10 minutes
5. Record the volume again.

The pupils will observe that the All-Bran has absorbed the water.

Other 'mysterious foods' without any labels could be brought into the lab e.g. a fresh bun from the bakery, a carrot, a piece of bacon, some cereal etc.
The pupils could carry out the same tests on these foods to identify the nutrients in each.

There are other food tests that can be safely demonstrated by the teacher:
Biuret Test for Proteins:
Add Biuret solution (sodium hydroxide + small amount of copper sulphate) – (blue) - to the test substance. Even though the result is not instantaneous, there is no need to apply heat. A colour change from blue to mauve shows the presence of a protein.

Emulsion Test for Fats and Oils:
Add ethanol (this can be alcohol, or industrial methylated spirits) to a very small amount of the test sample. Shake or crush (and possibly heat gently using a waterbath CAREFULLY - DO NOT USE A BURNER! - Ethanol is flammable!) in order to dissolve. Filter or dilute if necessary to obtain fairly clear liquid (which is of course a

solution of fat in ethanol). Take another tube containing water, and pour the ethanolic solution (prepared above) into top. A white (milky) emulsion indicates the presence of fats or oils.

Another simple test for fats and oils that can be carried out by the pupils is the transparency test with a brown paper bag. By rubbing the sample against the bag, if the bag becomes transparent, fats and oils are present.

Helpful Sources of Information

Food Tests:
http://www.biotopics.co.uk/nutrition/footes.html

Standard Food Tests:
http://www.geocities.com/CapeCanaveral/Hall/1410/lab-B-15.html

Preparing Benedict's Reagent:
http://faculty.mansfield.edu/bganong/biochemistry/reagents.htm

Traffic light Guidelines:
http://www.foodafactoflife.org.uk/Sheet.aspx?siteId=19&sectionId=75&contentId=240

Lesson 2

Let's 'C' all about Vitamins

Double Lesson

Introduction

From the experiment in the previous lesson, pupils have come to realise that one food may contain more than one nutrient and so the same nutrient can be sourced from more than one food or food group.

In this lesson, the pupils' knowledge and level of skill is challenged to a higher degree than before for the first time in this module. Pupils will have to research functions, sources and deficiency diseases in relation to each of the main vitamins. The experimental activity in this lesson requires much more detail and understanding than other activities in the previous lessons. It challenges the pupils' understanding of the experimental methodology.

Links to the Syllabus

The experiment in this lesson can also be used to explore reaction kinetics, and in particular the effect of reactant concentrations on the apparent rate of a reaction. In section 6.2 of the Leaving Certificate Chemistry Syllabus, "Factors affecting Rates of Reaction" are outlined: "concentration temperature, nature of reactants, catalysts". (Department of Education and Science, 1999)

In section 4.3 of the Leaving Certificate Chemistry syllabus, "Redox reaction and titrations" (Department of Education and Science, 1999) are outlined. These are also introduced in this lesson.

The descriptive chemistry of Vitamin C may also be linked to the Irish Curriculum.

Background Information

The word 'vitamin' comes from *vita* the Latin word for life. Everybody must eat a certain amount of vitamins to stay healthy. Vitamins are a type of chemicals that are found in very small amounts in different types of foods. They are identified by some of the letters of the alphabet. Tiny quantities are enough for the needs of the body. If people live on a very limited range of food, they may not get their proper share of vitamins.

Here is a brief summary table for the main vitamins:

Vitamin	Source	Function	Deficiency Disease
Water soluble			
C	Fresh fruits, green vegetables, peppers, citrus fruits, blackcurrants, rose-hip syrup, sprouting seeds	Healthy skin, gums and blood vessels, Absorption of Iron, Manufacture of connective tissue	Scurvy Delayed healing of wounds
B Group (There are 6 vitamins in the B Group)	Nuts, pulses, yeast, bread, cereals, wholemeal bread, meat and fish, milk, cheese, eggs.	Controls release of energy from food. Helps the nervous system.	Beri-beri: a nerve disease common in Eastern countries. Pellagra: tongue and skin become sore.
Fat Soluble			
A	1 Pure Vit A: Fish liver oils, liver, butter, margarine, milk, cheese, eggs. 2 Carotene: Carrots, dark green vegetables. Cabbage, watercress, spinach, peppers, peaches.	Growth, Healthy eyes, skin and healthy lining membranes, e.g. of nose and throat.	Retarded growth Night blindness Dry lining membranes of breathing organs.
D	Sunshine, cod liver oil, oily fish, margarine, eggs, liver and cheese.	Formation of bones and teeth	Rickets, brittle bones Unhealthy teeth
E		Healthy skin, protect against free radicals	
K	Vegetables, cereals. Vitamin K is also made in the human	Clotting of blood	Blood does not clot properly. Haemeraging

Water - soluble vitamins cannot be stored in the body, so a daily intake is necessary. In contrast, Fat - soluble vitamins can be stored in the body so daily intake is not necessary.

<u>Investigation of three anonymous Orange Juice Samples:</u>
Knowing that Vitamin C is an important vitamin for healthy gums and skin and knowing that it is found in citrus fruits and blackcurrants, pupils investigate which is the best source of vitamin C.

Safety Issues and Considerations:
Before disposal of the mixture afterwards, the mixture should be reduced by addition of Vitamin C and should be colourless.
Care should be taken when using Tincture of Iodine as it is flammable.
All lab safety guidelines should be adhered to- lab jackets and glasses worn, long hair ties back etc.

Recommendations
In this experiment pupils will use the reaction between ascorbic acid (Vitamin C) and an iodide solution to observe which sample contains the most amount of Vitamin C. This investigation allows pupils to work together in small groups (3 pupils per group), each with a clear understanding of their role and responsibility within the group. Each group could investigate the amount of Vitamin C in different Juices.
It may save time in class if the standards are made up before hand but explained to the pupils.

Background
This method determines the vitamin C concentration in a solution by a redox titration with potassium iodate in the presence of potassium iodide. Vitamin C, more properly called ascorbic acid, is an essential antioxidant needed by the human body (see additional notes).
When iodate ions (IO^{3-}) are added to an acidic solution containing iodide ions (I^-), an oxidation-reduction reaction occurs:
- the iodate ions are reduced to form iodine

$$IO_3^- + 6\ H^+ + 5\ e^- \rightarrow \tfrac{1}{2}\ I_2 + 3\ H_2O$$

- while the iodide ions are oxidised to form iodine.

$$2\ I^- \rightarrow I_2 + 2\ e^-$$

Combining these half-equations demonstrates the reaction between iodate and iodide

$$2\ IO_3^- + 10\ I^- + 12\ H^+ \rightarrow 6\ I_2 + 6\ H_2O$$

It is the iodine formed by this reaction that oxidises the ascorbic acid to dehydroascorbic acid as the iodine is reduced to iodide ions.

$$\text{Ascorbic acid} + I_2 \rightarrow 2\ I^- + \text{dehydroascorbic acid}$$

Due to this reaction the iodine formed is immediately reduced to iodide as long as there is any ascorbic acid present. Once all the ascorbic acid has been oxidised, the excess iodine is free to react with the starch indicator, forming the blue-black starch-iodine complex. This is the endpoint of the titration. The method is suitable for use with Vitamin C tablets, fresh or packaged fruit juices and solid fruits and vegetables.

<u>Helpful Sources of Information</u>
Micronutrient Information Centre:
http://lpi.oregonstate.edu/infocenter/vitamins/vitaminC/

Reference Guide for Vitamins:
http://www.realtime.net/anr/vitamins.html

Vitamin C Investigation:
http://www.odec.ca/projects/2002/walkerd/public_html/sf11.html

Lesson 3

Supplementary & Functional Foods

Single Lesson

Introduction

This lesson introduces pupils to food supplements and makes them more aware of the advantages and disadvantages of these. Pupils, through their own research may learn about other supplements such as protein drinks taken by athletes for example when weight training. By researching and reading genuine articles about real people, this will help the pupils understanding and make the topic more real for them and thus more applicable to their own lives.

Background Information

One in four adults in Ireland are currently taking food supplements in the belief that they will improve their overall health, according to a new survey by Safefood, the food safety promotion board. The survey showed that many people see nutritional supplements as a quick-fix solution to a less than healthy diet and that many of those who take supplements are unsure whether they actually need a supplement or if they are taking the right one. Dr Cliodhna Foley-Nolan, Director, Human Health & Nutrition, Safefood said that food supplements cannot match the health benefits of eating a healthy, balanced diet. It is the combination of nutrients working together in food that help keep bodies healthy, she said. Dr Foley-Nolan also warned that taking too much of certain food supplements or taking them with medication can be dangerous to health and that the advice of a GP or dietician should be sought before taking any food supplement. The only exception to this rule is folic acid, she said. All women of childbearing age who are sexually active should take a daily folic acid supplement to lower the risk of birth defects of the brain and spinal cord in the baby.

More Information can be seen at: www.safefood.eu.

It is important to distinguish between a Dietary Supplement and a Food Supplement: A dietary supplement, also known as food supplement or nutritional supplement, is a preparation intended to supply nutrients, such as vitamins, minerals, fatty acids or amino acids, that are missing or are not consumed in sufficient quantity in a person's diet. Some countries define dietary supplements as foods, while in others they are defined as drugs.

A food supplement is, typically, a nutrient added to a foodstuff, which would otherwise not contain that nutrient. In general, the term is restricted to those additives, which are deemed to be positive for health, growth or well being.

Suggested Activity

Using the same principle but altering the method of the investigation in the previous lesson, pupils can compare the amount of Vitamin C in three anonymous Vitamin Supplement tablets.
This activity will require additional laboratory skills as the tablets will have to be weighed and then crushed using a pestle and morter to form a solution. It is important that the same mass of each tablet is used to make the comparison valid.

Helpful Sources of Information

Food Supplement Legislation
http://www.fsai.ie/legislation/food_supp/index.asp

Food and Nutrition Information Centre
http://fnic.nal.usda.gov/nal_display/index.php?info_center=4&tax_level=1&tax_subject=274

Functional Foods:
http://www.nutriwatch.org/04Foods/ff.html

Image sourced: http://images.crateandbarrel.com/is/image/CrateandBarrel/EvolutionSaltPepperShakers?lg

Unit 3 - Food Additives

We all may have a favourite condiment to add to our food, but what exactly is added to the food before it reaches the dinner table?

In this unit we will become more aware of what our food is made up of. We will learn about what is added during processing and why this is added. Will we be able to isolate these ingredients from the processed product? Some natural ingredients in unprocessed foods may also surprise us!

Lesson 1

Do you know what you are actually eating?

Single Lesson

Introduction

This lesson highlights the amount of additives, natural and artificial added to almost all of the food that we eat everyday. Pupils will be able to recognise this by examining food labels and packagings. But what exactly are these and why are they added? Are they all necessary? The pupils may have heard of 'E numbers' before and have negative connotations about them. Through their research in books and on the net, pupils should learn what the different number ranges stand for and that some of these additives are natural while others may be artificial.

Links to the Syllabus

This unit links to Section 1A1 of the Junior Certificate Science Syllabus "contents of a variety of food products as described by their labels" (Department of Education and Science, 2003). This lesson also links to the Leaving Certificate Home Economics Social and Scientific syllabus, Section 1.3.6. "examination of food labels to establish what food additives were used and to suggest reasons for use" (Department of Education and Science, 2001)

Background Information

E numbers are number codes for food additives and are usually found on food labels throughout the European Union. The numbering scheme follows that of the International Numbering System (INS) as determined by the Codex Alimentarius committee. Only a subset of the INS additives are approved for use in the European Union, the 'E' prefix which stands for Europe. In casual language in the UK and Ireland, the term "E-number" is used as a pejorative term for artificial food additives, and products may promote themselves as "free of E-numbers" even though some of the ingredients (e.g. bicarbonate of soda) do have such a code.

E100-E199 – Colours

E200-299 – Preservatives

E300-399 – Antioxidants, acidity regulators

E400-499 – Thickeners, stabilisers, emulsifiers

E500-599 – Acidity regulators, anti-caking agents

E 600 – 699 – Flavour enhancers

E700-799 – Antibiotics

E900 -999 – Miscellaneous

E 1000-1999 Additional Chemicals

Emulsifiers

There are two kinds of emulsions: temporary and permanent. Temporary emulsions will settle out into layers when left standing undisturbed while permanent emulsions will not settle out into layers when left standing undisturbed. A common example of a temporary emulsion is a mixture of oil and vinegar (salad dressing). Mayonnaise is a common example of a permanent emulsion. Sometimes people want the emulsion not to settle out into layers when left standing undisturbed. If this is the case, an emulsifier may be used. The emulsion consists of droplets of one liquid in another liquid. The emulsifier has the ability to hold the droplets of one liquid suspended in the other liquid. A common food additive that is used as an emulsifier is lecithin. Lecithin is obtained from soya beans as well as egg yolks.

Artificial Colours

Though colours from plant, animal and mineral sources, which had been used in earlier times, the only colouring agents available, remained in use early in this century, manufacturers had strong economic incentives to phase them out. Chemically synthesized colours simply were easier to produce, less expensive, and superior in colouring properties. Only tiny amounts were needed. They blended easily and didn't impart unwanted flavours to foods. But as their use grew, so did safety concerns. This led to numerous regulations throughout the world.

The use of all food additives is controlled by legislation, which is harmonised across the European Union.

Colours used in food products, like other additives must be declared in the ingredients list. However, this does not apply to catering establishments and the consumers have to trust the restaurateurs to get the levels right.

Certain foods are not permitted to contain artificial colours and others have a maximum amount specified.

All additives in Europe are controlled by law, and can only be used following stringent tests and approval by an independent committee of scientists and medical experts.

However, some scientists have linked some additives to hyperactivity in children, allergies, asthma, migraines and even cancer.

These are three artificial colourings that have received negative press in recent times:

Tartrazine (E102)

This is a synthetic yellow azo dye found in products such as fruit squash and sauces. It is reported to cause the most allergic and/or intolerance reactions of all the azo dyes, particularly amongst those with an aspirin intolerance and asthmatics.

The estimated acceptable daily intake is 0-7.5mg/kg bw (body weight).

Sunset Yellow FCF (E110)

A synthetic 'coal tar' and azo yellow dye useful in fermented foods that must be heat-treated. It can be found in orange squash, sweets and sauces. It may cause allergic reactions and/or intolerance, especially amongst those with aspirin intolerance.

The estimated acceptable daily intake is 0-2.5mg/kg bw (body weight)

Ponceau 4R (E124)

This is a red synthetic coal tar or azo dye found in dessert toppings, jelly, soups and sauces. Again this colour can cause allergic reactions amongst those sensitive to aspirin.

Investigation:

Can you make your own "Apple Pie"…….. *without* apples?

This experiment was adapted from a similar experiment edited by Nancy S Bettys and Erika K. Jacobsen, "Apple Fool, An introduction to Artificial Flavourings", Journal of Chemical Education, 80(4) , April, 2003.

Safety Issues and Considerations

This investigation requires tasting. It should be done outside of the laboratory using clean kitchen equipment. Never eat anything that has been in the laboratory or that has been in contact with laboratory equipment.

Considerations

In this activity, pupils make their own artificial apple flavoured filling as is done in 'Mock Apple Pie'. The ingedients and materials necessary for this activity can all be sourced easily in the local supermarket; Cream crackers, sugar, cream of tartar and water.

In a sense, this activity differs from many of the other experimental investigations throughout the module. Some discretion is left in the hands of the students. This is because creating artificial flavourings is as much an art as it is a science. Pupils can decide themselves if they think their mixture is too runny, too sweet, or too thick etc. The sugar and the cream of tartar (potassium hydrogen tartrate $KHC_4H_4O_6$) mimic the sweetness of the apple while the cracker and water mixture mimic the bulk and texture of the cooked apple. Citric acid or lemon juice mat be used in place of cream of tartar. Adding cinnamon or cloves which is often served with cooked apples can also help to mimic the taste.

Possible Variation

As the teacher, you may have prepared some real cooked apples, to allow the pupils to compare the taste with their own artificial sample.

Suggested Activity

If time allows or if the facilities are available, this lesson could be extended to a taste test of different apple pies. (Two different artificial apple fillings may be used as well as a genuine apple filling. It is important that the samples are labeled anonymously e.g. Pie X, Pie Y and Pie Z). Frozen or fresh pastry may be used to make apple pies. The students could then conduct a research survey on a certain group of pupils in the school to see if the 'Mock Apple Pie' could actually fool some people.

This project could be conducted as a class project. This activity would lend itself well to team-work and co-operation bewtween the pupils. E.g. the class could be divded into sub groups, ech with their own responsibility; one group would be responsible for making the apple pies, another to prepare the samples, another for setting up the tasting stations, another group for supervising the tastings, another group to record the pupil feedback about each sample, another group to collect the results, and another group to present the results to the class etc.

Helful Sources of Information:
Artificial Coulours:
http://wwwsurreycc.gov.uk/sccwebsite/sccwspages.nsf/

An index of all the E numbers can be found at
http://www.ukfoodguide.net/enumeric.htm

Eggs as emulsifiers:
http://www.saskschools.ca/curr_content/science10/unitc/expemul.html

Lesson 2

Can we take away the additives?

Double Lesson

Introduction

The first activity in this lesson should surprise the pupils! Reading the list of ingredients, most of which will be unknown to the pupils may cause them to expect that the food or drink in question may be a processed and possibly unhealthy food. The revelation that it is indeed the list of ingredients of a strawberry milkshake may surprise many pupils. Pupils may be even more surprised when they see E numbers, anti oxidants and flavourings in a tomato!

Fresh fruit and vegetables often have complicated, unpredictable flavours that combine bitterness with sweetness. When flavourists create additives for adult foods, they try to imitate nature as closely as possible. When flavourists create additives for kids' foods, they usually get rid of the bitterness and increase the sweetness. Children's flavours are often twice as sweet as those made for adults.

As the lesson progresses, pupils will become more aware of different food additives; colourings, flavourings and preservatives.

The experiment in this lesson helps pupils to recognise that supplements too may be added to improve the nutritional value of foods.

Links to the Syllabus

As well as linking to the food section 1A1 of the Junior Certificate Science syllabus, "contents of a variety of food items as descrbed by their labels" (Department of Education and Science, 2003), this lesson also links to Section 1A5 "function of blood" (Department of Edcuation and Science, 2003) as pupils learn the function of Iron in the haemoglobin and the red blood cells. This also links to Section 1.1.6 "sources and functions of mineral elements" (Department of Education and Science, 2001) in the Leaving Certificate Home Economics Scientific and Social syllabus.

Ingredient Listings:

The first ingredient list is that of afast food Strawberry flavoured Milkshake. The second ingredient list is a list of some of the natural ingredients as found in a fresh tomato. The inclusion of the ingredients of the tomato reminds pupils that even though many of the chemicals in the strawberry milkshake may have been artificial and harmful, not all E numbers or flavourings are artificial.

Investigation:

Can we see and measure the Iron in a bowl of cereal?

This experiment was adapted from a similar experiment edited by Erika K. Jacobsen and Julie Cunningham, "A Magnetic Meal", Journal of Chemical Education, 81(11) , November, 2004.

Safety Issues and Considerations

This investigation involves a cereal which students may eat everyday. It is important to ensure however, that none of the cereal is consumed or tasted in the laboratory.

It is important that lab glasses should be worn at all times, especially when handling the small iron filings.
Disposal of the cereal mixture down a sink may clog pipes. You may wish to dispose of the mixture in the bin instead.

Considerations
In this investigation, pupils create a 'cereal slurry' by adding water to a weighed mass of cereal. A magnetic wand is then used to isolate the elemental Iron in the cereal. It is important that the cereal used for the experiment contains *elemental* Iron, otherwise, it will not be able to be isolated using the magnet.
Nestle Fitnesse contains 11.6mg of Iron per 100g of cereal. The elemental Iron can easily be identified using a cereal with an Iron level this high.
A magnet with a plastic covering would be most suitable for this experiment as it would make it easier fot eh pupils to see the Iron filings. You may find such magnets with a board game. If they are not available however, ordinary magnets will be sufficient.
A pestle and morter may also be used to crush the cereal if you feel the pupils would have a greater benefit through use of the laboratory equipment as opposed to the domestic rolling pin.
This investigation is most successful if students use fairly sensitive balances e.g. .001g. This is good practice for the students and also allows their results to be more accurate.

Possible Variations
This same experimental techique could be used to investigate and compare two anonymous cereal samples to identify which contains the highest amount of Iron. Each half of the class could test a different sample and then compare their results.

Time Management suggestion
It may be more time efficient in the class if background information about Iron, e.g. its' electronoc configuration, its' function, etc. were covered during the 20 minute waiting time after the cereal-water mixture was made up.

<u>Suggested Activity</u>
The iron filings as isolated in the experiment will turn a red-brown colour with the addition of vinegar, indicating the rusting of Iron.
$2Fe_{(s)} + 3O_{2(g)} = Fe_2O_{3(s)}$. This test takes 12-24 hours so could be done at the end of the class and reviewed in the next lesson. It could be used to prove that the filings are Iron and also to link the Food Science with chemistry.

<u>Investigation:</u>
<u>Are you smartie than a smartie?</u>
It is a good idea at the beginning of this investigation to ask the pupils to predict which colours they think make up the different colours of the smartie shells.

This simple experiment introduces pupils to chromatography.

The colour in the sugar coating of the smartie shell dissolves in the water. The water is drawn out through the paper by capillary action and moves in a growing circle. The different inks, which make up the smartie colour move at different speeds and so they are separated.

At the 'molecular level' smaller hydrophilic molecules migrate faster through the paper. Hydrophilic means a "water-loving" substance, as opposed to hydrophobic compounds, which are not soluble in water. Cooking oil is an example of a hydrophobic substance. The colors that migrate the furthest from the smarty have less of a mass than the ones closest to the smarty.

Helpful Source of Information:
Fact sheet about Iron is available at:
http://ohioline.osu.edu/hyg-Fact/5000/5559.html

How to pick a breakfast cereal:
http://www.drmirkin.com/nutrition/N180.htm

Lesson 3

How influenced are you by labels?

Single Lesson

Introduction

The introductory image in this lesson should lead to a pupil discussion about the honesty and validity of the labeling of food produce. The aim of this is to make pupils more aware of the 'small print' (literally) when examining and choosing different food items.

Links to the Syllabus

This lesson highlights "the responsibility of the consumer in informed decision making" (Department of Education and Science, 2001) as outlined in Section 2.2.2 of the Leaving Certificate Home Economics Scientific and Social syllabus. This cross-curricular link may help the pupils to recognise the significance of a good scientific understanding in their everday lives.

Background Information

Food labels should include information such as name and description of the food item, a list of ingredients, nutritional information, storage details, country of origin, an allergy advise box, date marking, contact details, health marking, size etc.
The FSAI (Food Safety Authority of Ireland) have available all the National and E.U. legislation about food labelling on their web page:
http://www.fsai.ie/legislation/food/legislation_labelling.asp#gen

Identifying the anonymous food label:

This activity lends itself well to co-operation and teamwork. Each group is given the nutritional value and ingredient list from an anonymos food. By allowing the pupils to work together in small groups of two or three more possibilities may be suggested to help to identify the food. In their groups, pupils will have to provide rationals for their suggestions.
Calculating the calorific value revises a skill which was first learned in Lesson 2 of Unit 1. Pupils will also have to recall the E numbers from the previous lesson.
Each group of pupils are given a Nutritional Value table and list of ingredients as cut out from a food packaging (each from a different food type e.g ceral box, tayto bag, jam jar, biscuit wrapping, bread wrapping etc.) The product however remains anonymous to the pupils. The pupils must analyse the Nutirtional Information.
This exercise revises the pupils' understanding and comprehension of the information given on food packaging. It may also surprise pupils about the ingredients in many of the commn foods they eat everyday. Hopefully the exercise will encourage pupils to become more aware of all of the information available to them on food packaging.
It may be interesting to have just 4-5 different labels between the whole class and so observe the different suggestions for each of the labels.

Research Poster

This activity gives pupils the choice and free-will to decide on their own topic of research within the broad guidelines provided. When given some lee-way, pupils may be more enthusiastic and motivated. Designing a poster allows the pupils to present their information in a more ineresting manner to the whole class.
A consequent acivity could be to combine all of these posters as a general Special Dietary Needs Awareness poster for the Science lab or Home Economics room.

Helpful Sources of Information:

An online guide to understanding food labels is available at:
http://www.drmirkin.com/nutrition/N180.htm

An explanation of food labeling terms is also available at:
http://www.eatwell.gov.uk/foodlabels/labellingterms/

Food Labeling Legislation:
http://www.fsai.ie/legislation/food/legislation_labelling.asp#gen

Image sourced at: http://purzone.com/images/food-processing.jpg

Unit 4 - Food Processes

In this unit, we will trace the steps backwards to see what the food on our table once looked like and where it once grew or lived!

Most of the food that we eat today has been changed in some way from its natural state, but why is food changed and processed? Is all food processing industrial or does some happen in our homes?

Lesson 1

From the farm to the shelf…

Single Lesson

Introduction
In this lesson the pupils will identify the natural and original ingredients in many of our well known processed foods. The different methods of processing foods will be explored to gain a clearer understanding of why some methods are more suitable than others.

Links to the Syllabus
Much of the study on the food processing will be linked to "biotechnology in industry" (Department of Education and Science, 2003) as outlined in Section 1C8 of the Junior Certificate Science syllabus. There is also a cross-curricular link to section 1.3.1 "the Irish Food Industry" (Department of Education and Science, 2001) as outlined in the Leaving Certificate Home Economics Scientific and Social syllabus.

Teacher's Note:
One of the main reasons for processing food is to preserve it. However, most of this lesson focuses more closely on the actual processes rather than the preservation aspect. More focus will be placed on food preservation in Unit 5, where food spoilage and suitable storage will also be considered. Because freezing is such a prominent method of food preservation, while it may be mentioned in this lesson, it also will be looked at in much more detail in Lesson 1 of unit 5.

Background Information
Food processing is the set of methods and techniques used to transform raw ingredients into food or to transform food into other forms for consumption by humans or animals either in the home or by the food processing industry. Food processing typically takes clean, harvested crops or slaughtered and butchered animal products and uses these to produce attractive, marketable and often long-life food products. Similar processes are used to produce animal feed.
In general, fresh food that has not been processed other than by washing and simple kitchen preparation, may be expected to contain a higher proportion of naturally occurring vitamins, fibre and minerals than the equivalent product processed by the food industry. Vitamin C for example is destroyed by heat and therefore canned fruits have a lower content of vitamin C than fresh ones.

It is important that the pupils recognise that they are involved in food processing to a certain extent everyday themselves. E.g. peeling a banana, boiling a potato, making scrambled egg, whipping cream etc.

Food processing can lower the nutritional value of foods. Processed foods tend to include food additives, such as flavourings and texture enhancing agents, which may have little or no nutritive value, or be unhealthy. Some preservatives added or created during processing such as nitrites or sulphites may cause adverse health effects.

Processed foods often have a higher ratio of calories to other essential nutrients than unprocessed foods, a phenomenon referred to as "empty calories". Most junk foods are processed, and fit this category.

High quality and hygiene standards must be maintained to ensure consumer safety and failures to maintain adequate standards can have serious health consequences.

Processing food is a very costly process, thus increasing the prices of foods products

Advantages 'V' Disadvantages
This activity motivates and stimulates the pupils to think about each method of food processing in greater detail than they may have known before. The concluding question at the end of this activity asking the pupils to decide on the one most effective method of processing food may be as such a 'trick' question. Through debate and disagreement, the pupils may recognize the need for the different methods for different types of food. E.g. Dehydrated sardines may not be too appetizing or smoked oranges etc.

Listing the processed foods
If the class is organized into small teams of two or three pupils, this concluding activity may add more interest and excitement to the lesson as pupils will be motivated to think of more processed food items than their fellow pupils. All of the class can work on the one food at one time or else different pairs of teams can work on different foods. Pupils can choose from the box of suggestions provided in the handout or more foods can natural foods can also be used in the same manner.

Helpful Sources of Information:

Teargas, the Irish Agriculture and Food Development Authority have outlined different food Processing regulations on this website:
http://www.teagasc.ie/research/reports/foodprocessing/index.htm

Dirty secrets of the food processing industry available at:
http://www.westonaprice.org/modernfood/dirty-secrets.html
may well surprise and interest the pupils

Further information about different food processes could be easily attained from any Leaving Certificate Home Economics book.

Lesson 2

The Basics of Baking

Double Lesson

Introduction
In this lesson, the aim for the pupils is to gain a clear understanding of what fermentation is and to be able to recognise examples in the world around us. The pupils will examine a slice of bread to recognise and understand how yeast causes it to rise. Pupils will also investigate the use of different raising agaents and conditions that may vary in baking. Pupils will gain a clearer interpretation by working in small groups discussing results and sharing ideas.

Links to the Syllabus
This lesson encourages the "investigation of micro-organisms" (Department of Education and Science, 2003) as outlined in Section 1C8 of the Junior Certificate Science syllabus. The realistic scenario involving *'Accomplished Cuisine'* may link with Section 1.3.1. "Small businesses and home enterprises within the food industries" (Department of Education and Science, 2001) as part of the Leaving Certificate Home Economics Social and Scientific syllabus.

How does bread rise?
In this activity, the pupils can work in pairs to examine a slice of bread. By seeing the 'air-hoes' in the bread, it may be easier for the pupils to understand that a reaction must have taken place with some of the ingredients in the bread.

Recommendation
A slice of white sliced pan may be the most suitable type of bread to use for this demonstration. When held up to the light, it is easier to see the 'air holes' in than for instance soda bread would be.

Explanation
For the purpose of this activity, we will concentrate on the flour, water and yeast, ignoring the other ingredients that may vary in bread making.
When the flour and water are combined and the mixture is kneaded, the protein in the flour forms gluten. This is a highly elastic structure of molecules. The analogy of bubblegum can be used to explain how the gluten works. While baking, yeast multiplies through cell division, it bubbles up into a froth, giving off carbon dioxide. When these bubbles are trapped in bread dough, the dough will rise higher and higher. The starches in bread dough are also food for re-producing yeast; and the yeast, in turn, gives bread its' special flavour and lightness. The gases inflate air bubbles in the gluten, similar to blowing bubble gum. This action causes the bread dough to expand with air bubbles.

Students can see these air holes made by the reaction of yeast, producing carbon dioxide, which expands the gluten by looking at the slice of bread against the light.

This is a simple word and chemical equation of what happens the bread in the oven

causing it to rise. These may help the pupils understanding of the whole concept.

Glucose $\xrightarrow{\text{yeast}}$ Ethanol + Carbon Dioxide

$C_6H_{12}O_6 \xrightarrow{\text{yeast}} 2C_2H_5OH + 2CO_2$

Yeast-Air Balloon:

Making a yeast-air balloon provides pupils with a better understanding of how yeast can cause the dough to rise in the oven.
As the yeast feeds on the sugar, it produces carbon dioxide. With no place to go but up, this gas slowly fills the balloon.
A very similar process happens as bread rises. Carbon dioxide from yeast fills thousands of balloon-like bubbles in the dough. Once the bread has baked, this is what gives the loaf its airy texture.
For this experiment, fresh yeast can be easily sourced in the bakery of many supermarkets.

Effect of temperature on Yeast:
150° C–205° C - Surface temperature of a browning crust.
100° C - Interior temperature of a loaf of just-baked bread.
55° C–60° C - Yeast cells die (thermal death point).
49° C–55° C - Water temperature for activating yeast designed to be mixed with the dry ingredients in a recipe.
41° C–46° C - Temperature of water for dry yeast reconstituted with water and sugar.
38° C (or lower) - When yeast is mixed with water at too low a temperature, an amino acid called *glutathione* leaks from the cell walls, making doughs sticky and hard to handle.
35° C - Temperature for liquids used to dissolve compressed yeasts.
27° C–32° C - Optimum temperature range for yeast to grow and reproduce at dough fermentation stage.

'Accomplished Cuisine' Scenario:

These experiments were adapted from an experiment edited by Nancy S Bettys and Erika K. Jacobsen, "Flat as a Pancake – Exploring Rising in Baked Goods", Journal of Chemical Education, 77 (10) , October, 2000.

Safety Issues and Considerations
Do not taste or eat any food that has been in the laboratory or has been in contact with laboratory equipment.
If you wish to taste any of the scones baked in this activity, carry out the investigation in the kitchen using clean kitchen equipment!

A: The company are involved in baking bread, scones, tarts and biscuits. The dispute lies between the head baker who prepares the scone dough and the baker who prepares the pastry for the tarts. They cannot agree on a raising agent.
The Managing Director has sent four different raising agents to the laboratory for testing. Can you help with the investigation?

Baking soda is sodium bicarbonate ($NaHCO_3$, a weak base). Cream of tartar is potassium hydrogen tartrate ($KHC_4H_4O_6$, a weak acid). Regular baking powder contains baking soda, calcium acid phosphate or sodium acid pyrophosphate ($Ca(H_2PO_4)_2$ and $Na_2H_2P_2O_7 \ 6H_2O$, weak acids), and corn starch (to absorb moisture). Double-acting baking powder contains baking soda, sodium aluminum sulfate
($NaAl(SO_4)_2 \ 12H_2O$), calcium acid phosphate, (weak acids—most of the reaction with base occurs at high temperature), and corn starch.
Bubbles and fizzing occur in cups that contain the baking soda and cream of tartar and the baking powder, but not in the cup containing the baking soda o its' own with the water.
All reactions are $HA + NaHCO_3 \rightarrow CO_2 + H_2O + Na^+ + A^-$
(where HA is the acid species).

After heating gently, additional bubbles will form only in the container with the baking powder.

Recommendations
If time and resources suffice, each group could investigate each of the raising agents using clearly labeled containers. If not, it is important that the results of each group are made known to all the class so that a final conclusion can be made.
This could be done using an over-head projector, the blackboard or a power-point presentation.

B: In the past, the baker who prepares the dough for the scones has always prepared the dough the night before and stored it in the refrigerator before baking in the oven the following day. Is this the best way to prepare and store the dough for the scones?

After the pupils cut the dough, the scones are unlikely to be perfectly level. Students may choose a particular side or area to measure, or always measure to the highest point.
The pupils' observations will vary depending on the condition that each scone sample was placed in. Dough in the refrigerator may not rise. Dough at room temperature and warmer should rise.
These three scones may not be as tall as the one initially baked.
Most rising will probably be observed while the biscuits are in the oven. CO_2 generated before baking may escape from the dough and not contribute to rising.

Recommendations
It will allow more time for the experimental investigation in the class if the dough is made in advance of the class. However, if the dough is going to be made by the teacher or someone else before the class, it is important that it is still relatively freshly made if possible.

It is also a good idea that while the pupils are waiting for the dough to cook in the oven and when the other samples are in their storing conditions, they will examine the ingredients on the baking soda packet and the baking powder to understand how they work. Through a clear explanation, pupils may develop a clearer understanding that

baking soda is a weak base, (needs to be reacted with a weak acid e.g. buttermilk) whereas baking powder contains baking soda and weak acids. Pupils can also examine different recipes and look at the other ingredients used with the raising agents to facilitate their reaction.

Possible Adaptation:
A similar experiment could be set up to investigate the difference between different raising agents and how each reacts under the different conditions. In the experiment outlined above, all of the scones were made from the same 'batch' of dough made with the same raising agent. If pupils were to make their own dough from different recipes would their results change?

The following quantities (sufficient for 24 reg. scones) should be sufficient for 10 groups of three pupils, each making four scones. The scones for these experiments can be made smaller than average scones:
However, these ratios can be doubled or halved depending on your class size.

- 450g Self-raising flour
- 100g Margarine
- 2 large eggs and 10 tbsp. milk (beaten together)
- 50g caster sugar (optional)

Method:

1. Sieve flour into a mixing bowl
2. Rub in the margarine
3. Make a well in the centre of the flour mixture
4. Add the beaten egg and milk mixture.
5. Mix to a soft dough using a fork.
6. Turn onto a lightly floured board and knead gently.

Helpful Sources of Information

More information can be found about the use of Yeast in Bread making:

http://www.pumpkincircle.com/bread/yeast.html

A useful experiment to investigate the conditions of Fermenation can be accessed at:

http://www.umsl.edu/~microbes/pdf/How%20Long%20Blue.pdf

Yeast Air Balloon:

http://www.exploratorium.edu/cooking/bread/activity-yeast.html

Lesson 3

Let's Agree to Disagree

Single Lesson

Introduction

In this class, we will look at some of the very prominent and pressing issues realted to food processing. Different groups of pupils will investigate different topics and then each issue will be debated !

This lesson involves the pupils in a debate where they must justify their views and opinions. It also helps the pupils to understand how the scientific food industry is relevant to so many aspects of their own lives.

Links to the Syllabus

This lesson extends beyond the familiar syllabus content and aims to "develop the young person's personal and social confidence, initiative and competence through a broad well balanced general education" (Department of Education and Science, 2003)

Recommendations:

The class should be divided into 6\six groups of 4-5 pupils. A variety of sources of information should be made available to the pupils. E.g. Internet access, encyclopedias, relevant newspaper articles etc. The broad source of resources will give pupils a greater opportunity to source more information. It may be a good idea to insist that each member of the group must source a piece of information to ensure that all pupils are contributing equally to the group.

Preparation for this lesson may also be done outside of the class time if the situation allows. This will then enable the pupils to have more time to present their arguments in the debate.

Helpful Sources of Information:

The following are websites that you may use to help direct the pupils' research:

Genetically Modified Foods:
http://www.actionbioscience.org/biotech/pusztai.html

Organic Foods:
http://www.mayoclinic.com/health/organic-food/NU00255

Processed Foods:
http://tiki.oneworld.net/food/food_processing.html

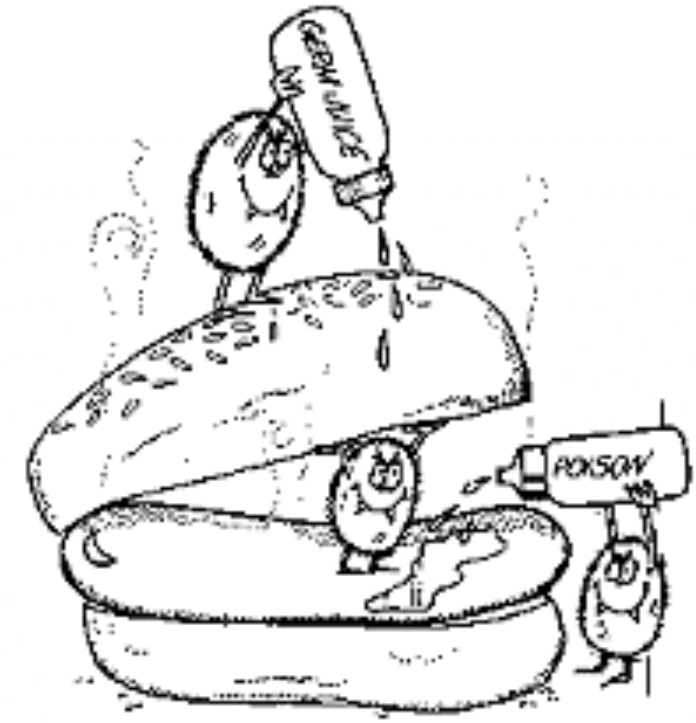

Image sourced: http://www.ccc.govt.nz/Health/images/burger.gif

Unit 5- Food Spoilage

In this unit we will look at food spoilage. We will investigate how different types of food are preserved and why they spoil differently.
We will investigate the different types of preserving food before they go into storage and during storage. We will see how preservation techniques have developed throughout history and also how many home preservation techniques mirror the large scale industrial methods. Through experimentation, we will learn to understand what causes the food spoilage, the dangers of it and so how to minimise it!

Lesson 1

Food Preservation

Single Lesson

Introduction

Food is preserved to prevent it from spoiling. Any method of treating food that makes it last longer is known as food preservation. In this lesson we will recall some of the food preservation techiques used by our ancestors and also link what we have learned about food processing in the previous unit to help in our comprehension of some of the industiral preservation techniques used today. A greater focus will be placed on freezing in this lesson as it is a simple process used by everyone in their homes.

Links to the Syllabus

This lesson is closely linked to section 1.3.9. “preservation” (Department of Education and Science, 2001) as in the Leaving Certificate Home Ecomonics Social and Scientific syllabus.

Background Information

In the previous unit, pupils will have looked at different methods of processing foods. Pupils should now be able to recognise preservation as one of the main reasons for processing food.

Having a clear understanding of the need to preserve food will in turn lead to an understanding of different methods and environments for food storage. Pupils will recognise a suitable storage place as a method of preservation in itself.

By introducing the topic through reference to historic methods of preservation and storage, this should make the topic seem more straight forward. The link to methods of preservation and storage in the home will make the topic mre relevant to the pupils’ own lives.

Freezing is a widely used method of preservation (storage) both commercially and at home. Food in a freezer is kept at a temperature that is too low for bacteria to grow. When water is changed to ice, the bacteria becme inactive until the ice thaws. Food may be damaged if it is frozen slowly. This is because slow freezing causes large ice crystals to form and these can break the cell walls in food. Nutrients and liquids can then be lost during thawing.

Tom’s Fruit Stall

This presentation of a realistic problem will hopefully encourage the pupils to beome more involved in the investigation.

Storage of the Bananas

Pupils can work in groups of three for this investigation. Each group is given green unripened banana. It is important that the pupils provide a rational for their choice of storage. They can then compare what they thought would happen with what the final result turns out to be.

It is important tha the pupils take a close recording of the appearance of the banana on the first day so it can be clearly compared to its' condition on the seventh day.
This activiy should lead to a classroom discussion as the pupils discuss their results and whether their choice of storage was successful or not.
The refrigerated banana may have a gree-brown colour after the week, and therefor not very appetising. In comparison, the banana in the brown paper bag should have a bright yellow colour with very few brown spots.

Adaptations
If the pupils suggest another method of storage that is not suggested in the handout, if it is feesible this should be made available to aid their curiosity.

Possible Activities
If time and facilities are available, the pupils could also investigate if the sugar and starch content of a banana varies as it ripens.
This activity would involve the pupils firstly hypothesising what they think the result will be and give a reason why. Each group of three pupils could then be given three bananas, a green banana, a ripe banana and an over-ripened black banana. The pupils recall the foodtests that they did in the beginning of the module to decide how to test for starch and sugar and what colour changes to expect. The results are recorded and discussed with the rest of the class.

One bad apple spoils the box
In this activity, the pupils will find that the one over-ripened apple will lead to the spoilage of the other apples also.
Through their investigation, pupils will also learn that in the same way, fresh flowers produce ethene which will speed up the ripening process of a bowl of fruit let nearby.

Ethene, also known as ethylene, is a plant growth substance. It can be produced by almost all parts of higher plants, though the rate of production is highest where cell division occurs. Its production is increased during leaf fall and fruit ripening. In addition, stress factors such as wounding, flooding, chilling, disease, high temperatures and drought seem to induce ethene synthesis.

Ethene has a deceptively simple structure and is lighter than air in physiological conditions - so it diffuses rapidly amongst the air spaces of a plant, and between plants. Perhaps it is these properties that make it such a powerful signal molecule. Certainly plants are sensitive to it, and responses occur at only 1 part ethene per million of air. Yet the concentration of ethene in the tissues of a ripening apple is 2500 times greater!

All fruits that ripen in response to ethene show a characteristic rise in respiratory rate before the ripening phase, called a *climacteric.* Some fruits such as apples, bananas, avocados, figs, mangoes, peaches, pears, persimmons, plums and tomatoes show a sharp peak in ethene production just before the respiratory burst, and these are called climacteric fruits. Other non-climacteric fruits, such as grapes, strawberries, cherries and citrus fruits, do not show these peaks of ethene production and respiratory activity. Climacteric fruits can be induced to ripen by the application of ethene, and

this is something that has been exploited by commercial suppliers in management of their fruit stores - so that the fruit is ripened at just the right time for sale.

Helpful Sources of Information

Fruit and Vegetable Ripening:
http://www-saps.plantsci.cam.ac.uk/osmoweb/ethenemenu.htm

What causes food Spoilage?
http://www.eufic.org/page/en/page/FAQ/faqid/food-spoilage/?lowres=1

Ways to prevent food spoilage:
http://gchava.myweb.uga.edu/prevention.html

Lesson 2

Food Soilage and how to prevent it

Double Lesson

Introduction
In the last lesson, we have looked at food preservation and storage, and recognised a clear link between each of these. In this lesson, we will take a closer look at food spoilage and the conditions that cause it. This will help us to understand how the different preservation and storage methods work. In this lesson, pupils will gain a clear understnding of the two distint ways that food can 'go bad' ; from within (enzymatic action) and from the outside (micro-organisms; bacteria, moulds and yeast)

Links to the syllabus
This activity introduces enzymes on a simpler, hands-on level and emphasizes the fact that we come into contact with chemistry on an everyday basis. Students often encounter items that illustrate the action of enzymes. For example, enzymes are commonly found in food products. This will give the pupils a brief introduction to Leaving Certificate Biology.

Background Information
Food spoilage can be caused by a combination of factors such as light, oxygen, heat, humidity and/or all kinds of microorganisms.
Therefore in general every kind of food should be stored in a dark dry place and at a proper temperature to keep its quality, whether fruits, vegetables, cereals, meat, fish, milk or milk products. The industry also has many techniques for protecting food from spoilage:
Avoiding light, oxygen, heat, humidity, moisture, altering the pH etc.

Juice 'V' Jelly
In this experiment, pupils can work in small groups perhaps of two or three pupils. The experiment lends itself well to class co-operation and communication.

This experiment was adapted from an experiment edited by Erika K. Jacobsen, "Investigating the action of Enzymes in Fruit on Gelatine", Journal of Chemical Education, 76 (5) , May, 1999.

Safety considerations and Recommendations
When food is used in the lab, there is temptation for students to taste or eat it. If the activity is done in a kitchen setting using clean kitchen containers and utensils, students may eat the gelatine and fruit after completing their observations. If the activity is done in a chemistry laboratory or with glassware and other items used previously in the lab, students should not taste or eat any of

the items.

Most enzymes are proteins that have evolved to function as catalysts for chemical reactions in living systems. Some fruits contain proteases, a group of enzymes that catalyze the cleavage of peptide linkages in proteins. This can have an undesired effect in a gelatine salad containing fruit, because proteases in the fruit can cleave the proteins that make up the structure of gelatine so that it will not set. This is the reason for the warning on many gelatine packages "Do not use with fresh or frozen pineapple." Other fruits may also be included in the warning. Fresh pineapple, kiwi, and figs contain the proteases bromelain, actinidin, and ficin, respectively. When the enzymes are denatured, which can result from heating during the canning process, they lose their ability to cleave proteins.

In this activity, students observe gelatine samples treated with substances that may or may not have an enzymatic effect on the protein in the gelatin. Substances used are fresh pineapple, canned pineapple, fresh pineapple that has been frozen and microwaved.

In cups containing fresh pineapple, and frozen pineapple the gelatin surface is watery. There may be a deepening outline of the pineapple chunk where the gelatine is breaking down.
In the cups that contain only gelatine and gelatine with canned pineapple and micro waved pineapple, the gelatine surface remains firm.
The canning process involves heating. Heat denatures the enzyme that would break down the gelatine structure. Heating pineapple in the microwave has the same effect as canning: it denatures the enzyme.
Freezing the fresh pineapple does not denature the enzyme and therefore does not change its effect on the gelatine.

Adaptations
If the cost of fresh pineapple is prohibitive, kiwi can be substituted.
Canned kiwi is uncommon, so cup no. 3 could be omitted.
You may need one four-serving packet of gelatin per group. However, if this is going to prove too expensive, less gelatine will suffice.

Possible Activities
If time and resources suffice pupils could observe mould growth in agar plates on a sample of white bread. One plate could be a control, with no food, another without heat, another without moisture etc. All of the plates should be left for the same length of time with pupils monitoring any mould growth at regular intervals.
Pupils should recognize the conditions necessary for bacterial and mould growth.

Helpful Sources of Information

What causes food Spoilage?
http://www.eufic.org/page/en/page/FAQ/faqid/food-spoilage/?lowres=1

http://www.biotopics.co.uk/pot/foodsp.html

Ways to prevent food spoilage:
http://gchava.myweb.uga.edu/prevention.html

Lesson 3

Polar Pathogenic Perspectives

Single Lesson

Introduction
This lesson is some-what different than previous lessons in that it requires the pupils the read two articles. The pupils should be then given time to develop their own opinions about each. Time should be allowed for a classroom discussion at the end of the lesson. Pupils may have many questions and different perspectives after reading both articles.

Links to the syllabus
This class helps to "reinforce and further develop the young person's knowledge, understanding, skills and competencies" (Department of Education and Science, 2003) as developed in the Junior Certificate. Such critical thinking will help to prepare the pupils for their Leaving Certificate programmes.

Possible Activities
This lesson could lead to many different activities. The pupils could search the net and newspapers etc. to find similar and other articles about the uses and dangers of moulds, yeasts and bacteria.
This may create an opportunity for an organised classroom debate.
Pupils could present their findings as a poster or research project etc.

Helpful Sources of Information

"Maker of the Miracle Mould"
Sourced at: http://www.abc.net.au/science/slab/florey/story.htm

"The Dangers of Food Bacteria"
Sourced at: http://www.vegekleen.com/food-bacteria.html

Image sourced: http://www.exploratorium.edu/cooking/icooks/images/Turkey_cooking_c.gif

Unit 6 - Science of Cooking

In this unit, we will move to the kitchen as we take a closer look at the science of food.
We will begin by investigating the different methods of food preparation and the effects of these on the nutritional value, the appearance and taste of the food.
The different methods of cooking food and their effects will be dicscussed and observed through experimental investigation. We will discuss why some of these different methods are used.
We will also learn about and research different food bourne illnesses and the dangers of these.

Lesson 1

Safe Food Preparation

Single Lesson

Introduction

In previous lessons in Units 4 and 5 , the pupils have become more aware of and gained a clearer understanding about how food is processed, preserved and stored. This unit, brings the food a step closer to the table as we investigate the different methods of food preparation and outline the guidelines to ensure safe handling in the kitchen.

Links to the Syllabus

This lesson is closely linked to section 1.3.10 in the Leaving Certificate Home Economics Social and Scientific syllabus " Food Safety and Hygiene: reheating procedures, personal hygiene and food hygiene" (Department of Education and Science, 2001).

Background Information

Personal Hygiene:

Hands should be washed thoroughly before food preparation, after going to the toilet, and after handling pets and raw food. Use soap and warm water, rubbing for at least 30 seconds.

Long hair should be tied back or a hair net worn. An apron should also be worn to protect your clothes.

Food Safety and Hygiene

Always check your food ingredients for wholesomeness before you start. The use-by-date, the look and the smell are excellent indicators that the item has not spoiled. Don't thaw foods at room temperature. Thaw frozen food completely in the refrigerator, or in a microwave oven if cooking immediately.

Keep food clean by avoiding cross-contamination. Keep dirty preparation activities well away from clean or cooked food. Do not share utensils, plates and chopping boards between dirty operations and clean cooked food. In between handling raw and cooked foods, wash utensils such as tongs, knives and chopping boards with hot soapy water. Make sure that utensils and equipment are always clean.

Cross-contamination

It is a good idea to present the idea bacteria as hitch-hikers to help the pupils understand this concept. These hitch-hikers can be carried around and deposited wherever contact is made. A dirty knife will deposit bacteria on freshly cooked meat. Dirty hands will deposit bacteria on the next sandwich you make. A dirty chopping board, which has just had raw chicken on it, will transfer those bacteria to your lettuce if you choose to use it without washing and sanitising first. The raw meat in the refrigerator is dripping juices (and bacteria) on to the food stored below. There are enormous opportunities for bacteria to move around your kitchen if we allow them to. Cross contamination is preventable and encompasses good cleaning practices, good personal hygiene practices and some organization to keep raw foods and

contaminated utensils away from cooked and ready-to eat foods. No contact, No transfer of bacteria.

Possible Activities

It may be a good idea to source a poster perhaps similar to those seen in a deli counter or in a hospital where it clearly outlines the proper technique to wash hands. If this is not possible, simply print one from a trusted internet site. This may be more effective for the pupils than a method that is simply outlined by the teacher.

When discussing food preparation techniques, chopping may be considered. If so, it is important to explain to pupils how chopping vegetables with a blunt knife reduces the nutritional value as more cells are damaged than if a sharp knife was used.
To remind pupils what a cell looks like and how it could be damaged, a possible activity could be to repeat the onion cell investigation using a microscope as in the present Junior Certificate Science syllabus "OB44- Prepare a slide from plant tissue and sketch the cell under magnification" (Department of Education and Science, 2001). This would allow the pupils to recognise how the nutrients within a cell would be lost if more cells than necessary were damaged by using a blunt knife.

Helpful Sources of Information

Safe method of hand-washing:
http://www.sproutnet.com/Reports/safe_hands.htm

Information about HACCP:
http://haccpalliance.org/

Food Preparation precautions
http://www.bordbiavantage.ie/bordbia/preview.asp?pid=4&mid=58&cid=93&id=93

Lesson 2

How cooking changes food

Double Lesson

Introduction

In this lesson, we look at different methods of cooking. We will investigate if we are using the correct cooking methods and consider why some methods are used more often than others. We will then investigate the effect of heat on food and the different changes and effects that it has on different types of food. The experimental investigation in this lesson involves the simple process of poppinf pop corn. However, through inspection, the pupils will gain a clearer understanding of the scientific principles causing the change in physical structure of the kernels.

Links to the Syllabus

This lesson incorporates the aims of the Junior and Leaving Certificate courses as it encourages "the development of manipulative, procedural, cognitive, affective and communication skills through practical activities" (Department of Education and Science, 2001)

Background Information

Below is a table providing a brief desriptive outline of some of the most popular cooking methods. More similar information may be found in any Junior Certificate or Leaving Certificate Home Economics book.

Cooking Method	Description	Equipment	Suitable foods
Stewing	A slow, moist method of cooking in a little liquid in a covered cooking pot	Heavy saucepan with a tightly fitting lid	Tough meat, fruit
Boiling	Cooking food in bubbling liquid	Saucepan, sometimes with a lid	Pasta, rice, meat, vegetables
Steaming	Slower method of cooking food in steam rising from boiling water	Steamer saucepan	Fish, puddings, vegetables
Roasting	Cooking food in an oven using hot fat	Roasting tin	Meat, poultry, vegetables e.g. potatoes
Deep frying	Cooking the food in a deep pan with enough oil to completely cover all of the food	Deep fat fryer	Chips, sausages, chicken nuggets etc.
Grilling	Quick method of cooking food under direct rays of heat	Grill and grill pan.	Tender cuts of meat, some fruit and vegetables

Baking	Cooking food in dry heat in an oven	Baking tins, cake tins, ceramic and pyrex dishes	Fruit, potatoes, bread, cakes and buns.
Microwave cooking	Heat builds up inside of the food because the particles in the food vibrate quickly. The heat then spreads throughout the food causing it to cook.	Microwave cookware, cling film, microwave. Do not use metal containers	Cooks most fresh food. Thaws frozen food, reheats cooked food. Fish is not suitable for microwave use.

Many factors can affect the method of cooking that is chosen. The first and perhaps most obvious reason is the availabilit of the necessar equipment. The amount of time needed also needs to be considered. E.g. steaming vegetables will take longer than boiling where more nutrients will be lost to the boiling liquid. Therefor, the possible nutrient loss should also be considered.
Personal preferences such as flavour, texture and appearance will also be determining factors e.g. a boiled potato tastes and looks different than a roast potato.

<u>What makes the popcorn 'pop' ?</u>

This experiment was adapted from an experiment written by Marissa B. Sherman and Thomas A. Evans and edited by Erika K. Jacobsen and Julie Cunningham, "Popcorn – What's in the bag?", Journal of Chemical Education, 83 (3) , March, 2006.

Safety Issues and Considerations
When popcorn is heated in a microwave oven, the bag and its contents get very hot. Use caution when handling the bag. Heating popcorn too long in a microwave oven can cause the popcorn and/or the bag to burn.
Wear gloves and goggles when handling the povidone–iodine solution when testing for starch in the second part of the experiment.

By providing the pupils with the diagram of the kernel, the pupils may then be better able to understand the structure of the popcorn and what causes it to pop when heat is applied.

Popcorn and its "popping" mechanism are well understood (1). Water is central to the popping process: a starch/water mixture inside an unpopped kernel becomes gelatinous at high temperatures, the vapor pressure of superheated water bursts the kernel, and the cooling effect of evaporating water transforms a liquid foam into a solid foam. Water's role as a polar solvent is also demonstrated as a starch-based popcorn flake dissolves in water but vegetable oils do not.
Microwave packaging for popcorn is influenced by the role of water. The aluminum susceptor improves the efficiency of heating water in the kernel and the bag's heat-sensitive adhesive allows water vapor to escape during popping.

Recommendations
Povidone-Iodine Solution is recommended for use in this experiment. It is available in the First Aid sections of Chemists or in a supermarket (it is often used as an antiseptic wash). It is a 1% iodine solution in which povidone, a vinylpyrrolidone polymer, forms a water-soluble complex with iodine. When a few drops of the solution are added to a mixture of flakes in hot water, the brown color of Povidone-Iodine Solution turns to purple.

Minimising Bacteria in the thawing and cooking of meat:

Safety Issues and Considerations:
Hands should be washed thoroughly before and after handling raw meat.
Safe Disposal of Plates:

At the conclusion of the experiment, all plates should be disinfected for safe disposal. The best way to dispose of bacterial cultures is to pressure-sterilize (autoclave) them in a heat-stable biohazard bag.

If autoclaves or pressure cookers are not available, an alternative is to bleach the plates. Wear proper safety equipment (gloves, lab coat, eye protection) when working with the bleach solution; it is corrosive. Saturate the plates with a 20% household bleach solution (in other words, one part bleach and four parts water). Allow the plates to soak overnight in the bleach solution before disposing of them. Please note that the bleach solution is corrosive and needs to be thoroughly rinsed afterwards.

This experiment enables pupils to understand the following terms and concepts:
1. Colony Forming Unit (CFU)
2. Serial dilution.

One way is to homogenize a sample of meat in a blender, dilute the sample, and then plate it on a bacterial culture plate. The plate is then incubated overnight (or longer), and visible colonies of bacteria are then counted. The goal is to dilute the sample sufficiently so that individual bacteria are separated from one another on the plate, meaning that each colony will have arisen from individual bacteria—referred to as a *colony forming unit* or CFU.

Typical laboratory cultures have between 10^6 and 10^9 bacteria/ml, and for plating bacteria, you typically use a volume of 100 μL (which is the same as 0.1 ml). So if you simply took your sample straight from the culture, you'd expect to have between 10^5 and 10^8 (100,000 to 100,000,000) bacteria in your 100 μl sample. You would end up with far too many colonies to count! In fact, the plate would be so densely covered that you wouldn't be able to distinguish individual colonies.

To get around this problem, the obvious solution is to dilute the sample. If you wanted to end up counting about 100 colonies per plate, then you'd need to dilute between 1,000– and 1,000,000-fold. It's not practical to make such large dilutions in a single step, so a good way to do this is by using *serial dilutions.*

The serial dilutions are continued until the desired final dilution is achieved. In order to calculate how many bacteria were present in the original solution, you count colonies on the plate, and then multiply by the total dilution factor. You can see that it is important to make the volume measurements accurately and reproducibly for this process. Errors in measurement will cause errors in the bacterial count.

Possible Variations:

For a more advanced project, you should try to determine the reliability of your bacterial counts. One way to do this would be to repeat the counts multiple times (minimum of three replicates). Since the serial dilution process can introduce considerable error into the counts, you would need to do a separate serial dilution for each count. Then you can take the average of your counts, and the standard deviation will give you an estimate of your error.

You could expand the experiment to include different types of meat. Are some types of meat more prone to contamination than others?

Helpful sources of Information

The effect of cooking methods on the nutritional value of green vegetables:
http://www.sciencedirect.com/science?_ob=ArticlURL
Why does popcorn pop?
http://amos.indiana.edu/library/scripts/popcorn.html
Bacteria on meat:
http://www.usc.edu/CSSF/History/2004/Projects/J1315.pdf.

Lesson 3

Why Heat what we eat?

Single Lesson

Introduction

There are eighty million species on earth (about 700,000 of which are animals) that thrive on raw food. Only humans apply heat to what they eat! Humans on average as a race, die at or below half their potential life span of chronic illness that is largely diet and lifestyle related. Domesticated pets also are fed cooked, processed, packaged food that likewise is denatured by heat. As a consequence, they suffer human-like chronic ailments including cancer, arthritis and other degenerative diseases.

In previous lessons in this unit, we have investigated the dangers of raw food and the safe methods of handling and preparing raw food. However, in this lesson, we will take a look at some of the disadvantages of heating and over cooking food. This will hopefully remind pupils that there are disadvantages and advantages to almost everything!

Links to the Syllabus

This lesson links to section 1.3.3 "Meal management and Planning" and section 1.3.4. "Food Preparation and cooking processes" (Department of Edcuation and Science, 2001). The investigation of the Raw Liver as a catalyst introduces the pupils to Section 6 of the Leaving Certifcate Chemistry Course; "Rates of Reaction" (Department of Education and Science, 1999)

Background Information

Denaturation

Cooking denatures protein. According to Encyclopedia Britannica, denaturation is a modification of the molecular structure of protein by heat or by an acid, an alkali, or ultraviolet radiation that destroys or diminishes its original properties and biological activity. Denaturation alters protein and makes it unusable or less usable. Protein molecules are readily altered by heat. Unlike simple organic molecules, the physical and chemical properties of protein are markedly altered when the substance is boiled in water. All of the agents able to cause denaturation are able to break the secondary bonds that hold the chains in place. Once these weak bonds are broken, the molecule falls into a disorganized tangle devoid of biological function.
The most significant effect of protein denaturation is the loss of its biological function. For example, enzymes lose their catalytic powers and hemoglobin loses its capacity to carry oxygen. The changes that accompany denaturation have been shown to result from destruction of the specific pattern in which the amino acid chains are folded in the native protein.

In the case of egg white, a gel or coagulum is formed when heat is applied, thereby forming enzyme resistant linkages that inhibit the separation of constituent amino acids.

Coagulation

You can see coagulation of protein take place on a macroscopic level when you fry an egg. The clear protein gel surrounding the yolk whitens, thickens, and coagulates into a glue-like consistency. Digestive enzymes (peptones and proteases) cannot readily break down coagulated protein molecules once they fuse together. Not only are heated proteins unavailable to your body, worse yet: the indigestible, coagulated protein molecules tend to putrefy as bacteria in the body feed upon this dead organic matter. Bacterial enzymatic by-products are carcinogenic. Coagulation occurs on a microscopic level in all cooked protein molecules whether witnessed or not.

The demonstration in this lesson shows the formation of a skin on the surface of the heated milk when it is not stirred. This is because the proteins coagulated (stuck together) as they were heated. Pupils should recognize that stirring prevents coagulation.

Comparing Cooked and Raw Liver:
This investigation uses the same scientific principle of the Iodine Snake as used in the Leaving Certificate Chemistry course.
The hydrogen Peroxide is decomposed by the raw liver to form water and oxygen forming a large erruption in the graduated cylinder. When the cooked liver is used the reaction does not take place. This demonstration illustrates how the catalysts in the liver are de-activated on cooking. This is one of the effects of heating and cooking food.
This experiment can also be altered to observe the effect of adding more or less of the catalyst (raw liver) and the effect this has on the reaction.

Helpful Sources of Information

The Raw food Diet
http://alissacohen.com/books.html

Dangers of micro-waved food:
http://www.relfe.com/microwave.html

Does cooked food contain less nutrition?
http://www.beyondveg.com/tu-j-l/raw-cooked/raw-cooked-2a.shtml

Image Sourced: www.questacon.edu.au

Unit 7 - Mmm … Tasty

In previous units, we have examined food from its' source to processing and packaging, to it's cooking and preparation. In this unit, we have brought the food closer to the table.
We will explore the sense of taste and the science behind what makes your mouth water with the thought of your favourite food. We will also investigate why that same food may cause someone else to gag! Other interesting questions will also be answered such as "how can the smell of a food make you hungry?"

Lesson 1

Tasting the Difference

Single Lesson

Introduction

In this first lesson, we will begin by helping the pupils to understand the importance of taste in our lives. Have you ever imagined how it would be if all food tasted the same? What influences the taste of food? Why do some people add vinegar to their chips while others don't? The pupils will also investigate how accurate their tastebuds actually are in a triangle sensory test.
The reference to the different taste of cooked and raw food can also be linked to the final lesson in the previous unit.

Links to the Syllabus

This lesson links to the sensory system section 1.B.3. as pupils develop an "awareness and response to surroundings through sense organs". (Department of Education and Science, 2003). This lesson helps the pupils to recognise Science as a tool of enquiry.

Background Information

Sensory science is a scientific method used to "measure, analyze, and interpret human responses to products as perceived through their senses of touch, taste, sight, smell, or sound." Sensory science is often used to improve existing products or to test people's views on new products, such as the softness of tissues, the crunchiness of an apple variety, or the aroma of air fresheners. It is also used to test the taste and color acceptance of new products, such as purple ketchup, or the sound characteristics of products, as in the crunch of snack foods. There are many different types of sensory tests. Attribute

Difference tests ask: How does a certain quality or trait differ between samples?
Affective sensory tests ask: What is the consumer acceptance of a product(s)?
Overall Difference tests ask: Does a sensory difference exist between samples?
A Triangle test (as is used in this lesson) is a type of Difference test to determine if there is a sensory difference between two products. For example, a researcher may want to see if changing one ingredient in a recipe to make a certain food product will affect the taste of the final product. Three coded samples are presented to each panelist, and each panelist is asked to pick out which sample they feel is different from the other two. There are also sensory tests which panelists have to be trained to detect taste thresholds (such as determining the concentration of a flavour which can be identified by the panelist when introduced into a food product) or to have trained panelists describe certain characteristics that researchers are interested in studying.

Sensory tests have to be conducted under controlled conditions to reduce bias (prejudice or influence) on how panelists view the product(s). The sensory room has to be free from distractions (sound, odors) to not influence people's decisions of the product. Sensory testing laboratories are able to adjust the lighting, air regulation, and individual booths according to the needs of each sensory test that is conducted.

Samples also have to be presented in a random order and assigned product codes, such as three-digit sample numbers, to keep food products anonymous to further reduce influencing the panelists' decision. The sensory test measures if any differences detected are truly significant by analyzing the sensory data for statistical significance. After statistical analysis, the researchers can make a meaningful interpretation from the results of the sensory data.
More information can be found in the book recommended with the other sources of information.

Triangle Sensory Test
The following experiment was adapted from a similar experiment prepared as part of the University of Maine's NSF GK-12 project by NSF Fellow Beth Calder, Mary Ellen Camire, and Susan Brawley.

Safety Issues and Considerations
This investigation requires the pupils to taste the food samples. As a teacher, you must respect that all taste tests have to be completely voluntary. You should also be aware of any possible allergies in the class that may affect this investigation. Because this essentially is a taste test, it cannot be carries out in the Science lab. The Home Economics room would be an ideal safe setting for the lesson if available.
It is important that the pupils do not speak to each other during the test, as this may influence their decisions.

This experiment, unlike many others, relies a lot on the accurate preparations of the teacher. The products to be used should be tasted beforehand, to ensure there is some valid difference in taste.
It is important that the samples are numbered with random three digit codes to ensure the pupils cannot recognise any trend in the coding system.
It is important to have the ballot table prepared for the pupils (as in the Student Handout) as many pupils may not have much prior experience in taste tests. All ballot sheets must be identical. (unless specific pupil needs require differently).
When the test is completed, you should be able to reveal four numbers to the class; two of which had labelled the regular biscuits and two of which had labelles the low-fat biscuits.
From this information, the pupils will be able to correct their ballot as accurate or inaccurate. Make a note on the board of how many pupils were accurate in their tastings and how many were not. Hopefully, this should lead to an interesting classroom discussion.

Possible Variations
A similar investigation could be carried out using low fat and full fat cheese for example, or any other suitable food product which may taste different, but has the same appearance.
Two similar biscuits made from different manufacturers could be compared to see if the pupils could recognise a difference.

Take Home Activity
Disorders of taste and smell generally have been difficult to diagnose and treat, often because of a lack of knowledge and understanding of these senses and their disease

states. An alteration in taste or smell may be a secondary process in various disease states, or it may be the primary complaint.

Although often discounted and overlooked in the basic examination, deficiencies in taste and smell can cause anxiety, depression, and even nutritional deficiencies due to decreased enjoyment of food.

Loss of smell and/or taste may be life threatening, impairing detection of smoke in a fire or ability to identify spoiled food!

The disorders of smell are classified as "-osmias" and those of taste as "-geusias."

- Anosmia - Inability to detect odors
- Hyposmia - Decreased ability to detect odors
- Dysosmia - Distorted identification of smell
    - Parosmia - Altered perception of smell in the presence of an odor, usually unpleasant
    - Phantosmia – Perception of smell without an odor present
    - Agnosia - Inability to classify or contrast odors, although able to detect odors
- Ageusia - Inability to taste
- Hypogeusia - Decreased ability to taste
- Dysgeusia – Distorted ability to taste

Smell and taste disorders can be total (all odors or tastes), partial (affecting several odors or tastes), or specific (only one or a select few odors or tastes).

Helpful Source of Information

Meilgaard, M, Civille, GV, Carr, BT. 1999. *Sensory Evaluation Techniques*. 3rd ed. Boca Raton: CRC Press LLC.

Disorders of Taste and smell
http://www.emedicine.com/ent/topic333.htm

Lesson 2

Can you taste with just *your mouth?*

Double Lesson

Introduction

One lick of your tongue and you know if it's yucky or good. How does this little muscle in your mouth give you so much information? The surface of your tongue is covered with thousands of tiny bumps. In this lesson, the pupils will learn more about these little bumps and how they actually work. Taste buds can detect four basic kinds of taste: sweet, sour, salty, and bitter. When you take a bite of food, the food spreads over you tongue. Taste buds detect chemicals in the food and send signals to your brain. In this lesson, you will be involved in investigations to recognize how many of our senses are actually used when we 'taste' food!

Links to the Syllabus

This lesson links to the sensory system section 1.B.3. as pupils develop an "sensory and motor functions of nerves". (Department of Education and Science, 2003). It links closely to the Leaving Certificate Biology syllabus requirments and enhances the knowledge learned at Junior Certificate level. This lesson again helps pupils to understand sensory Science.

Background Information

Smells can reach the olfactory epithelium by two routes.

The first route, *orthonasal olfaction*, is the detection of a scent through the nostrils by sniffing or inhalation.

The second route, *retronasal olfaction*, is the detection of a scent when it is released from food in your mouth during chewing, exhalation, or swallowing. During this process, the smell passes through the back of the nose.

Once in the olfactory epithelium, the odour molecules bind to olfactory receptors, which are expressed in olfactory sensory neurons in the nose. Once an odourant binds to the receptor, the olfactory receptors trigger a series of signals to the cells' interiors that ultimately results in the opening and closing of ion channels. The opening of the ion channels increases the concentration of positive ions inside olfactory cells. This depolarization causes the olfactory cells to release tiny packets of chemical signals called neurotransmitters, which initiate a nerve impulse. Odor information is then relayed to many regions throughout the brain. Each odorant binds to a unique combination of olfactory receptors, which means that a unique signal is sent to the brain for each odorant. In fact, there are at least 400 functioning olfactory receptors, which is why we can smell hundreds of smells!

Can you taste with your nose and eyes?

Safety Issues and Considerations

This investigation requires the pupils to taste the food samples. As a teacher, you must respect that all taste tests have to be completely voluntary. You should also be aware of any possible allergies in the class that may affect this investigation. Because this is a taste test, it cannot be carries out in the Science lab. The Home Economics room would be an ideal safe setting for the lesson if available.

It is important that the pupils do not give feedback to each other during the test, as this may influence their decisions.

Multi-cellular animals have nervous systems that generate behavior. Nervous systems are formed from specialized cells that conduct signals rapidly through the long cell extensions that make up nerves. The nerve cells communicate with each other by secreting specific excitatory and inhibitory molecules. In sense organs, specialized cells detect light, sound, and specific chemicals, and enable animals to monitor what is going on in the world around them. In this same way, humans can taste and smell food and drink. These sense organs send messages to the brain through a system of neurotransmitters to allow the pupil recognize the flavour that they believe to have tasted.

Possible Activities

A good introductory activity for the class, may be for the pupils to look at their tongues in a mirror to recognize and clearly see the 'bumps' and taste buds that will be referred to throughout the lesson. This activity depends on the availability of small mirrors for the pupils and the pupils' level of maturity.

Another investigation could be carried out in conjunction with this lesson, (or within the lesson, if time permits) to highlight how the appearance of food and drink also influences our taste:

"Is seeing Believing"

This simple experiment requires the teacher to add a few drops red food colouring to one bottle of 7-Up (or water). This gives the appearance of a raspberry or strawberry flavour.

A few drops of red and blue food colouring should be added to another bottle of 7-Up (or water). This gives the appearance of blackcurrant flavoured drink.

Allow each pupil to taste each anonymous drink. (Don't present the drinks to the pupls in the 7-Up bottles.)

Ask the pupils to guess the flavour of each drink.

Both drinks should actually taste the same as the colouring should not alter the taste. The revelation should impress the pupils. How many of them were convinced by their eyes rather then their tongue or nose?

This investigation could also be carried out with a sample of flavoured water e.g. Strawberry flavoured water. One sample could be coloured and the other left clear. How many of the pupils would recognise that the water actually tastes the same?

Helpful Sources of Information

Chandrashekar, J, Hoon, MA, Ryba, NJ, Zuker, CS. 2006. The receptors and cells for mammalian taste. Nature 444: 288-294.

Halpern, BP. 2004. Retronasal and orthonasal smelling. ChemoSense 6(3).1-7.

Lawless, HT and Heymann, H. 1998. Sensory Evaluation of Food: Principles and Practices. New York: Chapman & Hall.

Lesson 3

Why Taste at all?

Single Lesson

Introduction
This lesson takes a closer look at what happens food after it passes from our mouth. We will take a close look in particular at how proteins are broken down.

Links to the Syllabus
This lesson links ot Section 3.3.4. of the Leaving Certificate Biology course "Explanation of the mechanical breakdown and transport of food" (Department of Education and Science, 2001)

Background Information

Digestive System:
Anus - the opening at the end of the digestive system from which feces exit the body.
Appendix - a small sac located near the start of the large intestine.
Esophagus - the long tube between the mouth and the stomach. It uses rhythmic muscle movements (called peristalsis) to force food from the throat into the stomach.
Gall bladder - a small, sac-like organ located by the duodenum. It stores and releases bile (a digestive chemical which is produced in the liver) into the small intestine.
Large intestine - the long, wide tube that food goes through after it goes through the small intestine.
Liver - a large organ located above and in front of the stomach. It filters toxins from the blood, and makes bile (which breaks down fats) and some blood proteins.
Mouth - the first part of the digestive system, where food enters the body. Chewing and salivary enzymes in the mouth are the beginning of the digestive process (breaking down the food).
Pancreas - an enzyme-producing gland located below the stomach and above the intestines. Enzymes from the pancreas help in the digestion of carbohydrates, fats and proteins in the small intestine.
Rectum - the lower part of the large intestine, where feces are stored before they are excreted from the body.
Small intestine - the long, thin winding tube that food goes through after it leaves the stomach.
Stomach - a sack-like, muscular organ that is attached to the esophagus. When food enters the stomach, it is churned in an acid bath.

Does the Concentration of Pepsin Affect How Thoroughly Proteins Are Digested?
Tube 3 (5 ml pepsin- HCl mix + two drops HCl to pepsin solution) displays the most consistent results. Each protein absorbs most of the solution and was fairly broken down after the 24-hour period. This is because in the presence of HCl, pepsin changes into its active form: pepsinogen (the key enzyme involved in protein digestion in the stomach).
The least effective was Tube 4 (5 ml of pepsin solution plus two drops of 0.5%

sodium carbonate). This may be due to the fact that sodium carbonate can increase the stomach pH turning it from an acid to alkaline.
The results of Tube 1 (5 ml of pepsin solution) make sense since pepsin, without the presence of HCl cannot truly digest food.
The results of Tube 2 (5 ml of 0.4% HCl) can be explained in that HCl serves to break down foods as opposed to truly digesting them, which is the task of pepsinogen.
Overall, the most efficient digestive solution was Tube 3.

Helpful Sources of Information

Digestion of proteins:
http://www.usc.edu/CSSF/History/2005/Projects/S0413.pdf

Image sourced: http://www.comesatradehub.com/images/products/848504901.jpg

Unit 8 - Milk it!

In this synoptic unit, we will review and combine all of what has been learned, investigated, debated and discussed in the past seven units.

Through the study of the Science of Milk, we will explore its' nutritional value and composition, the different types of milk available to the consumer, how milk can be treated and processed into other dairy products.

We will investigate the production method and storage guidelines for these products. Could you make cream, butter, yoghurt or cheese at home?

Lesson 1

Just Milk

Single Lesson

Introduction

In this lesson, we will take a closer look at one of the main food comodities found in almost everyone's fridge at home. What nutritional value does milk provide?
How many different types of milk are available to the consmer?
We will also carry out a taste test to see if subjects can identify different types of milk!

Links to the Syllabus

His final unit aims to "extend and deepen the range and quality of the young person's educational experiences in terms of knowledge, understanding, skills and competencies" (Department of Education and Science, 2003). An overview of the main skills and knowledge learned throughout the module should help the pupils to conclude with a clear understanding.

Background Information

Importance of milk in our Diets

Babies need breast or formula milk as this is the only form of nutrition they receive for the first months of their lives. Children and adolescents need a concentrated form of animal protein as they are growing rapidly. Milk is easily digested. Children and adolescents can also gain energy from the fat (cream) and sugar (lactose) in milk. Pregnant and nurseing mothers require caciumand Vitamin D for bone formation and as a source of protein for the foetus, placenta and for milk production. If a pregnant woman has insufficiant calcium, it will be drawn from her own bones and lost during breat feeding. Over repeated pregnancies, this may lead to osteoporosis.
Elderly people require the digestable protein available from milk for the repair and replacement of damaged cells. Calcium, vitamin D and phosphorus prevent osteoporosis in this group. One glass of milk provides 1/5 of their R.D.A. of calcium. Covalescents can drink watered milk to prevent dehydration and to provide them with animal protein to repair diseased, damaged and wasted tissue. Milk is an alkaline so it should not upset the digestive system.

Milk Treatments

Homogenisation	This is the even distribution of fat globules throughout the milk, by forcing the milk through very tiny holes that break up the fat globules and disperse them evenly throughout the milk. Although, this is not a heat treatment, it does help the milk to last longer as it improves texture and flavour.
Pasteurisation	This is the most lidely used milk treatment. The milk is heated to 72ºC for 15 seconds and then cooled rapidly. This helps the milk to last longer as all of the pathogenic and some of the scouring bacteria are destroyed. However, the B vitamin, Thiamine is destroyed in this process and the taste is alterled slightly.
Ultra Heat Treatment (UHT)	This is the long life milk used on aeroplanes, ships and trains etc. In this process, the milk is heated to 132ºC for 1 second and then cooled quickly and put into sterile containers. This milk can last for months as all spores, pathogneic and scouring bacteria are destroyed. However, all of the B group vitamins are destroyed and the taste is altered greatly.
Evaporation	Evaporated milk is mainly used in desserts. It is pasteurised milk which is evaporated to half its' volume, them homogenised, sealed in cans and heat treated to 115ºC for 2 minutes. The B vitamins are lost but the milk keeps indefinitely.
Dehydration	Dried milk is useful when fresh milk is not available. It can easily be made up using water. In this process, firstly the milk is homogenised and then evaporated to 60% of its' volume. The milk is then either roller or sprayed dried and the remaining water is evaporated off. All of the vitamins and some of the amino acids are lost. The flavour is also altered.
Condensed Milk	This milk is also use din makin desserts such as Banoffi pie. Most of the B vitamins are lost in the process where pasteurised milk is evaporated to 1/3 of its' volume, then homogenised and 40% sugar is added. It is then sealed in cans and heated to 115ºC for 15 minutes. The extra 40% sugar that is added makes it very sweet and very high in calories.

Storage of Milk

Milk should be stored in a fgridge between 2ºC and 4ºC. you should check the date on the carton before buying. Older milk should always be used first. Old and new milk should never be mixed.

If milk is delivered, it should be taken indoors as soon as possible, since the sunlight can cause the milk to turn sour and also damage the B vitamin, Riboflavin which is sensitive to light.

Buttermik and cream can absorb flavours, so they should be covered and stored away from strong smelling foods in the fridge. Milk jugs and cartons should be rinsed with cold water as hot water will cause the protein to coagulate making them more difficult to wash.

Nutritional Significance

Protein 3.5%	Animal origin, contains most of the essential amino acids, 95% Biological value. Main proteins are caseinogen (which is converted to casein in the stomach by rennin, and then combines with calcium to form calcium carbnate), lactalbumin and lactoglobulin.
Fats 4%	Form on the top of milk as cream. Milk contains the fatty acids; oleic and butryic. These are saturated fats. Milk is emulsified by a natural agent- lecithin (which is a type of cholesterol)
Carbohydrtates 4.5%	Milk contains the disaccharide- Lactose. This is the least sweet of all the sugars. Milk is the only food in which Lactose is found naturally. As milk turns sour, the lactose turns to lactic acid.
Minerals 0.7%	Calcium, Phosphorus in large amounts and Potassium and Magnesium in small amounts.
Vitamins	Fat soluble vitamins A and D Water Soluble B Group vitamins (Riboflavin, Thiamine and Niacin) The amount of Vit D increases in the Summer as cows are in the sun. The amoun tof Vit A also increases in the Summer as the availability of green grass also increases for the cows.
Water 87%	Milk is a quite bulky food as it is almost 90% water!

Scenario:
The machine for printing labels for the Full-fat, Skimmed and Buttermlk cartons has ran out of ink.
The Creamery is now left with three pallats of unlabelled and unidentified cartons of milk.
One carton from each batch has been dropped into the Home Economics room.

There are intentionally no guidelines or helpful hints in the Student Handout for this scenario.
You may provide guidelines depending on the level of aility of your own class.
It is expected that the pupils should be able to set up a Sonsory test in the Home Economics room using their experience from the tests they participated in as part of Unit 7.

The milk samples should be presented to the pupils as Milk A, Milk B and Milk C. As the teacher, you should have made note of the true identification of each sample.

It would be recommended for the pupils to work in pairs for this investigation

Materials needed per pair of pupils:

- A labeled glass of each milk sample
- 6 plastic cups (3 for each pupil)
- 3-4 crackers and a cup of water (to clear the palate after each tasting)
- A tasting card
- Biro

Sample Tasting card:
The pupils should be encouraged to design their own as a class

Milk I.D. Test

Sample:	Milk A ↓	Milk B ↓	Milk C ↓
Type of milk as identified by the Sensory Test:	_____	_____	_____

Pupils should recognise the benefit of using their nose and eyes as well as their tongue for this *Sensory* Test as the Buttermilk may be identified correctly even without tasting.
The pupils will have to co-operate as a class to co-ordinate their results to decide on the final identification of each milk sample as determined by the majority of the results.

Possible Variations
If time or resources don't allow for the Sensory Taste to take place, the pupils should at least make a class plan of how the test would be carried out.

It may also be a good idea to divide the pupils into groups with different responsibilities e.g. Organising the sensory stations, designing the Sensory Test Card, collecting the results, counting the results, presenting the results to the class, tidying up etc.

Other types of milk could also be used in the taste test e.g. Soya Milk, Goat's milk etc. These may be easier to recognise and identify.

Helpful source of Information
National Dairy Council
http://www.ndc.ie/

Lesson 2

What can we make from milk?

Double Lesson

Introduction
In this lesson, we will take a closer look at milk as a natural food and discover the many possible ways in which it can be processed into different dairy products. Where are dairy products manufactured? Could some of these techniques be repeated in the school Home Economics room or at home?

Links to the Syllabus
This lesson links to section 1.3.5 "Food Processing and Packaging" (Department on Education and Science 2001) as pupils explore and gain anunderstanding of each of the steps involved in the production of many dairy products.

Background Information
Allergy to Dairy Produce
Lactose is a sugar found naturally in milk. It's important to distinguish between lactose intolerance and milk allergy, because milk allergy can cause severe reactions. Lactose intolerance is caused by a shortage of the enzyme lactase, which is needed to break down lactose so it can be absorbed into the bloodstream. When someone doesn't have enough of this enzyme, lactose isn't absorbed properly from the gut, which can cause symptoms such as bloating and diarrhoea.
An understanding of such allergies will help pupils to appreciate the necessity of the wide range of milk products as discussed in the first lesson of this unit e.g. Soya Milk.

Making Your Own Butter

Safety Issues and Considerations
If the pupils intend on tasting the butter that they make, the butter will have to be made outside of the Science lab. The home Economics kitchen would be a suitable setting for this lesson.
Cling film or greaseproof paper would be recommended to use to wrap the butter if the pupils wish to bring it home with them.

You may use your own discretion on how much cream is used by each group as this will deterine the amount of butter made. However, purchasing this much cream may be expensive, so perhaps the pupils could bring in their own.
Double cream as it is much thicker is more suitable for butter making that regular pouring cream.
Stabilisers in commercial butter help it to last longer than home-made butter.
It is important that all of the buttermilk is removed from the butter as this may cause the butter to go rancid!

Possible Variation
The use of the food processors greatly speed up the process to facilitate time management in the classroom. However, it may be a worthwhile demonstration to have one group of pupils to make the butter in a jar with a sealed lid by simply

shaking the jar. This mehod may help the pupils to see the change in the structure cream to butter more easily.

Making Ice-cream in a bag:

Safety Issues and Considerations:
Like the other experiments involving food, If the pupils wish to taste their ice-cream after making it, it cannot be made in the Science lab.

Ice has to absorb energy in order to melt, changing the phase of water from a solid to a liquid. When you use ice to cool the ingredients for ice cream, the energy is absorbed from the ingredients and from the outside environment (like your hands, if you are holding the baggie of ice!). When you add salt to the ice, it lowers the freezing point of the ice; so even more energy has to be absorbed from the environment in order for the ice to melt. This makes the ice colder than it was before, which is how your ice cream freezes. Ideally, you would make your ice cream using 'ice cream salt', which is just salt sold as large crystals instead of the small crystals you see in table salt. The larger crystals take more time to dissolve in the water around the ice, which allows for even cooling of the ice cream.
You could use other types of salt instead of sodium chloride, but you couldn't substitute sugar for the salt because (a) sugar doesn't dissolve well in cold water and (b) sugar doesn't dissolve into multiple particles, like an ionic material such as salt. Compounds that break into two pieces upon dissolving, like NaCl breaks into Na+ and Cl-, are better at lowering the freezing point than substances that don't separate into particles because the added particles disrupt the ability of the water to form crystalline ice.
The more particles there are, the greater the disruption and the greater the impact on particle-dependent properties (colligative properties) like freezing point depression, boiling point elevation, and osmotic pressure.
The salt causes the ice to absorb more energy from the environment (becoming colder), so although it lowers the point at which water will re-freeze into ice, you can't add salt to very cold ice and expect it to freeze your ice cream or de-ice a snowy sidewalk (water has to be present!). This is why NaCl isn't used to de-ice roads.

Possible Variation:
Ice-cream could also be made using liquid nitrogen . The liquid nitrogen causes the fat and the water particles to stay very small; giving the ice cream it's creamy consistency. The goal is to avoid ice crystals - similar to what you get when you make ice milk. According to food science experts, rapid freezing preserves the nutrients in food (a quick-frozen vegetable that's three months old will likely have a nutrient composition closer to harvest levels than a five day old fresh vegetable. The faster you freeze, the less you destroy tissue structures that could lead to a more rapid loss).

Helpful Sources of Information
Lactose intolerance:
http://www.theallergysite.co.uk/dairy.html

Making Butter
http://www.instructables.com/id/How-To-Make-Butter-and-Buttermilk/

Lesson 3

Careers in The Food Science Industry

Single Lesson

Introduction

In the past 7 units, the pupils have become familiar with the nutritional significance of different food types, how foods can be processed, what can be added or taken away from food in manufacturing etc. Pupils have also learned about safe food storage and different food preparation and cooking techniques.
In this final lesson, the pupils will organise a visit to a local Food Industry e.g. a Creamery (since this final unit has focused closely on milk) and see for themselves the stages in the production line from the cow to the fridge as they have learned about the in tha past weeks.

Links to the Syllabus

This lesson links to section 1.3.1 'The Irish Food Industry' of the Leaving Certificate Home Economics Social and Scientific syllabus as the pupils are involved in collecting "information on a local factory, business or home enterprise and assess how the business fits into the industry structure, how it contributes to the area and the career opportunities it creates" (Department of Education and Science, 2001)

Background Information

There is no standard method of cheese making; limitless variations exist for all stages of the process: pre-ripening, curdling, addition of artificial ingredients and salt for flavour, and aging. This variation in processing accounts for the wide range of cheeses commercially available, differing in texture and flavour. The curd can also be processed with other techniques to make a variety of desserts. However, all processes have one thing in common: the separation of the curd from the whey.

In the production of cheese, fresh milk is pasteurised and then soured converting the lactose to lactic acid, which helps to preserve the cheese.
At 30˚C an enzyme rennin is added. This causes the separation of the solid curd and the liquid whey. The solid curd contains the fat-soluble vitamins, thiamine, coagulated proteins and most of the calcium. The curd is cut to release the whey and heated to 30˚C to expel more whey and help to achieve the correct constituency.
The cheese is then drained further before being cut into blocks, which are pile don top of each other to facilitate draining. This process is called 'cheddaring'. 2% salt is added as a preservative and to add flavour. The salted curd is pressed for 24 hours and then sprayed with hot water.
The cheese is then allowed to ripen at 10˚C for 3-4 months to allow it to develop its' distinct flavour, texture and smell.

It is a good idea when organising a class trip to give responsibility to the pupils. When pupils are involved in the preparation, they will look forward to the visit to the Factory and in return learn more from the whole experience.

Possible Variation
In the Student Handout, it was outlines as a visit to a Creamery to investigate th manufacture of cheese. However, this can vary depending on the suitablility of the visit. A visit to any factory where any type of food production is happening would be beneficial to the pupils after studying and experiencing this Food Science module.

Some Careers in the Food Science Industry:

Advertising Specialist - organizes advertising for print media, coordinates advertising promotions, and is familiar with the food industry
Grocery Store Manager - oversees all grocery store employees, advertising, marketing, and purchases.
Food Processing Worker - a person who works in a food processing plant that has a specific role in creating the finished food product.
Extension Educator - a person who works in the county educating the public on a variety of issues and topics.
Health Inspector - a health department worker who is responsible for inspecting restaurants and cafeterias. They assign a rating for the public to view after each inspection.
Food Technologist - applies science and engineering to the manufacturing process of food development.
Baker - a person who bakes and uses foods such as breads and cakes.
Home Economics Teacher - a person who works in Second Level School and educates students on general food preparation and preservation, general nutrition, and life skills such as cleaning and organization.
Researcher - a person who researches and investigates proposed methods and new discoveries.
Food Broker - a person who buys or sells food for food manufacturing companies.
Food Scientist - applies scientific and engineering principles in research, development, product technology, quality control, packaging, processing, and utlisation of food.
Butcher - a person who slaughters or dresses animals for food; also a dealer in meat.
Food Salesman - a person who markets, represents, and promotes the sale of certain food products for a specific food manufacturing company.
Test Kitchen Manager - a person that manages the employees and work performed in a test kitchen. Test kitchen workers research and develop new food ingredients and products.
Nutrition Aide - a person who works in a nutrition or dietary department and completes a variety of tasks. These tasks may include delivering trays to patients in a hospital or serving food in a cafeteria.
Public Relations - a person who works in the marketing and representation of food products to the general public.
Caterer - a person who provides food and service, for example at large parties or wedding receptions.
Food Demonstrator - a person who demonstrates the preparation of a recipe. Demonstrators may work in a kitchen store, TV stations, or restaurants.
Writer for Newsletter - a person who writes about specific food related topics for newsletters. Topics may include food, restaurant, or recipe reviews, food preparation techniques, or nutrition and wellness advice.
Hospital Food Service - a person who works in a hospital kitchen preparing and

serving food to patients, workers, and guests.
Dietitian - a person who coordinates, plans, and conducts programs to educate patients about nutrition and administers medical nutrition therapy. Dietitians also may oversee a food service operation.
Nutritionist - a person who conducts programs on nutrition; often works in wellness or weight loss clinics.
Farmer - a person, who operates a farm, including raising livestock, planting, and harvesting land.
Stock Person - a person who works with inventory in a food warehouse. This person oversees the entering and exiting of food from a manufacturer's warehouse.
Packer - a person who works in a food processing plant that packs foods in product packaging according to food safety and freshness requirements.
Waiter/Waitress - a person who waits on tables in a restaurant, serving food and drinks.
Statistician - a person who works with the supply and demand of food. Statisticians interpret data to determine percentages.
Truck Driver - a person who transports food either from the farmer to the processing plant or from the processing plant to the grocery store, restaurant, or food market.
Food Service Worker - Prepares salads, sauces, desserts, and entrees according to proper preparation methods. Serves food to customers.
Food Photojournalist - a person who writes about food, recipes, or techniques using photographs as the main story, with small captions underneath

Helpful Sources of Information

Cheese Production form Milk
http://www.eng.umd.edu/~nsw/ench485/lab1.htm

Steps involved in Cheese Production
http://www.frencheese.co.uk/diduknow/history.php?id_art=58&id_topic=18