Fusion 3: How Science Works – Media messages

National Curriculum Link up
•1.2b, 3.3d

Learning Objectives	**Teaching / Learning activities**	**Teaching suggestions**
Pupils should learn: What is meant by genetic modification. How genetic modification can be applied to crops. The advantages and disadvantages of growing genetically modified crops.	**Lesson structure** **Starter – Design your own food** Ask the pupils to imagine that they are given a machine which will change any food crop in any way. You put the seeds into a chamber, choose how you would like the final food to be, press the button, grow it and eat it. Ask what would they produce? Encourage them to be as imaginative as possible. Work in small groups or singly, allowing them to illustrate ideas if they choose to and sharing their thoughts with the rest of the class in a brief discussion. (10 mins) **Main** Exposition: Show a PowerPoint slideshow simply summarising what genes are and the methods we have of taking them from one organism and putting them into another one. Give interesting examples, such as 'glow-in-the dark' mice (which have a luminous protein produced by a gene taken from a jellyfish) and low-temperature resistant tomatoes (which have a natural antifreeze production gene isolated from arctic fish incorporated into them). The pupils can now go through the pupil book at this point and read the quoted comments on GM soya beans, constructing a table of positives and negatives. When the pupils have completed their individual tables, summarise the positives and negatives on the board and discuss. The pupils could then go ahead with the suggested activity and write a balanced newspaper article based on this information (or this can be done for homework). Set up a series of information points around the room. At each point, provide some simple information on other examples of genetically modified food crops: the importance of drought resistance, the development of disease-resistant strains (illustrate the devastating effects of some plant diseases, e.g. the Irish potato famine), the incorporation of genes for vitamins (e.g. 'Golden rice' engineered to produce vitamins to overcome deficiency diseases), the 'Terminator gene' which makes some GM seed sterile (discuss the consequences if this should get out into the wild and be passed from plant to plant), self-protecting plants developed to produce a chemical insecticide. On completion, pick on individuals and ask them to tell you something new that they now know now. Pupils could debate the issue of GM soya beans, or GM crops in general. Divide the class into groups of at least four pupils. Tell each group to prepare a short speech in favour of GM foods and one against GM foods. They can make use of the material in the pupil book, plus any other arguments they might have come across. Choose, by drawing lots, a group to propose that GM crops be banned and one to propose that GM crops be developed. Follow this by choosing a second speech for each side and then open up the debate. **Plenary - GM quiz** Go to the Food Standards Agency website: www.food.gov.uk/multimedia/webpage/gmquiz and carry out the springboard quiz there. (5–10 mins)	• **Special needs.** In the first of the main lesson suggestions, give the pupils laminated cards showing the stages of the process of genetic modification and ask them to put them in the correct order. Supply the words needed to complete the cloze passage, so that pupils can place them in the right spaces. • **Extension.** Pupils could research the attempts made to incorporate the genes for nitrogen fixation into crop plants. If this becomes possible in the future, ask: 'What impact would it have on crop production and the use of artificial fertilisers?' Pupils could summarise their findings and ideas in the form of a poster or pamphlet to be displayed in the classroom. • **Learning styles.** *Visual:* Watching the slide show in the exposition about GM. *Auditory:* Listening to the explanations of how GM crops are developed. *Kinaesthetic:* Designing food in the starter. *Interpersonal:* Taking part in group work in the designing food starter, the debate and the plenary quiz. • **Homework.** Writing, or completing, the newspaper article about GM soya beans.

Learning Outcomes	**Additional teachers notes**
All pupils should be able to describe genetic modification and name some genetically modified crops. *Most pupils should be able to* explain how genetic modification of crops is carried out and to describe some advantages and disadvantages of growing such crops. *Some pupils should also be able to* understand how genetic modification of crops could have an impact on world food supplies. **How Science Works** Evaluate the issues, benefits and drawbacks of scientific developments with which they are familiar. (1.1b)	**Equipment and materials required** **Safety.**

Fusion 3: How Science Works – Trouble in the rainforest

National Curriculum Link up
•1.3a, 2.3a, 3.4c, 4d, g ,j

Learning Objectives
Pupils should learn:
Why the Amazon rainforest is so important to conserve.

How gold mining affects the forest.

The issues to consider for the future of gold mining in Brazil.

Teaching / Learning activities
Lesson structure
Starter – Gold rush
Ask pupils to write down everything they know about gold. Largest list wins. You could, if you have time, let them use reference sources to complete this task. Encourage them to think about where gold is found (native, in the ground), its properties (metal, soft, any typical metallic properties) and what it is used for (e.g. jewellery, coating electrical contacts, reflective coating on space-suits). (10 mins)
Main
Ask pupils to read all of the thoughts and opinions in the pupil book. If you have time, you could assign pupils to read each of the 'parts' out loud. Explain the purpose of the task; to hold a live TV debate about the contentious subject of gold mining in the Brazilian Amazon. Appoint the presenter of the show. You could ask the class to nominate someone for this role. In the absence of a suitable pupil, you could do it yourself.
_ Pupils should find enough information in the pupil book to hold the debate. Here are some other pieces of information which may assist:
_ The area of the Brazil in question is Serra Palada which is in the north of Brazil, near to the mouth of the Amazon river.
_ A garimpeiro is a small-scale, self-employed gold miner. (A garimpo is a mine). Often they work by panning for gold using mercury to make it easier to identify the gold. They were granted rights, in 1984, to mine certain areas previously used by the official mining company. There is some suggestion they have operated illegally in other areas.
_ It is estimated that Europe was once around 80–90% covered with forest. The current level of forestation is only about 25%. In Britain the figure is even lower; only around 10% of the country is forested. Deforestation happened as European society developed; the wood was used for building, fuel and even ships. In 1698, King William III was so worried about the depletion of England's forests that he ordered the replanting of parts of the New Forest in Hampshire which had been created by William the Conqueror in 1086. His aim was to ensure a source of wood with which to supply the navy; some 2000 mature oak trees were needed to build even a small navy ship at that time. Some people argue that the prosperity of Western Europe owes much to deforestation and the idea is not wasted on many governments from the Amazon region. They argue that it is their right to develop their prosperity for the benefit of their people in the same way that Europe once did for itself.
_ Mercury is considered to be poisonous by skin contact, ingestion of the liquid by eating and of the vapours through breathing. It is an accumulative poison which means that it is not readily removed from the body.
Plenary - What's your opinion?
End the debate by holding a class vote on the way forward. This could be something as simple as: 'Should the mining continue or not?' but you may want to add more options. (5 mins)

Teaching suggestions
• **Special needs.** Lower attaining pupils may find the live debate difficult. Extra time for planning and focusing on the opinions of only a few characters may help.
• **Extension.** A higher attaining pupil is the ideal host of the debate. If you have a number of suitable pupils, you could ask some to play the characters described in the pupil book.
• **Learning styles.**
Auditory: Reading, understanding and interpreting information; personal learning and thinking skills.
Interpersonal: Discussing the issues involved in exploiting the Amazon rainforest.
• **Homework.** Pupils could be encouraged to find out more about this issue through research at home and to present a written report or poster about their findings.

Learning Outcomes
All pupils should be able to describe the damage to the environment caused by deforestation.
Most pupils should be able to explain their view on the gold mining in Brazil.
Some pupils should also be able to develop a balanced argument which considers the needs of more than one group of people.
How Science Works
Recognise that different decisions on the use and application of scientific and technological development may be made in different economic, cultural and social contexts. (1.1b)

Additional teachers notes
Equipment and materials required

Safety.

Fusion 3: How Science Works – Smart meters

National Curriculum Link up
•1.2a and b, 4c, d, g, h, j

Learning Objectives
Pupils should learn:
That electricity costs can vary at different times of the day on some tariffs.

That arguments can be made for reducing the impact on the environment of electricity use.

That consumers are able to make informed choices about their electricity use.

Teaching / Learning activities
Lesson structure
Starter – Fair share
Show the students the latest information about energy use for a range of countries including the G7, some rapidly expanding economies and some of the poorest nations. This information could be energy totals and energy per head of population. Do the pupils think that they are using too much? What would happen if everybody demanded the same resources? (10–15 mins)
Main
In this lesson, the pupils will be looking at the technology behind smart meters and the arguments for and against their use. They also need to consider the physical design of the units and how they would convey meaningful information to the users. The goalis to get the pupils thinking about their personal and their country's energy use, and to consider carefully the arguments for making consumers more aware of the monetary costs and the global environmental consequences of their electricity use.
There are a couple of ways to focus this lesson and you can bias the lesson one way or another, depending on your group's ability. One way is to look at the design of the meters and how they would operate in practice; the other is to look at the social implications of using this type of meter.
Here are some points you can discuss if you choose to focus on the design and operation of the meters:
It will be difficult to establish exactly where the meter should be placed so that consumers take notice of it. Should there be readouts in all of the rooms of the house? Could it be connected to the TV or PC so that messages are displayed now and again? Wouldn't that be annoying? The meter is meant to stand out, but who would want something like that in their living room?
How often would you want the meter to inform you about your electricity use? The system could be connected to a mobile phone so that you receive a text every day about your usage or even an email. Perhaps you could send a message back to turn devices off remotely.
Plenary - No charge
Some people generate enough electricity in their homes actually to sell some of it back to the national grid. Their bills are negative. The pupils should discuss how this is done and if it would be practical to fit systems like wind turbines or solar panels to their own homes. (10 mins)

Teaching suggestions
• **Special needs.** You could provide the pupils with partial designs for the meters and they could adapt them to fit in with room designs. The pupils could also make physical models of the meter. You could provide partially completed scripts and writing frameworks if you want the students to have a debate about some of the issues brought up.
• **Extension.** The discussions and designs are fairly open-ended and you can extend any areas of interest the pupils have shown. They could script a debate on one or more of the issues and perhaps record or film it.
• **Learning styles.**
Visual: Designing advanced electricity meters.
Auditory: Discussing of a range of issues.
Kinaesthetic: Constructing of models.
Interpersonal: Discussing issues in groups.
Intrapersonal: Thinking about personal responsibility related to global issues.
• **Homework.** The design and/or construction of the meters could be completed at home.

Learning Outcomes
All pupils should be able to design a system to present electricity use and costs clearly.
Most pupils should be able to present reasoned arguments for and against the installation of smart electricity meters in their homes.
Some pupils should also be able to discuss the implications of electricity use in terms of environmental impact, sustainability and it's implications for a technological society.
How Science Works
Evaluate the issues, benefits and drawbacks of scientific developments with which they are familiar. (1.1b)

Additional teachers notes
Equipment and materials required

Safety

<table>
<tr><td colspan="3">Fusion 3: How Science Works – Careers and Science</td></tr>
<tr><td colspan="3">National Curriculum Link up
•4i</td></tr>
<tr><td>Learning Objectives
Pupils should learn:
Some of the career opportunities that qualifications in science can lead to.</td><td>Teaching / Learning activities
Lesson structure
Starter – Different skills
Ask pupils to work in pairs to write down a scientific skill or attitude and link it to a job in which that skill/attitude would be useful, e.g. manual dexterity – surgeon. Make as many pairs as possible in 5 minutes. After 5 minutes ask for volunteers to read out their pairs, allowing questions from the rest of the class if clarification is needed. (10 mins)
Main
The strategy in this lesson is to start with occupations in which science plays a major role, working towards jobs which are science related, then going on to jobs in which science plays some, not always obvious, part. This helps pupils appreciate the relevance of studying science.
_ You might have careers posters from ASE which can be used as stimulus material in this lesson.
_ Consider the jobs of science teacher, science technician, school caretaker and workers in the school canteen. What, if any, qualifications in science do these jobs need? Invite some people in to talk about their work and its links to science, e.g. the school caretaker will be familiar with the hazards associated with cleaning materials.
_ Alternatively invite a professional from the fi re, police or ambulance services to talk to the pupils, focussing on the science involved in their work.
_ Consider TV programmes which portray characters with science-related jobs, e.g. hospital and police forensic work in documentaries and dramas. How are the scientific elements of the jobs shown to viewers? You could show some examples to the class to open the debate.
_ Discuss the drop in numbers of candidates taking A level science subjects and the closure of university chemistry departments over the last few years. Encourage pupils to speculate on the reasons and possible consequences if these trends continue. What can be done to reverse the trends?
_ The pupils can do some research and design a leaflet for a careers adviser to use with Year 9 pupils (see Summary question 3).
Plenary - What does the future hold?
Organise the pupils to talk in small groups about their ideas about possible careers and consider the significance of science in the jobs mentioned. Will they need science qualifications? At what level? Ask each group to make a list of any questions they could not answer in the course of their discussions. (10 mins)</td><td>Teaching suggestions
• Special needs. Lower attaining pupils may find it easier to classify a pre-prepared list of occupations as major or minor users of science.
• Extension. Some pupils could carry out a role play, challenging
the stereotypical images of scientists.
• Learning styles.
Visual: Producing an appealing leafl et promoting careers in science.
Auditory: Listening to discussions about future career opportunities.
Interpersonal: Working in groups to produce lists of major science users.
Intrapersonal: Considering their own career prospects.
• Homework. Pupils could finish their careers leaflet or produce a
table of occupations divided into major and minor users of science.</td></tr>
<tr><td colspan="2">Learning Outcomes
All pupils should be able to list several jobs in which science plays a major role.
Most pupils should be able to classify workers as major or
minor users of science.
Some pupils should also be able to explain the significance of science in a range of different careers.</td><td>Additional teachers notes
Equipment and materials required

Safety.</td></tr>
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