

GCSE

Edexcel GCSE in Science

There's One Earth

(Context approach)

June 2006

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Support material

Edexcel GCSE in Science  
There's One Earth  
(Context approach)

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## Scheme of work for Topic 7: There's One Earth

Lesson 1: Future fuels							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1b 7.11 C1b 7.2	9H Using chemistry	Production and disposal of substances have environmental impacts.	<p><b>Starter</b></p> <p>Display words associated with fuels on the board (could use a computer to display them one at a time). Challenge pupils to guess the topic of the lesson. Then write down the properties they think make a good fuel.</p> <p>Demonstrate the burning of ethanol and test for the two products with lime water and anhydrous copper sulphate paper.</p> <p><b>Main</b></p> <p>Students burn some fuels and observe and assess their properties. Compare to students' ideas of ideal fuel. Use fuels to heat water.</p> <p><b>Plenary</b></p> <p>Make hydrogen by adding a small piece of magnesium to dilute hydrochloric acid and light it. Discuss a clean fuel for the future.</p>	<p>Experiment 7.1: Observing fuels burn</p> <p>Tin lids, Bunsen burners, tripods, small amounts of fuels such as cyclohexane, wood, ethanol, coal macaroni, sugar magnesium and diluted HCl clamp stands, copper calorimeters.</p> <p>RSC Classic Chemistry Demonstrations 66.</p>	<p>Describe the properties of a useful fuel including: sootiness, colour, heat energy and residue.</p> <p>Explain that the products of complete combustion of hydrocarbons are carbon dioxide and water and energy is released.</p>	<p>PS: 1.2 2.2</p> <p>WO: 1.1 1.2 2.2</p>	<p>Consider asthmatics.</p> <p>Use small amounts of fuel.</p> <p>Check HAZCARDS for all fuels used.</p>
<b>Homework:</b> Following further research, describe all the qualities that make a good fuel and contrast them with the qualities of poorer fuels.							

## Scheme of work for Topic 7: There's One Earth

Lesson 2: Danger — carbon monoxide!							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1b 7.19 C1b 7.20 C1b 7.21	7F about possible effects of burning fossil fuels on the environment and how these effects can be minimised.	Production and disposal of substances have environmental impacts.	<p><b>Starter</b></p> <p>Project or hand the students some sensational headlines, eg 'famous footballer and wife found dead in their flat', 'old boiler kills family of six'. Ask students to suggest the gas responsible. Compile a list of its dangerous properties.</p> <p>Make carbon monoxide.</p> <p>Show the reaction is a dehydration using word and balanced formula equations.</p> <p><b>Main</b></p> <p>Give out pre-prepared boiling tubes of CO for students to investigate solubility and flammability.</p> <p>They should construct word and formula equations for the combustion reaction.</p> <p><b>Plenary</b></p> <p>Discuss how CO is detected and the responsibility of property owners to ensure their boilers are checked.</p>	<p>Demonstration 7.2: Making carbon monoxide.</p> <p>Concentrated sulphuric acid, formic acid.</p> <p>Demonstrate a CO gas detector.</p>	<p>Explain that incomplete combustion can occur in faulty gas appliances and other heating appliances and that this can be dangerous.</p> <p>Explain that incomplete combustion can produce carbon and carbon monoxide.</p> <p>Recall that carbon monoxide is a toxic gas and explain that it lowers the ability of blood to carry oxygen.</p>	C: 1.2 2.1	<p>Check HAZCARDS .</p> <p>Students to wear safety glasses and to work in fume cupboards. And told not to sniff the gas.</p>
<p><b>Homework:</b> Make a poster informing people of the false economy of not having their boilers checked. Make sure that the poster contains relevant scientific information.</p>							

## Scheme of work for Topic 7: There's One Earth

Lesson 3: Global warming							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1b 7.3 C1b 7.1 C1b 7.4	7F about possible effects of burning fossil fuels on the environment and how these effects can be minimised.	Production and disposal of substances have environmental impacts.	<p><b>Starter</b></p> <p>Demonstration: The Greenhouse Effect.</p> <p>Pupils can record the temperatures using thermometers and enter them into a prepared table. The results can be entered straight onto suitable graph axis of temperature against time. Refer to the table on page 169 RSC Classic Chemistry Demonstrations: 67 and, through questions, elicit the idea that carbon dioxide is an important greenhouse gas.</p>	RSC Classic Chemistry Demonstrations: 67.	<p>Explain how burning fossil fuels may lead to global warming.</p> <p>Discuss how the idea of global warming went from a single scientist's idea to a widely accepted theory.</p> <p>Discuss how the composition of the Earth's atmosphere and its temperature have varied over different timescales.</p>	C: 1.1 1.2	Check HAZCARDS for all fuels used.

## Scheme of work for Topic 7: There's One Earth

Lesson 3: Global warming (continued)							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
			<p><b>Main</b></p> <p>Provide groups of students with a set of statements, eg:</p> <ul style="list-style-type: none"> <li>• Burning fossil fuels produces water, carbon dioxide and heat energy.</li> <li>• The heat energy released in combustion of fossil fuels is responsible for global warming.</li> <li>• Driving cars does not increase global warming.</li> <li>• Cutting down rain-forests causes global warming.</li> <li>• Hydro-electricity causes global warming.</li> <li>• Burning coal to make electricity reduces global warming.</li> <li>• Individually we are not responsible for global warming.</li> <li>• All fossil fuels contain only hydrocarbons.</li> </ul> <p>Ask them to agree whether they are true or false. Discuss pupils' answers with them and agree a list of key points.</p> <p><b>Plenary</b></p> <p>Provide pupils with a jumbled up timeline of climate change and get them to put it in chronological order.</p>	<p>Subscription needed for New Scientist website.</p> <p>A timeline can be found at <a href="http://www.newscientist.com">www.newscientist.com</a></p> <p>You can then also get the students to highlight the references to temperature. They can then add information about how the composition of atmospheric gases has changed over that time period.</p> <p>Video: The Greenhouse Effect.</p> <p>Phillip Harris B6A29634.</p>			
<p><b>Homework:</b> Jean-Baptiste Fourier was an important contributor to the idea of global warming. Find out when he made his prediction about climate change. He was not an environmental scientist. Find out in which area of expertise he was famous. Write an obituary for an environmental newspaper.</p>							

## Scheme of work for Topic 7: There's One Earth

Lesson 4: Global warming — Part two							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1b 7.5 C1b 7.10	7F about possible effects of burning fossil fuels on the environment and how these effects can be minimised.	Production and disposal of substances have environmental impacts.	<p><b>Starter</b></p> <p>Explain that computer models are used to predict the future climate.</p> <p><b>Main</b></p> <p>Get students to look at some websites and write an article, suitable for a school newspaper, which either supports or opposes the use of computer models. Get them to look critically at the origin of the website and assess whether there is any bias by the writer before they incorporate the ideas into the article. The article produced could be in a word processing or presentation package.</p> <p><b>Plenary</b></p> <p>Use a white board to explore a variety of websites to investigate the concept of bias in presentation about global warming and weather patterns.</p>	<p>www.channel4.com for 2080 weather predictions.</p> <p>www.globalclimate.org</p> <p>www.epa.gov for educational website on global warming.</p>	<p>Recognise that the predictions about the amount of warming of the Earth are based on computer models, which carry uncertainties.</p> <p>Demonstrate an understanding of how the internet can be used to research up-to-date data and information about global warming, how to check these for authenticity and bias, and how to critically analyse and incorporate such data and information into their own work.</p>	ICT: 1.1 2.1 1.3 2.3	None
<p><b>Homework:</b> Complete the article for a school newspaper.</p>							

## Scheme of work for Topic 7: There's One Earth

Lesson 5: Combating global warming							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1b 7.6 C1b 7.22	7F about possible effects of burning fossil fuels on the environment and how these effects can be minimised.	Production and disposal of substances have environmental impacts.	<p><b>Starter</b></p> <p>Explain that computer models are used to predict future climate changes.</p> <p><b>Main</b></p> <p>Students or groups generate lists of ways to reduce global warming.</p> <p>Follow this up by finding websites with information to support each suggestion.</p> <p>Use the internet to look up how atmospheric pollutants aggravate respiratory diseases such as asthma.</p> <p><b>Plenary</b></p> <p>Provide documented evidence from websites of the effects of pollutants on respiratory diseases.</p>	<p><a href="http://www.aeat.co.uk">www.aeat.co.uk</a></p> <p><a href="http://www.asthma.org.uk">www.asthma.org.uk</a></p> <p><a href="http://www.bbc.co.uk">www.bbc.co.uk</a></p>	<p>Propose an argument, based on the precautionary principle, for how to combat global warming.</p> <p>Interpret and evaluate given data relating respiratory disease such as asthma to atmospheric pollutants.</p>	ICT: 1.1 2.1 1.3 2.3	None
<p><b>Homework:</b> Complete an article making recommendations for how to combat global warming.</p> <p>[Higher-tier students make a leaflet explaining what asthma is and how some named atmospheric pollutants (eg NO<sub>2</sub>) affect it.]</p>							

## Scheme of work for Topic 7: There's One Earth

Lesson 6: Alternative fuels							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1b 7.12 C1b 7.14 C1b 7.13	7F about possible effects of burning fossil fuels on the environment and how these effects can be minimised.	Production and disposal of substances have environmental impacts.	<p><b>Starter</b></p> <p>Project or hand out pictures of petrol car, hybrid car and hydrogen car (3.03 RSC Contemporary Chemistry) and an ethanol car. Get students to write the advantages and disadvantages of each in groups. Challenge groups to ask you one question about each car type to improve their work.</p> <p><b>Main</b></p> <p>Prepare the roleplay described in RSC Contemporary Chemistry 3.04.</p> <p>Encourage students to think of alternative fuels.</p> <p><b>Plenary</b></p> <p>Look at the progress from coal to petrol and now future fuels for vehicles. Examine the physical properties to explore why petrol and diesel liquids are much used and the problems of hydrogen gas.</p>	<p>Access to the internet.</p> <p>Worksheet 3.04 from RSC Contemporary Chemistry.</p>	<p>Explain why bio-fuels are sometimes an attractive alternative to fossil fuels.</p> <p>Discuss the benefits and drawbacks of switching cars from petrol to hydrogen fuel.</p> <p>Explain that alcohol obtained from sugar cane or beet, is a useful bio-fuel which can be used to reduce the demand for petrol, but large areas of fertile land have to be used.</p>	C: 1.2 2.2	None
<p><b>Homework:</b> Write a short report describing the outcome, looking at it from the point of view of your role. Worksheet 3.13 Fuel cell cars — the GM Autonomy RSC Contemporary Chemistry for Schools and Colleges.</p>							

## Scheme of work for Topic 7: There's One Earth

Lesson 7: Recycling							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1b 7.8 C1b 7.7 C1b 7.9	<p>7H how to separate mixtures into their constituents using distillation, chromatography and other appropriate methods.</p> <p>Links to GCSE Science Unit B1a 1.5.</p>	<p>All substances are obtained or made from substances in the Earth's crust, sea or atmosphere.</p> <p>Production and disposal of substances have environmental impacts.</p>	<p><b>Starter</b></p> <p>Explore the concept of recycling.</p> <p>Get pupils to write down the advantages and disadvantages of hot countries recycling water by desalinating seawater. Share ideas in pairs and then construct a list on the board. How do we recycle water in the UK?</p> <p><b>Main</b></p> <p>Divide the class into groups. Give each group a bin or tray of typical household rubbish. Get them to sort the rubbish into the different materials that it is made of. Produce some large empty containers at the front. Get the pupils to suggest labels (eg glass, paper, cardboard). Get the pupils to put the appropriate material into each box.</p> <p>Question pupils and construct a table of 'What we should recycle' and 'What we do not'.</p> <p>Show images of landfill sites. Get the pupils to think about how many of the bins of rubbish could be placed in their gardens with and without recycling.</p>	<p>Trays or bins of paper, glass, plastic, cardboard and general, (clean) household rubbish.</p> <p>Five large empty boxes.</p> <p>If it is near enough you could take pupils' to a recycling centre to see how often it is used in the time you were there.</p>	<p>Explain the importance of recycling waste products such as glass, metal and papers.</p> <p>Evaluate a range of economic, environmental considerations, of recycling a natural material, such as glass, metal, or the desalination of water in hot countries.</p> <p>Explore how sustainable development involves the balancing the need for economic development, standards of living, and respect for the environment.</p>	<p>PS: 1.2 2.2</p> <p>WO: 1.1 1.2 2.2</p>	<p>Students to wear disposable gloves when handling materials.</p>

## Scheme of work for Topic 7: There's One Earth

Lesson 7: Recycling (continued)							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
			<p><b>Plenary</b></p> <p>Explain what is meant by 'sustainable development'.</p> <p>Show some produce in wrappers.</p> <p>Discuss whether the products could be construed as over-packed.</p> <p>Put pupils into groups. Give each group a different over-packaged product. Get each group to write a letter to the producer of the product explaining how the excess packaging does not support sustainable development. They should include what is meant by sustainable development and how they would recommend that the packaging could be changed.</p> <p>Get each group to report back to the rest of the class.</p>	<p>www.sustainable-development.gov.uk</p>			
<p><b>Homework:</b> Give at least five reasons for each why we recycle glass, metal and paper.</p>							

## Scheme of work for Topic 7: There's One Earth

Lesson 8: Fractional distillation — 1							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1b 7.15 C1b 7.16 C1b 7.17	8F that mixtures (for example, air, sea, water and most rocks) are composed of constituents that are not combined.  7H how to separate mixtures into their constituents using distillation, chromatography and other appropriate methods.	Products obtained from crude oil are essential to modern life.  Many natural resources are mixtures of substances.  All substances are obtained or made from substances in the Earth's crust, sea, or atmosphere.	<b>Starter</b>  Display pictures of toy cars, and airplanes and samples of products made from crude oil. Use questions to explore their origin. Carry out the fractional distillation of a crude oil substitute and talk about the process. You can then demonstrate the flammability and viscosity of some of the fractions of crude oil.  <b>Main</b>  Get students to use the oil section of the Multimedia Science School programme to look at fractional distillation of crude oil or use a fractional distillation animation from the internet. They should complete the activity.  <b>Plenary</b>  Discuss why alcohol is now being added to oil-based fuels to form bio petrol and bio diesel.	Selection of oil-based products.  Multimedia Science School.  www.schoolscience.co.uk  Activity 7.8. ASE: School Chemistry Experiments, page 229.  Oil fractions from BP educational service.  www.bpes.com	Describe the fractional distillation of crude oil.  Describe the uses of the main fractions of crude oil (gases, petrol, naphtha, kerosene, diesel oil, fuel oil, bitumen).  Explain where the main fractions of crude oil (gases, petrol, naphtha, kerosene, diesel oil, fuel oil, bitumen) are produced on the fractionating column and relate this to their boiling points, sizes of their molecules, viscosity, ease of ignition and uses.	C: 1.2 2.2	Check HAZCARDS for all fuels used in demonstration.  For crude oil substitute see CLEAPSS Recipe Card 20.
<b>Homework:</b> Note all the products made from crude oil that you come across in one day. State if there are any alternatives to using that product, eg walk to school instead of using a car. [Higher tier students keep a record of how far travelled in cars, buses, etc and the length of time each journey took]. If you can walk approximately three miles per hour, calculate how long each journey would take if you had to walk.							

## Scheme of work for Topic 7: There's One Earth

Lesson 9: Fractional distillation — 2							
Spec. code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
C1b 7.17 C1b 7.23	7H how to separate mixtures into their constituents using distillation, chromatography and other appropriate methods.	Many natural resources are mixtures of substances.  Products obtained from crude oil are essential to modern life.	<p><b>Starter</b></p> <p>Demonstrate the ease at which short pieces of string can be pulled out of a container of short pieces (corresponding to short hydrocarbons-hence lower boiling points) compared to medium length or long pieces of string being plucked out of a similar container.</p> <p><b>Main</b></p> <p>Video: Refining and products from oil and gases from the air to show industrial uses of fractionating.</p> <p><b>Plenary</b></p> <p>Explain how fractional distillation can be used to separate air. Write key words on the board and get students to write their own explanation.</p>	<p>String cut into three different lengths and placed in containers.</p> <p>RSC video: Industrial Chemistry — Oil Refining.</p> <p>BP video from <a href="http://www.bpes.com">www.bpes.com</a></p> <p>RSC video: Industrial Chemistry — Gases from the air.</p>	<p>Explain where the main fractions of crude oil (gases, petrol, naphtha, kerosene, diesel oil, fuel oil, bitumen) are produced on the fractionating column and relate this to their boiling points, sizes of their molecules, viscosity, ease of ignition and uses.</p> <p>Describe how nitrogen and oxygen can be obtained by fractional distillation of liquid air.</p>	C: 1.2	None
<p><b>Homework:</b> 'We should be more careful with our use of oil today so that there will be more for our children and their children.' Write an essay supporting with this statement. Think of all the ways you can that would save the overuse of oil today.</p>							



## Experiment 7.1: Observing fuels burn

### What you will learn from this experiment

- 1 Some fuels are more efficient than others.
- 2 Fuels give out different amounts of heat.
- 3 Fuels give out different amounts of pollution.

### What you will know when you finish this experiment

- 1 Ethanol (alcohol) is a clean fuel.
- 2 Oil-based fuels can give out smoke that consists of carbon particles.
- 3 There are a variety of solids that can be fuels.

### How you may be assessed

- 1 The details of your observations.
- 2 Your ability to evaluate your results and draw conclusions.

### What you will do

- 1 You will have a tin lid on which to burn your fuels.
- 2 Clean the tin lid carefully.
- 3 Put 1.0 g of the fuel on the lid.
- 4 Fill a clean 100 ml beaker with 50 ml of water.
- 5 Measure the temperature of the water.
- 6 Light your fuel using a Bunsen burner with its air hole half open.
- 7 Clamp the beaker about 5 cm above the top of the flame from your fuel.
- 8 Measure the highest temperature the water reaches.
- 9 Inspect the base of the beaker for soot.
- 10 Repeat the experiment with different fuels.
- 11 Complete a chart of your observations similar to the one below.
- 12 Gather information from others who have used different fuels.
- 13 Draw conclusions about the fuels.

Fuel	Ease of lighting	Colour of flame	Starting temperature	Final temperature	Temperature difference	Amount of soot

# Experiment 7.1: Observing fuels burn

## Notes for teachers and technicians

### Aim

To find out more about fuels.

### Previous skills, knowledge and understanding required

Safe ways of working with flammable substances.

### Skills, knowledge and understanding to be gained

- 1 How to observe and record observations.
- 2 How to record observations collected from their experiment.
- 3 How to work in a sensible sequence.

### Equipment and chemicals required

The following are needed:

- tin lids
- beakers
- $-10^{\circ}\text{C}$  to  $110^{\circ}\text{C}$  thermometers
- balances
- wood shavings
- coal bits
- coke bits
- ethanol
- crisps
- macaroni
- granulated sugar
- Bunsen burners
- copper calorimeters
- clamp stands.

### Health and safety issues

- Check HAZCARDs for all chemicals being used.
- Use only small quantities of fuel only.
- Safety spectacles/goggles must be worn.

### Links with KS3

This experiment builds on the following skills, knowledge and understanding from KS3:

- 7F Simple chemical reactions
- 7I Energy resources
- 9G Environmental chemistry
- 9H Using chemistry.

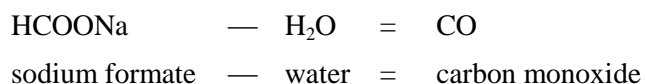
## Demonstration 7.2: Making carbon monoxide

### What you will learn from this demonstration

- 1 Concentrated sulphuric acid removes water from molecules of sodium formate. This is dehydration.
- 2 The physical properties of carbon monoxide.

### What you will know after you see this demonstration and take your own experimental work

- 1 The reaction is:



- 2 That carbon monoxide is a poisonous gas which is lighter than air, flammable and insoluble in water.

### What to do

Your teacher will show you how carbon monoxide may be produced. Watch what happens when your teacher adds a few drops of concentrated sulphuric acid to a little formic acid in a test tube.

### What to do next

You will be given three test tubes each containing carbon monoxide gas.

Undertake your own experiments to find out more about carbon monoxide as follows:

- 1 Test to see if carbon monoxide is flammable with a lit splint.
- 2 Test to see the effect of carbon monoxide on lime water. How does this result differ from the effect of carbon dioxide on lime water?
- 3 Test to see if carbon monoxide is soluble in water by opening a test tube of the gas under water.

Write a balanced formula equation for the combustion of carbon monoxide.

## Demonstration 7.2: Making carbon monoxide

### Notes for teachers and technicians

#### Aim

Knowledge of the physical properties of carbon monoxide.

#### Skills, knowledge and understanding to be gained

- 1 Working in careful manner.
- 2 Collection and testing of gases.

#### Previous skills, knowledge and understanding required

How to collect gases using a variety of techniques.

#### Equipment and chemicals required

The following are needed:

- sodium formate
- concentrated sulphuric acid
- prepared boiling tubes of carbon monoxide
- Bunsen burners
- beakers.

#### What to do

Use a fume cupboard — add 2 ml of concentrated sulphuric acid to 0.5 g sodium formate in a test tube (scale up if necessary) to produce carbon monoxide gas.

#### Health and safety issues

- Care with concentrated acids.
- Carbon monoxide is poisonous — see HAZCARD 21.

#### Links with KS3

This demonstration builds on the following skills, knowledge and understanding from KS3:

- 7F about possible effects of burning fossil fuels on the environment and how these effects can be minimised.

#### Suggestions for further work

- 1 Students could examine the reaction between carbon monoxide gas and sodium hydroxide solution. This reaction could be compared to that obtained when carbon dioxide reacts with sodium hydroxide.
- 2 Students could see the effect of carbon monoxide on animal blood. Refer to the School Science Review Volume 54 (1972) page 303 and also the CLEAPSS hygiene documentation section 14, chapter 13 on hygiene and blood spills.

## Activity 7.8: Fractional distillation

### What you will learn from this activity

- 1 Fractional distillation produces a range of products.
- 2 Different fractions have different boiling points.
- 3 The lowest boiling fractions are collected from the top of the column and the highest boiling fractions from the bottom of the column.
- 4 Different fractions have different physical properties.

### What you will know when you finish this activity

- 1 Low boiling fractions are light in colour, runny and easily flammable small molecules.
- 2 High boiling fractions are dark in colour, thick and not very flammable large molecules.

### What you do

- 1 Watch the demonstration of fractionation by your teacher.
- 2 Watch the video about oil refining.
- 3 Complete the table using books, any experimental work you have done and the internet, if needed, to get specific details.

Fraction	Boiling point range	Viscosity (runniness)	Ease of lighting	Number of carbon atoms in molecule	Other observations	Uses
Gases						
Petrol						
Naphtha						
Kerosene						
Diesel						
Fuel oil						
Bitumen						

## Activity 7.8: Fractional distillation

### Notes for teachers and technicians

#### Aim

To find out about the different fractions available from crude oil.

#### Skills, knowledge and understanding to be gained

How to observe and record observations.

#### Links with KS3

This experiment builds on the following skills, knowledge and understanding from KS3:

- 7F Simple chemical reactions
- 7I Energy resources
- 9G Environmental chemistry
- 9H Using chemistry.

June 2006

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