Let’s get critical

We are all used to watching people, especially scientists, present their area of expertise, but what makes a presenter a good one and would you do it differently? This activity develops the skills of giving and receiving constructive criticism on students’ own presentations.

Outcomes
Students will be able to:

• identify the features of a good presentation
• give and receive constructive criticism.

Time required
Allow ten minutes for each presentation, five minutes for questions, and five minutes to feed back comments. Spend the rest of the lesson on group discussions and feedback to the rest of the class.

Outline of the activity
This is a chance for everyone to get feedback on their presentation style and to learn how to give a better presentation.

Give all students a copy of the presentation evaluation sheet. They have a few minutes to prepare a short, ten minute presentation (without using a computer) on a topic they have learnt about in class. They then get into groups of four and each student takes it in turns to present to the rest of their group. After each presentation has finished all group members take a few minutes to fill in their evaluation. The group feeds back to the student who has given the presentation, while this student listens and accepts the comments.

At the very end, all members look at each other’s presentation evaluations and discuss what they found. Did their feelings about their own presentation match those of their peers?

You could end by asking the class the following questions.

How do you communicate your ‘tips for improvement’? Were you all polite when giving feedback?

Do you feel confident enough to tell someone that their presentation could be better?

Did you notice body language that distracted you from the presentation?

What did you learn through receiving criticism?

If there is time, some students can try out their presentations again, this time taking on the constructive criticism, and then ask the audience to say if they feel the presentations have improved.

Tips and strategies
This activity could be run in parallel with Activity 6.4 Preparing a longer presentation.

Make sure students understand that giving constructive criticism and critiquing a presentation is very different from ‘criticism’ you may hear in day-to-day life. We should be extremely professional about criticising. Receiving a criticism is also a skill which needs to be developed. Criticism helps us to improve and develop, so should be valued.
Let’s get critical

Presentation evaluation sheet

In this activity you will develop the skills of giving and receiving constructive criticism.

**Giving constructive criticism**

You will be given time to prepare a ten minute presentation on a scientific topic. In groups of four students, each of you will have the opportunity to give and receive constructive criticism on the presentations.

Fill in the table for each of the presentations in your group, the first column is for you to write down how you think you did.

<table>
<thead>
<tr>
<th>Title of presentation</th>
<th>Name:</th>
<th>Name:</th>
<th>Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three good points about the presentation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three not-so-good points about the presentation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Let’s get critical

Presentation evaluation sheet

<table>
<thead>
<tr>
<th>What would you change about the presentation?</th>
<th>Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did the presenter have any particular habits (distracting or good ones)?</td>
<td>Name:</td>
</tr>
<tr>
<td>If you had given the presentation what would you have done differently? (If it was your presentation, how would you improve it?)</td>
<td>Name:</td>
</tr>
</tbody>
</table>

Once you have finished filling in the table, swap evaluations with the rest of your group and see what you have all written. Do you all agree? Discuss.
SNAB
Topic 2

Let’s get critical

Briefing sheet

Receiving criticism
During this activity, listen to the criticism from your peers without responding. Thank them for their comments when they have finished. Make some brief notes below for your own reference.

Title of your presentation:

What I need to work on to improve my presentation skills:

How my own evaluation compared with comments from other students about my presentation:
A series of brief articles is presented to the students who complete individual and / or group exercises to explore and develop their approach to reading text.

**Outcomes**

Students will be able to:

- identify useful articles from a selection by skim reading
- assign the approximate level of understanding needed to access the article (KS3, GCSE, A-Level and beyond).

**Time required**

Allow 30 minutes.

**Outline of the activity**

This activity helps students develop the skills needed to skim read articles to identify those worth reading or following up in more detail. The in-class portion of the activity focuses on paper-based materials. The homework activity will be done online, although students may choose to print their articles to read in hard copy.

Note that the titles of the articles have been omitted - this means the students have to engage with the text. For the timed activities you could change the timings from those suggested to suit your students.

1 Give students the ‘Science in brief’ articles. Tell them they have got one minute to find articles relating to their A-Level subject.

2 Discuss outcomes with the class. It would be good to get students who found the task relatively easy to share their approach with the rest of the class.

3 Give out the briefing sheet. Ask students which areas of science are covered by the articles and which are not science related. Enter the agreed topic areas into column two in the table on the briefing sheet.

4 Give students two minutes to decide which age group the article is written for - school pre-16, school / college 16-18 or university over 18 years.

5 When the two minutes are up, ask students to discuss their decisions about age group for five minutes, in groups and then complete columns three and four of the briefing sheet.

6 The groups then share their agreed views on the levels of the articles with the class. They are expected to indicate any areas of disagreement within the group.

The group discussion will provide a supportive environment for students who lack confidence in this area. It should allow them to develop strategies to help them to tackle this sort of thing in future.

**Tips and strategies**

*See next page.*
Tips and strategies

When introducing the activities, make it clear that you are giving the students a chance to learn more about how they tackle reading tasks and that they will be able to learn from the experiences of others in the class. Explain the importance of being able to skim through pieces of text to assess the value of the document/article. If we read everything that comes our way in great detail, we would find that time would run out very quickly! We need to learn to be selective.

Some students will do better than others and it is important to be encouraging towards those who struggle. It is particularly important that the students do not view it as a head-to-head competition. If you have a spread of ability within the class, or there are students with specific educational needs, you could get the students to work in groups. Some dyslexic students will have learned some helpful techniques which would be valuable to share with the rest of the class.

Mingle with the groups as they discuss their findings (stage 5 of the activity outline). This will give you insight into how individual students tackle the task and you will be able to offer advice where required.
In this activity you will explore some techniques for skim reading and make decisions about the level of some articles.

Your teacher will have given you the ‘Science in brief’ sheet and you will have identified the articles relating to your A-Level subject.

Decide which topic is covered by the ‘Science in brief’ articles that you have selected and enter them into column two of the table below. Then, in groups, decide which age group each article has been written for and enter this into column three of the table. In column four explain the reason for your groups decision. If you could not agree explain why not.

<table>
<thead>
<tr>
<th>Article number</th>
<th>Topic covered in article</th>
<th>Which level is the article aimed at? (see below)</th>
<th>How did you come to this conclusion? Were there any disagreements in the group?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
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<td>3</td>
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<td>4</td>
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<td>5</td>
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<td>6</td>
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<td>9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Choose your age group from:

- school    14 - 16 years
- school / college  16 - 18 years
- university  over 18 years
Science in brief articles

1
Energy from the Sun holds the key to a sustainable future for mankind. It is estimated that the Earth receives in excess of a staggering 120 PW (1 PW = 1 x 10^{15} W) of solar radiation each year, which is thousands of times more than we actually consume across the globe.

The question is ‘How do we harness this energy?’ Plants have been doing it successfully for millions of years, with photosynthesis effectively allowing plants to trap sunlight as chemical energy in glucose, allowing them to use the energy to grow and carry out life processes. We all depend on this for our own survival, whether we are vegetarian or not. Furthermore, fossil fuels were formed from the remains of living things that sourced their energy from sunlight, and the chemical energy stored in the fuels drives much of our lifestyle today.

Science holds the key to unlocking the potential of solar energy as a viable energy source for mankind, be it through the development of new solar cell technology, or finding better ways of processing the energy in plants for our own use.

2
One fascinating fact about rocky shore species is that they are distributed in bands or zones on the shore and, as such, show very simple and easily understood patterns of distribution. Studies of patterns of distribution in relatively simple habitats like this have been very helpful in finding out the sorts of factors controlling why animals and plants live where they do. When oil spills have affected rocky beaches, knowledge of the biology and ecology of the species living there has proved useful in understanding how to best manage the spillage. Because people have been interested in these fascinating animals for a long time, they are also now useful for scientists looking for climate change effects. A long set of data collection, starting in the 1950s, exists about barnacle distribution around British shores, and these are now being looked at again and compared with the present day pattern.

There are many indications in the data that warming is taking place, for example the warm water species Chthamalus montagui is found in more places in Scotland than it used to be. The favouring of Chthamalus by the warmer seas has released it from competition with Semibalanus, which is therefore suffering. These studies show that, no matter how sophisticated our instrumentation gets, living things are still often the most sensitive way of finding out what is going on in the environment.

3
Kirklees Council has been at the forefront in demonstrating the use of renewable energy technology. In order to help reduce carbon emissions it has pioneered the installation of photovoltaic cells and wind turbines to generate electricity on municipal buildings. Local woodlands are harvested to feed woodfuel boilers to reduce carbon emissions; at the same time, this improves woodland habitats for wildlife.

However, the emission savings made by using renewables are minor in the context of what we need to do. This is acknowledged in the national debate about how we move away from fossil fuels to alternative energy sources such as wind, wave and nuclear power. This debate ignores the gross inefficiency of British national housing stock.
A large proportion of houses are poorly insulated so that much of the energy used to heat them is wasted. Within Kirklees a decision has been taken to fund cavity wall and loft insulation for all homes within the district. The principle here is to apply technology appropriately and cost-effectively to deal with energy inefficiency and reduce the demand for energy. This is a much more sustainable approach. The council also aims to ensure that new houses and buildings are built to the highest standards of energy efficiency and have built in renewable energy installations, where possible, over and above that required by central government.

4
Melting is when a solid turns into a liquid. Did you realise that this process could threaten the lives of millions of people? Here’s how...

You probably know that ice is a solid form of water, with the particles all arranged in a regular pattern so they cannot move past each other. When you increase the temperature of ice, the particles can start to move past each other and the ice turns into liquid water. How can this be a threat to people?

Well, there are millions of tonnes of ice at the north and south poles. If this ice starts to melt because of global warming, it could mean that sea levels rise across the Earth, which could cause flooding in a lot of places.

Scientists believe this is happening already. Think about what you can do to help those people who live in places that might be affected by floods – one day it could be you!

5
Over the centuries both scientists and non-scientists have kept records of natural events. In 1736, Robert Marsham began recording 27 indications of spring in the UK and we have recently found a few even older records dating back to 1703. When correlated with temperature these phenological records show how nature is responding to a changing climate. The Marsham family continued recording until 1958. A nationally coordinated scheme ran from 1875 to 1947 and the UK Phenology Network (UKPN) began in 1998.

In autumn 2000 UKPN had 350 recorders. Two years on there are more than 14,000 recorders spread across the UK, mostly working over the Internet. Although recordings of natural events by the public are sometimes dismissed as unscientific, the UKPN records are producing some important results which are statistically significant. When a large number of people are recording, the data as a whole become credible because anomalous records can be spotted.

Phenology is taken very seriously. The IPCC sees it as legitimate research into climate change and phenological events are now part of the UK Government’s Climate Change Indicators.

6
Trees are vital to life on Earth. They provide fuel, fibre, food and shelter for humans, and habitats for a vast range of animals. One of the most important functions of trees is their ability to use atmospheric carbon dioxide (CO$_2$), a greenhouse gas, in photosynthesis:

$$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$

The biomass produced stores large amounts of carbon, and oxygen is released.
Reconstructions of Earth’s past climate, and the observed impact of vegetation on global atmospheric carbon dioxide levels, have changed the way we perceive the Earth’s system.

We can measure variations in atmospheric carbon dioxide and temperature from tiny air bubbles trapped up to 3 km deep in Antarctic ice. Although there are major variations over glacial cycles of around 100 000 years, atmospheric temperature and carbon dioxide follow each other — we say that there is a close correlation between temperature and carbon dioxide levels. Notably, carbon dioxide remained below 300 parts per million (ppm) until the twentieth century.

‘Bio’ means good, doesn’t it? Not necessarily …

You’ve probably heard of biofuels such as biodiesel and bioethanol. From April 15th 2008, all petrol and diesel sold in the UK must contain 2.5% biofuel, which might sound like a good thing. Some environmentalists don’t think so, however.

Some of the biofuels that are finding their way into our fuel tanks aren’t as environmentally friendly as you might think. In some countries, large areas of rain forest have been cut down to make way for crop fields to produce biofuels. Not only does this destroy habitats of rare animals like the orangutan, but the trees are often burned, producing polluting smoke and the greenhouse gas carbon dioxide.

Elsewhere, farmers are switching from producing crops for food to those that are used in biofuel production. The net result is that there is less food available for us to eat, meaning that food prices go up and some of the world’s poorest people go hungry.

Are all biofuels bad? No, of course not, but we need to overcome the problems described above if we are going to find a real alternative to fossil fuels.

8

Do you remember that practical you did back in year 7 or 8 where you used paper chromatography to separate out the different coloured dyes in ink? Everyone remembers that one! But did you realise that a related technique can be used to analyse athletes’ urine samples?

There are a number of different types of chromatography that are used in different applications.

Chemists use a technique called TLC (it stands for thin layer chromatography) to analyse mixtures when they do chemical reactions. A larger scale process called column chromatography can be used to separate pure substances from complex mixtures.

Gas chromatography (GC) is the technique that can be used to analyse things like urine samples. It is especially powerful when combined with a technique called mass spectrometry (MS). The GC separates the chemicals in a mixture, and the MS helps us to work out what the chemicals are. This way we can easily see if an illegal substance is present in the urine.

So next time you hear of an athlete who has lost a medal thanks to a drug offence, think about how they were found out!
During a recent short break on the South Wales coast, I headed for the beach down a familiar gully, but found my way blocked. The gully was full of undulating, wobbling foam, to a depth of at least 2 m. The foam, forming as waves broke on the sandy beach in the bay, was being blown into deep drifts across the beach and piling up in the gully. In the odd corner the foam was starting to dry out, collapsing to leave a thin smear of dark green powder on the sand and rocks. Beneath the powder the sand grains had been cemented together to form a firm crust up to 5 mm thick. Some of the foam was being blown up the cliffs and inland onto fields.

A foam-flecked surfer provided an explanation. There had been an algal bloom — very rapid growth — in the Bristol Channel and the algae produce lots of sticky mucilage. Hence the foam produced by the breaking waves.

When I was a secondary school pupil, my main impressions about chemistry were those of the industrial processes, particularly the Haber process to make ammonia and the manufacture of fragrant esters. But my perspective broadened. In the 1980s, the chemistry of the atmosphere and its link to life became prominent through two topical environmental issues: the ozone hole over Antarctica and global warming. It was around this time that my interest in the chemical composition of the Earth’s atmosphere took hold. I found myself wondering why the Earth’s atmosphere has the bulk chemical composition that we find around us. To put the question another way, how did the atmosphere evolve?

On the modern Earth, living organisms regulate every key constituent of the air with the exception of the inert gas, argon. By far the most unusual constituent is oxygen (O₂), which is not found in abundance in the atmosphere of any other planet. Until around 2.4 billion years ago, the Earth’s atmosphere had negligible oxygen and, without oxygen to respire, the large life forms that seem so familiar to us, such as multicellular plants and animals, could not exist. Indeed, there are no fossils visible to the naked eye in rocks from before 2.5 billion years ago, an aeon known as the Archaean. Instead, all you can find are the tiny microscopic fossils of single-celled microbes which make up stromatolites, laminated mineral mounds left behind by microbial communities.
Extracting key information from a scientific article at ‘first glance’

Students learn about the basic structure and style of scientific articles by first testing their own ability to extract key information from such an article. The teacher led part of the activity will help students formalise their approach. It is important to note that the articles used here should not be research papers, but should be less formal articles which are more accessible.

**Outcomes**

Students will be able to:

- apply techniques for browsing scientific articles
- show improvement in their ability to extract key information which can be used to ascertain the value of the article
- describe the structure of written articles and outline their functions.

**Time required**

Allow 30 minutes.

**Outline of the activity**

1. Before giving students the resource sheets, tell them that they will be asked questions relating to it afterwards, but do not indicate what questions. Tell them that they are not allowed to annotate the article with notes, but they can write anything down on separate sheets of paper. Give students five minutes to read the article.

2. Tell the students to put the article away and give them the sheet to fill in. It is likely that most of them will struggle with this, and some may fail to answer any questions.

3. When most students have completed the briefing sheet to the best of their ability, get them into pairs or groups to mark their work. Allow them to mark by using the article to find the correct answers. If they are struggling, you could make it a teacher-led exercise, taking them through the article and identifying the correct answers as you progress.

4. Ask the students ‘What is the typical structure of this sort of article?’ There should be an introduction, a discussion and a conclusion. This will not always be the case and you might ask students why.

5. This activity needs to be followed up by repeating it to reinforce knowledge. Issue a second article either for homework or during the lesson and repeat the steps 1 and 2, using a blank copy of the briefing sheet.

**Tips and strategies**

To counter the frustration that students may naturally feel if they initially struggle with this, make sure you frame the activities as being an opportunity for them to formalise their approach to reading scientific articles in the future. This will help to save them a lot of time and effort and will help them with their studies at A-Level and beyond.

Do point out to the students that they are not expected to read these articles in detail. They will get the chance to do so at a later stage.

As with activity ‘Skim reading a series of articles’, this is an ideal opportunity for students to share their approach with others, passing on hints and identifying / eradicating bad habits.
In this activity you will agree an approach to a ‘first glance’ of an article.

Complete this activity with the article you have just read out of sight. Don’t worry, this isn’t a test.

1 What was the title of the article? ______________________________________________________
_____________________________________________________________________________________

2 Who was (or were) the author(s)? _____________________________________________________

3 What further information can you give about the author(s) (e.g. location, occupation, qualifications)?
_____________________________________________________________________________________

4 In what year was it published? _______________________________________________________

5 Who is the publisher, or what is the name of the publication? ___________________________

6 What type of illustrations were included? _______________________________________________

7 What sort of symbols and formulae were used, if any? ____________________________________

8 Which of the following appeared in the article? (answer yes or no)

   An abstract   _______   An introduction or preface _______
   A conclusion or discussion _______   A list of references   _______

9 Write a brief summary of the main points of the article. __________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________
Diabetes in young people
The search for genetic links

Juvenile diabetes is a genetic disease, but the causes are still not entirely known because of its complexity. This article describes what is being done to improve our understanding of the genetics behind this disease, and the range of activities in medical research.

Going to work with diabetes?

Jason Cooper has been diabetic since he was a teenager. Each morning after breakfast, he injects himself with a dose of insulin, kisses his wife Irene and daughter Maddi goodbye, then hops on his bicycle to Addenbrooke’s Hospital in Cambridge. But he is not about to see a doctor regarding his diabetes. He works there everyday at the medical genetics department in the University of Cambridge, and his work is about understanding the genetics of juvenile diabetes.

What is juvenile diabetes?

Juvenile diabetes, also known as Type 1 diabetes, affects over 200,000 people in the UK. People who suffer from this disease have an inadequate supply of insulin, a hormone that is essential for maintaining blood glucose at a constant level – see Box 1. In diabetics, the insulin-producing cells in their pancreas are destroyed by their body’s own immune system (which normally defends against infections). As the disease develops, less and less insulin is produced, blood glucose levels rise and, without treatment, the patient may suffer from a hyperglycaemic (high blood sugar) reaction which can be life-threatening. This can be for a whole host of reasons, including damage, over a long time, to the heart, kidneys and blood vessels. In the short term, a condition known as Diabetic Ketoacidosis may develop; this causes the blood pH to become too low for the proper functioning of enzymes. Finally, there may be osmotic problems which lead to the production of a lot of urine, which can lead to dehydration and, eventually, coma.

Box 1: How insulin helps to control blood sugar?

At some time after a meal (after some digestion has happened), the level of sugar in the blood starts to rise. This is detected by cells in the pancreas, which respond by secreting the hormone insulin. This is carried all over the body in the blood (as are all hormones) but it has its main effect on cells in the liver. These are stimulated to take up glucose from the blood and make it into the polysaccharide glycogen, and so blood sugar falls back to normal. Later, when blood sugar starts to fall, the pancreas is stimulated to secrete another hormone, glucagon, which has more or less the reverse effect of insulin, raising the blood sugar.
After diagnosis, insulin replacement is usually given by injection. Good control of blood glucose levels is critical in minimising long term complications and improving long term survival. Although most patients do not have relatives in their immediate families who also suffer from the disease, juvenile diabetes is a genetic disease as scientists have identified that certain DNA sequence variations (variations in the sequence of bases along the DNA molecule) increase the risk of developing juvenile diabetes.

How are the risk sequence variations identified?

It is now known that over 99% of the approximately three billion bases of the human genome are identical amongst individuals. Interestingly, a small proportion of the remaining DNA could be important for explaining what makes people different — for example, why people are different in height and why some people may be more susceptible to certain genetic diseases than others. Scientists such as Jason and his colleagues survey DNA sequence variations on every chromosome from thousands of people with and without the disease. This provides clues to scientists in identifying which DNA sequence variations are involved in the disease process. The basic idea of the strategy is that if there is a version of a sequence (called an allele) that contributes to increasing risk of the disease, this risk-allele should be observed more frequently in patients than in the unaffected subjects — see Figure 1.

Figure 1
Consider two sites with sequence variations (1 and 2) in the genome. There are two alleles (red or green) for site 1, and two alleles (blue or brown) for site 2. When we inspect the genomes of healthy people and patients, it appears that the green allele in site 1 is more frequently found amongst the patients. The blue and brown alleles of site 2 appear evenly spread across the healthy and disease groups. This suggests that the green allele of site 1 is more likely to be a risk-allele than the other alleles observed.

By contrast, observing the different alleles of a disease-neutral sequence variation would be equally likely in patients and in unaffected subjects. “The huge challenge in detecting the DNA sequence variations with an increased risk of juvenile diabetes and many other complex diseases is that, unlike single gene disorders (such as Cystic Fibrosis), the disease is driven by multiple sequence variations located throughout the human genome, as well as by the environment,” Jason explained.

“As the majority of disease-associated sequence variations are expected to make only a small contribution towards the risk of the disease, to detect them we need to conduct big studies with large numbers of patients and unaffected subjects.”

See Box 3 on page 21 if you are uncertain of some of the genetics terms used in this article.
A statistician uses software to look for patterns in the data. He or she is also involved in designing research projects to ensure that the data produced is useful.

A statistician uses software to look for patterns in the data. He or she is also involved in designing research projects to ensure that the data produced is useful.

Robotic machines are run by the geneticists to record hundreds of thousands of DNA sequence variations simultaneously. This technology has only been available in recent years and has revolutionised the research by empowering the scientists to survey more than 500,000 sequence variations very rapidly. The geneticists also work with the statisticians because many detection methods are based on mathematical models. As the data which the DIL is dealing with are large and complex, sophisticated computer systems are necessary to manage the records carefully and perform the analyses efficiently. Vincent Everett is the computer systems manager of the laboratory. "There are about ten I.T. professionals working here and we do a lot of computer related tasks such as designing a barcode catalogue system for the DNA samples and creating database software for integrating the information we generate at different stages of our research. Besides biology, skills in mathematics and computer science can also be readily applicable in medical research."

DNA samples are stored in liquid nitrogen at -196°C for future use.

### Table 1

<table>
<thead>
<tr>
<th></th>
<th>Single Gene Disorders</th>
<th>Multi-factorial Complex Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>Cystic Fibrosis,</td>
<td>Juvenile Diabetes, Rheumatoid</td>
</tr>
<tr>
<td></td>
<td>Huntington's Disease,</td>
<td>Arthritis, Multiple Sclerosis</td>
</tr>
<tr>
<td>Incidence</td>
<td>Tend to be rare</td>
<td>More common, incidence often</td>
</tr>
<tr>
<td></td>
<td></td>
<td>varies between populations /</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ethnic backgrounds</td>
</tr>
<tr>
<td>Disease</td>
<td>An individual who</td>
<td>Inheriting one or more risk-</td>
</tr>
<tr>
<td>inheritance</td>
<td>inherits a disease-</td>
<td>alleles could increase the risk</td>
</tr>
<tr>
<td></td>
<td>allele or becomes</td>
<td>of the individual developing the</td>
</tr>
<tr>
<td></td>
<td>a carrier (if the</td>
<td>disease</td>
</tr>
<tr>
<td></td>
<td>disease is a recessive trait)</td>
<td></td>
</tr>
<tr>
<td>Genetic location</td>
<td>Disease-allele(s) are usually found within a single gene (for example: the CFTR gene for Cystic Fibrosis)</td>
<td>Risk-alleles can spread over multiple locations in the genome and are sometimes found on a stretch of DNA outside genes</td>
</tr>
<tr>
<td>Environmental influence</td>
<td>Generally not influenced by external factors</td>
<td>Genetic risk of disease is greatly modified by the environment, for example: smoking, diet and infections</td>
</tr>
<tr>
<td>Disease mechanism</td>
<td>Disease-allele introduces changes in gene sequence which leads to disruption of the protein's or enzyme's normal functions</td>
<td>It is not entirely clear but the changes introduced by risk-alleles are likely to be very subtle and complicated</td>
</tr>
</tbody>
</table>

### Researchers in action

Jason works as a statistician at the Diabetes and Inflammation Laboratory (DIL) in the University of Cambridge with over 50 colleagues. "We have many people from a wide range of disciplines working here in the DIL," said Jason. The laboratory has connections with many hospital doctors and nurses for recruiting patients and healthy volunteers from all over the UK and many parts of Europe. Once the blood or mouth swab samples have arrived at the laboratory, there are molecular biologists who extract and process the DNA. They do so to ensure the high quality and continual supply of DNA for experiments.

Each plastic tube contains an individual DNA sample.

### What benefits will this work bring?

Laboratories such as the DIL hope to understand how the disease develops and, ultimately, to help prevent the disease. Since 2000, when the DIL was first established, they have found several DNA sequence variations, identifying regions of the human genome that influence juvenile diabetes susceptibility in Western European populations. Once a sequence variation has been identified, there are still many additional experiments required for scientists to understand how the sequence variation would lead to the destruction of the insulin-producing cells. For example, the changes caused by the DNA sequence variation to protein (e.g. enzyme) function and abundance, and subsequently to the immune system, are studied using biochemistry and cell biology techniques in the DIL.

When scientists have a better understanding of which DNA sequence variations are involved and how they are involved in juvenile diabetes, there will be more opportunities for finding new treatments, such as new drugs. Another future possibility is
gene therapy whereby the genes containing risk alleles are replaced by protective alleles. For this purpose, the identification of the genetic factors involved in the disease is essential.

A further prospect comes from the observation that some patients can respond to different drugs with varying degrees of success. In the future doctors might be able to prescribe treatments to individuals according to their genetic background and environmental exposure. The successes of the possibilities mentioned above will depend on the advances in science and the dedication of the scientists for many more years. Indeed, defeating a disease like juvenile diabetes is a very long battle. Nevertheless, a great deal of progress has been achieved by the DIL and other international efforts in recent years. It is hoped that having a cure for the juvenile diabetes sufferers like Jason will one day be a reality.

The DIL is supported by the charities Juvenile Diabetes Research Foundation (JDRF) and the Wellcome Trust. Information on juvenile diabetes can be found on the webpage of JDRF and Diabetes UK.

Look here!
The DIL is supported by the charities Juvenile Diabetes Research Foundation (JDRF) and the Wellcome Trust. Information on juvenile diabetes can be found on the webpage of JDRF and Diabetes UK:
www.jdrf.org
www.diabetes.org.uk
www-gene.cimr.cam.ac.uk/todd/

Each gene may exist in many forms, each one is called an allele, and this variation in which allele of each gene we have is at the heart of what makes us all different.

Box 3 Basic genetics

The cell nucleus contains all the genes of that organism. In a human, all the genes of that person, the GENOME are packaged on structures called chromosomes, 46 in humans. Like a string of beads on a wire, they are coiled up into the chromosomes.

These genes are packaged on structures called chromosomes, 46 in humans. Like a string of beads on a wire, they are coiled up into the chromosome.

Genes (and therefore alleles) are made of DNA, and the information they carry is stored in the sequence of bases.

Published incidence rates of type 1 diabetes in children (0-14 age range) (cases per 100,000 population per year)
Delving deeper into an article at ‘second glance’

Having completed the activity ‘Extracting key information from a scientific article at “first glance”’, students now develop their ability to gain a more detailed sense of the structure and subject matter of an article.

Outcomes
Students will be able to:
- locate the theme(s) and keywords within an article
- summarise the theme(s) of an article
- use these skills to make judgements about the value of an article based on browsing.

Time required
Allow 30 minutes.

Outline of the activity
The briefing sheet includes questions that relate to an article about using surfactants. These could easily be adapted if you wish to use other articles on topics of your own choice. All students could be issued with the same article, or you could get the students into pairs, with one student looking at the first article, and the other at the second. They could then discuss their findings at the end of the activity.

1 Ask ‘How can we draw information from the article without reading every word?’ If students stick with what they learned in the previous activity, point out that you are looking for a bit more detail this time. You could write some suggestions on the board.

2 Issue the article(s) to the students (unless they already have them) and the appropriate briefing sheets. Explain that they are being asked about where the answers to the questions are in the article, rather than the actual answers themselves. Give the students ten minutes to read through their article and complete the briefing sheet.

3 Go through the answers to the questions, identifying what students have done wrong if they do not have the correct answers.

Tips and strategies
It is important to ensure that students are aware that this ‘second glance’ approach is still a selective reading method which will require them to ‘skim read’ to an extent, rather than reading every word in the article. The tips given on the briefing sheets will help them to implement an approach that allows them to complete the task in the time specified.

The activities ‘Skim reading’, ‘Extracting key information’, and ‘Delving deeper’ follow a logical progression from very basic skim reading to the guided extraction of key information from articles. After completing ‘Delving deeper’, explain to students that they will benefit from using the skills they are learning in these activities, whether they are reading a chapter in a textbook, an article in a publication, or a website. This will help them to make judgements about the value of the article they are reading, as well as helping them to speed up the process of locating and extracting the information they are looking for.
Delving deeper into an article at ‘second glance’

Briefing sheet

In this activity you will develop the skills necessary to obtain information from an article.

You have ten minutes to look at the article you are given and answer the questions below.

Tips: Read the first line of each paragraph, note the keywords, look at the illustrations and captions and read through equations and formulae.

Part A Bibliographic details

1 Write down the following bibliographic details of the article:

Title: _________________________________________________________________________

Year of publication: ________ Place it was published: _____________________________

2 Who is (or are) the author(s)? __________________________________________________

Are they experts in this field? How do you know? ____________________________________

______________________________________________________________________________

3 What further information can you give about the author(s) (e.g. location, occupation, qualifications)?

___________________________________________________________________________

Part B Looking at the article

Write down where you found the answers (i.e. which page / paragraph in the article)
NOT the answers to the questions themselves!

1 How would you demonstrate the surface tension of water?

___________________________________________________________________________

2 How do molecules with hydrophobic and hydrophilic parts arrange themselves in water?

___________________________________________________________________________

3 What is the total volume of air in your lungs? ___________________________

4 What is ‘lung surfactant’? ________________________________________________
5 How many alveoli are there in human lungs? _____________________________

6 What happens to air once it is breathed into the lungs? ______________________________

7 Why are premature babies more likely to suffer from RDS? ___________________________________________________________________________________

8 What is the goal of current research into lung surfactants? _________________________________________________________________________________
Our lungs have a specially designed coating on the inside and without it breathing would be impossible. This coating is called Natural Lung Surfactant and it reduces the work required to breathe. When babies are born very prematurely they can lack this surfactant, and this can make it very difficult for them to breathe. This is called Respiratory Distress Syndrome (RDS). This article looks at the background science of lung function, the development of treatments for RDS and future research directions.

Breathing is something that each of us does on average more than 20,000 times per day, every day of our lives. The breathing rate is even higher, more like 70,000 per day, for newborns. This is something that takes place without us having to think about it; in fact it is impossible for a healthy person to stop themselves breathing. The structure of the lungs is crucial to this process but so too is the surface which separates the lung tissue from the air breathed in.

The structure of the lungs

The internal surface of the lung is coated with a thin layer of liquid. It is the surface of this liquid which is in contact with the air and which the oxygen must cross to get from the lung sacs into the bloodstream. The composition of this liquid is vital because if it does not have the right properties then breathing cannot take place. One of the crucial factors is the surface tension of the liquid surface. The surface tension of water arises because water molecules attract each other strongly - more strongly than they attract molecules of the air. So molecules at the surface of water are pulled inwards, into the bulk of the liquid. This makes it much harder for any substances to cross into the water – see Box 1.

You can see the effect of surface tension if you look at water droplets. They adopt a shape which gives the minimum possible surface area, so drops of water and bubbles of air in water are spherical. This surface tension effect can also be seen when water is placed on a surface it doesn't like, such as a car that has been waxed or the outer surface of a tent.

Box 1

The surface tension of water

Here's how to observe how the surface tension of water prevents transfer across the water air barrier. Take a small bowl or cup of water and float a pin on it. It is easy to do as the surface tension of the water is strong enough to prevent the pin from crossing the surface. This is the force that the lungs would have to overcome if they did not have lung surfactant. If a single drop of detergent is added to the water, the pin sinks straight away. In a similar way, lung surfactant makes it easier for oxygen to pass from the air in the lungs into the blood.
The surface tension of water pulls inwards on each droplet, preventing the water from wetting the entire surface.

The lungs are not two large empty chambers but consist of large numbers of bunches of alveoli. There are about 600 million of these very small circular chambers. It is these which are lined with liquid and which change their size during breathing. The strength of the surface tension over all the alveoli is so high that if they were lined with pure water breathing would be almost impossible. This is where Lung Surfactant (LS) comes in; one of its main roles is to reduce the surface tension of the lungs to enable breathing.

Respiratory Distress Syndrome (RDS), suffered by some premature babies, is a condition in which the lungs do not have sufficient LS. In a normal 9 month pregnancy, the lungs start to produce surfactants about 2 months prior to birth; babies born earlier than this are likely to have RDS because the strength of the surface tension forces makes it impossible for them to breathe. Prior to the development of treatments, RDS was a significant cause of death in premature babies.

### Surfactants

Surfactants, an abbreviation of SURFace ACTive AgeNTs, are molecules that stabilise the surface between water and oil or water and air by lowering the surface tension. One part of the surfactant molecule likes water (hydrophilic) while the other does not (hydrophobic.) Because of this surfactants congregate at water/oil or water/air surfaces reducing the surface tension. Surfactants are key components of many everyday products such as detergents, fabric softeners, emulsions and foods like mayonnaise. In applications using these products the surfactant stabilises the surface where the oil and the water meet. In a detergent, one part of the molecule (the hydrophilic part) will interact with the water while the hydrophobic part interacts with an oily stain to help remove it from the item being cleaned.

When you breathe in, air enters the internal space in the alveoli; oxygen diffuses across into the blood vessels, while carbon dioxide diffuses in the opposite direction.

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**Box 2: How big are your lungs?**

The total volume of air in your lungs is about 6 litres. However, the structure of the alveolus means that they have a large surface area.

Using the following information, you can calculate the surface area of a single alveolus and then the total surface area of the lungs.

- **600 million alveoli in lungs**
- **Radius of one alveolus = 0.1 mm**
- **Area = \(4 \times \pi \times r^2\)**
- **1000 mm = 1 m**

Is the total area closest to ...

- a. A football pitch (about 4500 m²)
- b. A squash court (about 65 m²)
- c. A double bed (about 4 m²)

Answers on page 21.
On the surface of water, surfactant molecules have their hydrophilic ‘heads’ in the water and their hydrophobic ‘tails’ in the air.

**Lung surfactant**

LS is a very complex mixture of many components with the majority being phospholipids. Phospholipids are the molecules that make up most of the body’s cell membranes and they can act as surfactants because they contain hydrophilic and hydrophobic regions. There are at least six different types of phospholipids in the LS mixture. There are also four different proteins which are a part of LS.

The behaviour of phospholipids has been extensively studied as they are a crucial component of every cell in the body. The Lung Surfactant Proteins have proved to be more difficult to study as purifying them from the lungs is a long process. Scientists have conducted experiments on the proteins to try to understand their size and shape at an air-water surface and how this is affected by phospholipids. This is a difficult system to study so experiments started with protein and have progressed to simple mixtures of protein with one or two of the main phospholipids. These experiments are not carried out on people or animals but in a lab using a Langmuir trough (see Box 3) which provides a good model system for the fluid layer in the lungs.

The Langmuir trough provides a way of controlling the amount of area at the air-water surface so we can simulate or model the difference between breathing in (large surface area) and breathing out (small area). Scientists then use a range of methods to study the different components as the area is changed to try to understand the location and possible role of each in the breathing process. As a result of experiments carried out over the years a number of treatments for infant RDS have been developed. These have resulted in a dramatic drop in the number of infant deaths from RDS.

A baby with RDS is usually helped to breathe in some way and given oxygen. If necessary, lung surfactant can be sprayed into the baby’s lungs along with the oxygen. Most babies who develop RDS now make a full recovery.

**Research goals**

The proteins used in these treatments come from animal sources (mainly cows) and this can lead to problems. The goal of current research is to improve our understanding of the role of the main components of LS so that the simplest possible treatment mixture may be used until the premature baby’s body can produce its own LS. The second aim is to work out how to synthesise the essential protein components, giving safer treatments which will be more widely available, particularly in the developing world.

**Stephen Holt** is a research scientist who works for the government-funded Science & Technology Facilities Council. His own studies are aimed at understanding the behaviour of surfactants and proteins at surfaces.

**Look here!**

Visit this Canadian website to see animations and to learn more about premature babies, RDS and lung surfactants.

http://tinyurl.com/yswwt4

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Make your own Langmuir trough and use it to measure surface tension - see Try this on page 21.
In this activity, students summarise information from three different sources on the same topic. This will help them with more complex activities they will encounter later on, such as writing an abstract.

### Outcomes
Students will be able to:
- locate and use three sources of information about a topic
- identify the key points covered in their sources
- write a summary based on their research.

### Time required
Allow 60 minutes plus homework (the research activity could also be set for homework, but some lesson time would be needed to brief the students).

### Outline of the activity
Management of the task depends on whether students are looking at the same topic (e.g. catalytic converters), or choosing their own. This outline assumes the former, but can easily be adapted.

1. Explain that the main purpose of the activity is to practise writing summaries.
2. Outline the topic that students are going to research in this activity.
3. Tell the students that they need to write a list of questions they would like to find out about. You could issue the briefing sheet to help them with this task. This should be done on an individual basis.
4. Give the students a few minutes to think about which sources of information they are going to use. Tell them to provide specific information about each source, saying ‘the Internet’ is not enough.
5. Explain briefly what you expect from the students in terms of their summary. See briefing sheet 2, issued to assist students with this task.
6. Students now need to carry out their research - this could be done in class time, or it could be set as homework. Ensure that students have access to required resources such as the Internet, library and textbooks.
7. Students could write their summaries in class if time allows, but it is probably more appropriate to be set as homework.
8. If time allows, you might organise peer assessment of the summaries, or you may mark them yourself.

### Tips and strategies
If you specify the topic yourself and you wish to steer the students in a particular direction to suit your teaching, you could select one resource (e.g. an article or textbook entry) to get students started. An article about fruit flies and genetic diseases is included as one possible source.

If some students find coming up with questions difficult, you could start a brief discussion so that students can share some ideas first.

Students should not get too carried away - they need to write a summary, not a review. You may choose to allow them to use more than three sources, but it would probably be inappropriate to use more than five.

Encourage students to explore using document templates. These can become more sophisticated as they learn about additional features.
Writing a summary

Briefing sheet 1

Your task is to write a summary of information from three different sources. Your teacher may give you a topic, or tell you to choose your own. This briefing sheet will help you to choose some questions to investigate.

Part 1  Selecting questions to find out about

1 Select your questions before you look at any sources of information. Write down a few questions (six to eight) you would like to find out about.

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

2 Which sources of information are you going to use? Be as specific as you can - do not just say ‘textbooks’ or ‘the Internet’, but give some idea of which books or websites.

_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________
_____________________________________________________________________

3 When carrying out the research task, you will need to make notes based on what you find in your sources of information. This activity is an opportunity to practise skills learned through other LSS activities, such as reading and representing text using visual methods.
SNAB

Topic 2

Writing a summary

Part 2 Writing a summary

This is a guide to the process of writing your summary.

As always, it is good practice to write a first draft. You could record your findings under the following headings before starting this.

1 Title of summary

2 Short introduction explaining why your questions are important, and how they relate to the topic.

3 Short explanation of how you found out the information and where you looked.

4 What are your conclusions about what you have learned?

The final draft of your summary should be in the following format:

Length: 1 page of A4 (no more than 500 words)
Font: Arial
Title: 16 point font, bold, centred
Name of author(s) and institution: 12 point font, italicised, aligned left (this is you and your school)
Summary text: 12 point font, aligned left
It is important to stick to the format specified, as many scientific publications and journals ask that articles are submitted in a particular format. In some cases, articles may be rejected if they are in an incorrect format.

5 Create a template in Word or another word-processing package to conform to this format. Save the template so you can use or adapt it in future. Send your work to your teacher electronically so they can check your template, or use other members of your group to review this work.
In this article we look at some basic aspects of GCSE genetics and then at how fruit flies are being used in novel ways to study genetic diseases.

The instructions for constructing a living organism are encoded in long molecules called deoxyribonucleic acid (DNA). DNA is contained within the chromosomes in the nucleus of every cell in all organisms larger than bacteria.

DNA and genes
The DNA molecules look like tiny twisted ladders; each rung on the ladder is formed by a pair of chemicals called bases (Figure 1). There are four different bases, symbolised by the letters A, C, T and G, that can pair up (A with T and C with G) to make the rungs. The order in which the bases are stacked up in the DNA molecule determines what the DNA does.

The function of much of the DNA in an organism is rather mysterious; some may have no function at all while some is involved in controlling the cell. Only small fragments of the total DNA have a clear function and these parts are called genes. The DNA in a gene tells each cell how to make a particular protein.

What do proteins do?
Proteins have a wide range of roles in cells, but we can think of them either as tools or as building blocks for the organism:
- They can be thought of as tools when they perform an action such as digesting food (digestive enzymes), releasing energy from sugar (enzymes in respiration), carrying oxygen in blood (haemoglobin) or acting as hormones (insulin).
- They can be thought of as building blocks when they make up bones, tendons (collagen), nails and skin (keratin).

To remain healthy the genes in the body must produce the correct amount of the right proteins. Small differences in genes cause the characteristics in people that we recognise as running in families, such as eye colour, hair colour, baldness and height. In animals and plants these genetic differences cause the characteristics that we can alter by selective breeding, such as milk production in cows or stalk length in wheat.
How do genes cause disease?
Random changes to a gene (mutations) may drastically disturb the activity of a gene. This can result in a marked imbalance in protein activity, which shows itself as a disease.

Alkaptonuria
The first genetic disease to be described, called alkaptonuria, was discovered by Archibald Garrod in 1908. Patients with this disease suffer with arthritis (pain and damage to joints) and Garrod noticed that their urine turned black when exposed to the air. The arthritis and the coloured urine are now known to be caused by the build-up of a chemical called homogentisic acid. Normally this chemical is removed by an enzyme (a specialised protein), but in sufferers the gene is mutated so that the enzyme is no longer active. If an individual inherits two copies of the mutant gene then he or she cannot remove homogentisic acid from the blood and develops the disease. Alkaptonuria is a rare disease.

Cystic fibrosis
One of the commonest genetic diseases in the UK is cystic fibrosis. This is caused by mutation in a gene involved in mucus production. Individuals with two copies of the mutant gene produce mucus that is too thick and sticks in the lungs, resulting in repeated lung infections. This thick mucus is also produced in the gut and from other internal surfaces of the body.

Haemochromatosis
Some genetic diseases are caused by mutations in genes that make their proteins overactive. Haemochromatosis, the most common genetic disease in the UK, is an example of this; in this case the mutant protein causes the body to absorb too much iron from the diet. Normally iron is required as part of haemoglobin, the protein that carries oxygen in red blood cells, but too much causes damage to many organs including the liver, heart and kidneys.

Alzheimer’s disease
Alzheimer’s disease is a common cause of memory loss in elderly people. About 5% of cases are caused by mutations that result in faulty forms of the enzymes that would normally remove a potentially toxic protein from the brain. Mutant forms of these enzymes allow the accumulation of toxic peptide fragments (called Aβ peptides). As these Aβ peptide fragments build up in the brain the nerve cells that are required for memory stop working and the patient becomes ill.

How do fruit flies get Alzheimer’s disease?
Genetic diseases are the subject of much research as scientists try to work out better treatments for them. One line of research is to utilise fruit flies with the human gene involved in Alzheimer’s disease. The fruit fly (Drosophila melanogaster) has been used in genetic experiments for 100 years (see ‘A life in science’, pages 20–21). Scientists are now able to make a lot of different transgenic flies by placing new DNA into their chromosomes (see Box 2 and Figure 3). If the DNA is a human gene then the flies can be made...
to produce the corresponding human protein. If the human protein is involved in human disease we may find that the fly will suffer a similar disease. We can then use these flies to test new treatments that could be useful for human patients.

We want to find treatments for Alzheimer’s disease, so we gave the fruit flies the human gene for the toxic Aβ peptides so that they produced the peptides in their brains. Using a microscope we looked carefully at the brains of the transgenic flies (Figure 2); we also measured their life-span and their walking abilities. We found that the Aβ peptides cause damage in the fly that is similar to the disease in the human brain.

Testing drugs for Alzheimer’s disease

Because the fly develops the disease within a few days, rather than after 50–60 years as in human patients, we can do experiments much more rapidly. Importantly, we can test new drugs on the flies by putting the drugs in their food and testing whether the flies live longer or walk better. Since the genes in flies and humans are very similar we can start to think about new drugs for human patients by using the genetic information that we get from the flies.

Damian Crowther qualified as a medical doctor and specialised in neurology (concerned with nerves and muscles). He now works on Alzheimer’s disease in the Departments of Medicine and Genetics at the University of Cambridge.

You will probably learn in your science course about how transgenic bacteria are made. Check that you understand this and compare it with Figure 3. Two enzymes are needed to insert the human gene and the red eye gene into the plasmid — what are they called?
Appropriate levels of communication

In this activity students pick out what makes a science story accessible and learn how to write at an appropriate level for a particular audience.

Outcomes
Students will be able to:

• write successfully for a desired audience
• use the Gunning fog index (GF index) to analyse their own writing.

Time required
Allow one hour.

Outline of the activity

In linguistics, the GF index is a test designed to measure the readability of a sample of English writing. The resulting number is an indication of the years of formal education that a person requires in order to understand the text easily on the first reading. That is, if a passage has a GF index of 12, it has the reading level of a year twelve student. The test was developed by Robert Gunning, an American businessman, in 1952.

The GF index is generally used by people who want their writing to be read easily by a large segment of the population. Texts that are designed for a wide audience generally require a GF index of less than 12.

It is important to consider how important the GF index is for different audiences.

Start off with extract 1 and extract 2 on the briefing sheet (‘Scintillate’ and ‘A research team’) and ask students to work out what they think both mean. Tell students they are likely to know both as famous nursery rhymes, but they are difficult to recognise because of the style they’re written in (‘Twinkle twinkle’ and ‘Jack and Jill’). They can use the dictionary (or thesaurus) to help them.

Some more examples of these texts are available on ‘If scientists wrote nursery rhymes’: http://www.rfcafe.com/miscellany/humor/scientists_nursery_rhymes.htm.

Once students have worked these out, ask them to get into twos or threes and using the three different pieces of text provided (see ‘Resources required’) work out the GF index for each. Run through how to calculate the GF index as given on their briefing sheet.

Ask students then to choose a paragraph of their own writing, and find out the GF index, and say what they think about this. Have a discussion about their answers to the final questions on their briefing sheet. Do students think that scientists have a responsibility to make themselves understood - to all, or just other scientists? Do all scientists understand all science?

Tips and strategies

It is useful to comment on and get students to comment on the style and clarity of texts they engage with in their studies. This encourages a more critical appreciation of written style.
In this activity you will examine texts using the Gunning Fog index (GF index) to measure ‘readability’ for an audience.

Part 1 What makes you choose a particular book / magazine to read?
Would you be looking for the same qualities when choosing to read science-based material?

Have a look at the following two extracts. Place a cross on the scales given below, to show your assessment for the extract. Use a different colour for each extract. Give reasons for your answers.

**Extract 2**
A research team proceeded toward the apex of a natural geologic protuberance, the purpose of their expedition being the procurement of a sample of fluid hydride of oxygen in a large vessel, the exact size of which was unspecified. One member of the team precipitantly descended, sustaining severe fractural damage to the upper cranial portion of his anatomical structure. Subsequently, the second member of the team performed a self-rotational translation oriented in the direction taken by the first member.

---

**Easy to understand**

**Difficult to understand**

**Enjoyable to read**

**Boring to read**

**Expecting too much prior science knowledge**

**Not expecting too much prior science knowledge**

**Expecting a high level of general vocabulary**

**Not expecting a high level of general vocabulary**

**Expecting a high level of science vocabulary**

**Not expecting a high level of science vocabulary**

---

**Extract 1**
Scintillate, scintillate globule aurific - Fain would I fathom thy nature specific Loftily perched in the other capacious Strongly resembling a gem carbonaceous.
What nursery rhyme does each extract refer to?

Extract 1: __________________________

Extract 2: __________________________

Have a look at the three pieces of scientific text supplied and work out the GF index. The GF index is an equation you can use to find out how many years of formal education someone needs to be able to understand your writing. The lower the number, the younger the audience could be and therefore the largest audience you could have.

To do this, you need to:

1 Randomly select about 100 words of text.

2 Find out the average sentence length by dividing the total number of words by the number of sentences.

3 In the same section, count all the words that have more than three syllables.

4 Then find the percentage of complex words by dividing the number of complex words (found in stage 3 above) by the total number of words in your chosen section and multiply by 100.

5 Add together the average sentence length and percentage of complex words.

6 Multiply your answer by 0.4.

GF index = 0.4 x ([average sentence length] + [percentage of complex words])

Now that you have worked out the GF index for all three texts, what can you say about each of them?

Text 1: __________________________

Text 2: __________________________

Text 3: __________________________
SNAB Topic 2

Appropriate levels of communication

Briefing sheet

Rewrite one of the passages using language that you consider is simpler and clearer. Recalculate the GF index for the passage. Discuss your original and edited passage with your group. Is it always a good thing to use the simplest possible language?

Find a piece of your own scientific writing. What is your GF index? How does it compare with the three texts above?

Part 2

In pairs, discuss the following:

1. Is it important to write in a way that all people can understand?

2. What makes a piece of writing interesting, apart from the actual subject content?

3. Do scientists have a responsibility to make themselves understood
   • by the general public?
   • by other scientists?

4. Do you feel you need to improve your writing style? If so, why? How will you do this?
**Appropriate levels of communication**

**Resource**

**Gene therapy success ‘reverses’ blindness**  
28 April 2008

Experimental gene therapy trials have improved the vision of four people who suffer from hereditary blindness.

The preliminary results of two independent studies suggest that “repair” genes delivered to the eye might one day cure Leber Congenital Amaurosis (LCA), a rare disease that strikes about 1 in 80,000 people in the UK, and 2,000 Americans in total.

Equally important, say researchers, the treatments proved safe in the six patients who received the genes - delivered by a disabled virus - via eye surgery.

“This is really an exciting result for gene therapy as a field,” says Katherine High, of the University of Pennsylvania Medical School in Philadelphia, who was part of an international team that presented the findings at a conference yesterday.

Another team led by Robin Ali, of University College London, presented similar results.

**Dog success**

In High’s trial, the vision of all three patients improved noticeably, while one of Ali’s patients saw well enough to navigate an obstacle course in dim light - a task that had been a struggle before the treatment.

While extremely rare, LCA is a debilitating disease that strikes patients at birth. As their retinal eye cells die off, most patients become completely blind by their 30s.

Mutations in at least six genes cause LCA, but both teams treated patients with a mutated version of a gene called RPE65, which is responsible for about 6% of cases.

In 2001, scientists reversed the blindness of dogs born with the same mutated gene. A harmless virus called adeno-associated virus injected a working copy of RPE65 to the animal’s retinal cells, kicking them back into action.

**Speedy improvement**

After proving the treatment safe in other animals, including primates, each team gave the modified virus to three LCA patients in their late teens and early 20s.

“They were not completely blind, but they were severely visually impaired,” says Jean Bennett, a colleague of High’s at the University of Pennsylvania. For instance, patients could see a hand waving in front of their face, but most had trouble reading any letters on an eye chart.

After receiving surgery to inject the virus into one eye - the weakest - all three of Bennet and High’s patients noticed quick improvement.

They saw better in dim light, and two patients could now read the first three lines on an eye chart. One patient, who fumbled through an obstacle course before the surgery, had few problems navigating after treatment.

**Youngest benefit**

So far only the youngest of the three subjects in Ali’s trial, an 18-year old man named Steven Horwath, has had improved vision after surgery. “Before the operation, I used to rush home from college when it started to get dark because I was worried about getting around,” he says. “Now I can take my time and stay later.
at college if I need to, for band rehearsals and things like that," he says.

Less subjective tests that gauge the eye's response to a tiny flash of light also indicated that patients' treated eyes had improved.

Both teams plan to test the therapy on younger patients who might regain even more of their sight. "I think the effect will be most dramatic in younger individuals, when the retina has not degenerated so extensively," Bennett says.

**Turning point**
The treatment also seems safe. Patients in both studies showed little immune response to the virus, a problem in some previous gene therapy trials. And the virus seemed not to stray from the eye region.

One patient in Bennett and High's study, a 26-year old male, developed a microscopic hole in his retina after surgery. The treatable complication didn’t worsen his vision, but it could be a problem for younger LCA patients with better sight, says Joan Miller, a retina specialist at Harvard Medical School in Boston, not involved in either study. But the success of both studies should buoy gene therapy's troubled past. "I think it could be a real turning point," Miller says.

Last year, a patient enrolled in a gene therapy trial to treat her rheumatoid arthritis, died - although regulators say the therapy probably didn’t cause the patient's death. And in 1999, 18-year-old Jesse Gelsinger died after receiving gene therapy to cure a rare metabolic disease.

*From: New Scientist Magazine*
http://www.newscientist.com
Copycat

In this activity students learn what plagiarism is and why it is wrong.

Outcomes
Students will be able to:

- explain why plagiarism is wrong
- describe ways to combat ‘accidental’ plagiarism
- recognise signs of plagiarism
- explain how to remember without memorising (by visualising).

Time required
Allow one hour.

Outline of the activity
Plagiarism is passing off somebody else’s work as your own. It can range from getting someone else to write your work or cutting and pasting from the Internet to incorrectly referencing information in your work. There are useful tutorials on plagiarism available on the Internet. An example is listed below:

http://www2.le.ac.uk/offices/ssds/sl/resources/writing/plagiarism/plagiarism-tutorial

Give students a copy of the briefing sheet and explain what plagiarism is. Ask them to work out which extract in each example on their briefing sheet is the non-plagiarised one, and why.

Have a short discussion with the class about how and why people plagiarise. Reasons could include:

- laziness - not making an effort to come up with another way of writing a phrase
- accidental - taking notes from an article without referencing it in your notebook so you believe it is your own work
- memorising - learning words by rote can lead to ‘regurgitating’ words without meaning to
- ‘no one will notice’ - it is blatant copyright infringement if you decide to take credit for the hard work of someone else.

Then give students copies of the abstract. Ask them to read it thoroughly and then turn the page over. Without referring to the abstract students should write down everything they remember from it in their own words.

Tips and strategies
This activity can be run with 5.7 Writing a scientific review article. Once students have understood the concept of plagiarism, they should be better able to summarise without copying.

A good idea is to ask students to use highlighter pens to find out how much of a text resembles the original. The more highlighter used, the more likely the text has been plagiarised.

A tip for teaching students to learn without memorising is to promote the skill of visualising what is happening in the text whilst they are reading it. This allows them to remember the gist without the actual specific words. It is detailed reading and note-taking that usually results in plagiarism.

The topics of copyright, ownership and patent law could be discussed in this activity, especially with regards to discoveries in science such as Alec Jeffreys’ work in DNA fingerprinting.

Students may need help with some of the terms in the abstracts mentioned such as polymorphism, microsatellites and PCR.
In this activity you will learn about plagiarism and why it is wrong.

1. What does plagiarism mean?

2. Do you think plagiarism is over emphasised? Give a reason for your answer.

3. These three extracts have been taken from the *New Scientist* article: ‘Controversial forensic DNA test gets the green light’. Below each is a way of rephrasing the extract. Can you spot which one in each case has not been plagiarised?

**Extract 1**

Although Caddy’s report backs the science behind the analysis, it criticises the lack of uniformity in the way that police forensics teams collect and interpret DNA evidence, and the lack of awareness that contamination with DNA could falsify matches.

i. Even though Caddy’s report backs the science behind the analysis, it doesn’t back the lack of uniformity in the way that forensics teams collect and translate DNA evidence, and the fact they are not aware that contamination with DNA can falsify matches.

ii. Caddy has said that forensic teams do not all collect and interpret the evidence that they find. There is also the added problem of forensic teams not realising that contamination with other DNA can lead to the wrong conclusion.

iii. Caddy’s report might have supported the analysis’ science, but it criticises the lack of uniformity in the forensics team’s collection and interpretation of DNA evidence, and that contamination with DNA could falsify matches.
Extract 2

There are also technical problems with the process caused either by the unexpected appearance in DNA profiles of extra chunks of DNA, or the disappearance of chunks that should be there. The former is caused by contamination, the latter because working with such tiny quantities means sometimes the amplification enzymes miss bits of DNA.

i Sometimes through contamination we find that there are DNA sequences that are not supposed to be in the profile. Alternatively, the amplification enzymes miss sections of DNA and these sections will not appear in the profile.

ii There are technical difficulties with the process when there is either a sudden appearance of extra chunks of DNA, or the disappearance of bits that were meant to be there. The first appearance is because of contamination, the disappearance is because of working with small amounts so the amplification enzymes miss chunks of DNA.

iii The technical problems which occur are caused by contamination where there is the unexpected appearance of extra chunks of DNA, or the disappearance of chunks which should be there, which is caused by working with such tiny amounts of DNA, that the enzymes don’t work properly.

Extract 3

As to the technique itself, the panel said it was satisfied that the three organisations offering the service to the police in the UK had each taken the required steps to ensure reliability and repeatability, even though the validations hadn’t been independently peer-reviewed and published.

i Regarding the technique itself, the panel were happy that the three organisations offering the service to the UK police force had made sure that they had ensured reliability and repeatability, even though this had not been independently published and peer-reviewed.

ii The panel says of the technique, that it was satisfied that those organisations offering the service to the police had each taken the required steps to ensure reliability and repeatability without independent peer review and publication.

iii All reliable techniques are usually written up, submitted for publication and undergo the peer-review process. However in this case the panel stated that the organisations offering the technique had done more than enough to make sure that results would be reproducible and accurate.
4 Have a look at the abstract entitled ‘Application of plant DNA markers in forensic botany’ (http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6T6W-4JVTCD-1&_user=10&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&acct=C000050221&_version=1&_urlVersion=0&md5=d5019bda6ff843f2b4603f109bf0f4aa). Read it, and ask your teacher or look up the terms you do not understand. Turn over the abstract so that you can no longer see it and then write down what you remember in your own words.

5 In your group, discuss how similar to the original your ‘remembered’ versions are. Then agree and write down three key points for avoiding plagiarism in your work. You should consider methods of taking notes and remembering which are less likely to result in exact repetition of sources.
Controversial forensic DNA test gets the green light

April 2008

A super-sensitive method of DNA fingerprinting has been declared fit for purpose by a panel of UK experts.

“We are happy that the science is sound and secure, and that the systems have been properly validated and are fit for purpose,” said Brian Caddy of the University of Strathclyde, UK, and head of the panel which published its report on 11 April.

The low-template DNA technique has seen increasing use because it works on picogram amounts of DNA – that’s the amount found in as few as four or five human cells. Conventional DNA only works at nanogram levels, where there are about 160 cells or more, the number in a tiny speck of blood.

The UK government commissioned the study after severe criticism of the technique last year. A suspected terrorist, Sean Hoey, was acquitted of planting a bomb in Omagh, Northern Ireland, that killed 29 people in 1998.

The trial judge criticised the technique and Northern Ireland police suspended its use.

National standards

The technique is still used in mainland Britain, however, and has helped solve high-profile international cases, such as the murder in 2003 of Swedish MP, Anna Lindh, and the murder in 2001 of Briton Peter Falconio in the Australian outback.

Although Caddy’s report backs the science behind the analysis, it criticises the lack of uniformity in the way that police forensics teams collect and interpret DNA evidence, and the lack of awareness that contamination with DNA could falsify matches.

It recommends introduction of national standards to correct this, and courses to train forensics teams how to collect and handle DNA for LTD analysis.

The default, according to co-author Adrian Linacre, also of the University of Strathclyde, should be that samples are collected on the assumption that they might at some point be subjected to LTD analysis.

Extreme caution

To avoid contamination of samples either at the crime scene or in the laboratory, collection kits should be standardised and guaranteed to be DNA-free, through treatment with chemicals such as ethylene oxide.

There are also technical problems with the process caused either by the unexpected appearance in DNA profiles of extra chunks of DNA, or the disappearance of chunks that should be there. The former is caused by contamination, the latter because, working with such tiny quantities means sometimes the amplification enzymes miss bits of DNA.

Another problem is that the enzymes can be inhibited by innocuous substances such as blue dyes in denim jeans.

The panel therefore warns that results from LTD analysis should be interpreted with extreme caution in court cases, and expert witnesses should go no further than simply saying that the profile matches that of a defendant.
The report says juries should always be told that “the nature of the original starting material is unknown, that the time when the DNA was transferred cannot be inferred, and that the opportunity for secondary transfer is increased in comparison to standard DNA profiling”.

**Validation needed**

“It is inappropriate to comment upon the cellular material from which the DNA arose or the activity by which the DNA was transferred,” it continues.

As to the technique itself, the panel said it was satisfied that the three organisations offering the service to the police in the UK had each taken the required steps to ensure reliability and repeatability, even though the validations hadn’t been independently peer-reviewed and published.

However, the panel said that for the method to be accepted internationally, it needed to be validated by an international panel.

“The lack of clear, explicit consensus reflects the extremely challenging nature of the analysis,” says the report. “At the same time, it is clear that the need to articulate such a consensus at national and, ideally, at international level is pressing.”

Linacre said that use of the technique is definitely spreading – it is now used in the Netherlands, Germany, New Zealand and Australia, as well as in the UK and in parts of the US.

From: *New Scientist* magazine

http://www.newscientist.com
Students revisit the skill scientific writing, this time with a focus on writing for a more general audience. This is akin to the sort of writing found in newspapers, magazines and some websites.

Outcomes

Students will be able to:

1. demonstrate an appreciation of the different language and writing style required for articles for different audiences
2. write a summary article on a difficult A-level topic which is aimed at an audience of GCSE students
3. communicate scientific ideas to individuals whose understanding of the underlying science is not as extensive as their own.

Time required

Allow 20 minutes introduction in class plus homework.

Outline of the activity

The task requires students to write an article for an audience of GCSE science students. You may wish to review again the differences between a scientific article and a scientific paper. Students should also consider the difference a GCSE audience will make to the style and of their writing. With the class you may wish to construct success criteria for the activity. An example is listed below.

A good GCSE Science article should be between 500 and 1000 words long and include:

1. an explanation of the background of the topic
2. why the topic is important to them
3. sentences and paragraphs concise and punchy
4. topic sentences at the beginning of paragraphs
5. language a GCSE student would be familiar with
6. helpful images.

1. Start by issuing copies of an article (or several articles) written for a general audience on a science-related topic.

2. Ask the students ‘How does the content and style differ from the scientific articles we have looked at previously?’

3. Issue the student briefing sheet. There is space on the sheet for students to make notes when you outline the topic and run through your requirements - you can tailor the guidance to the topic / specification you are teaching. The task of writing the article can then be set as a homework.

Students first write an article on an A-level topic for GCSE students. The main body of the article should be written so as to be accessible to all GCSE students. Students then write a ‘Science in-depth’ section at the end presenting the A-level aspects of the science, still using language appropriate to the audience.

Then students summarise the article in 100-150 words (with one diagram / illustration) to explain the significance of the topic to primary school students. This will involve the students using a range of skills that they have developed during the LSS activities.

If possible, part of the assessment should include showing the article written in part 1 to some GCSE students, particularly those who have expressed an interest in studying A-levels. These articles could be combined with posters from Activity 6.7 Preparing a scientific poster to form part of an ‘A-level taster day’ for GCSE students interested in further study.

Tips and strategies

No attempt has been made to write a guidance sheet specifically for an advanced-level topic owing to the wide variation in the requirements of the different exam boards in this area.
Part 1

You will write an article for a magazine or website which is aimed at GCSE students. Information on the structure of your article is given below, and there is space for you to make notes on the scientific topic and content that you are writing about which your teacher will cover.

Structure of the article

The main body of the article should be written in a style that any GCSE student should be able to understand. You should explain the background to the topic, and why it is important to them and to the rest of us. It is helpful to include images, and to keep sentences / paragraphs concise and punchy. The article should be between 500 and 1000 words long.

At the end of the article, you should write a section called ‘Science in-depth’ where you present advanced-level aspects of the topics, including equations and formulae if appropriate and examples of calculations if this is relevant. You should still try to write this in a way that a bright GCSE student will be able to understand.

The topic and scientific content

The topic your article is going to be on is:

You must cover the following material from your A-level specification:

Further requirements of your work (e.g. illustrations, formulae, equations) are:

Part 2

You will write a 100-150 word summary of this article to explain to primary school students why this topic is important to them. You should include some simple scientific ideas and one illustration. (If you are unsure what level these students are at, do some Internet research on the material examined in Key Stage 2 Science SATS.)

Write three main points summarising the differences in writing for these two audiences. Discuss this in your class.
Matching graphs

Students develop skills in analysing graphs and matching graph shapes to different phenomena.

Outcomes
Students will be able to:

- demonstrate a familiarity with different shapes of graphs
- formulate appropriate labels and units for the axes of graphs
- relate graph shapes to scientific understanding of different concepts
- give a verbal description and explanation of the shape of a graph.

Time required
30 minutes.

Outline of the activity
This activity looks at different shapes of graphs and how they describe the relationship between two variables. It is a revision activity from GCSE and is therefore a good starting point for work on graphs. Students should already know that:

- the independent variable is the one you change and it is on the x-axis
- the dependent variable is the one you measure and it is on the y-axis
- a straight line shows a proportional rate of change
- curves show an increasing / decreasing rate of change
- a straight horizontal / vertical line means no change for one of the variables.

You will need to copy and cut out the cards in resource sheets 1 and 2 for each pair or group of students. Six cards with outline graphs and a corresponding six cards with descriptions of the situations that the graphs represent are given out. Students can work individually or in pairs or groups to do this. Issue the briefing sheet which outlines the requirements of the activity.

Tips and strategies
This activity would be suitable as an introduction to an AS course or as a revision activity.

It can be used to assess students’ prior knowledge of a range of topics, or to assess students’ skills and knowledge of How Science Works.

The activity could introduce complex units such as rates.

This activity could be varied by providing some ‘blank graphs’ so students have to sketch the graph using the description.
Matching graphs

Briefing sheet

For this activity your group will be given one set of cards with graphs drawn on them, and another set with captions, or for Physics, cards with \( x \)-axis and \( y \)-axis variables on them.

1. In your group, discuss the cards and match each graph to the correct caption (or \( x \) and \( y \)-axis variable).

2. Agree and write down an explanation of the shape of each graph and how you came to your decision about which caption went with each graph.

3. Write down appropriate labels and units for both axes on each graph.

4. Compare your answers for Question 2 and Question 3 with those of another group. Agree which would be the best answers for each question.

5. Back in your original group, allocate one graph to each student. Prepare a scientific explanation for your graph’s shape, and suggest other variables that would produce a similar shape.

6. Present your explanation to the rest of your group. Discuss any new ideas you have learned during this activity and make a note of these.
Adding an inhibitor caused a rapid decrease in enzyme activity.

The plant grew slowly at first, then more quickly. It reached a height of 50 cm after ten weeks.

The amount of DNA in a cell nucleus doubles before mitosis starts, then returns to normal after division of the cytoplasm.

My heart rate rose quickly to 100 beats per minute during exercise. It took longer to fall back to normal when I stopped. My heart rate was back to normal five minutes after I started exercising.

When the hedgehogs were first introduced to the island, their numbers increased rapidly, beyond the point where there were 50 breeding pairs.

The rate of photosynthesis increased with increasing light intensity until the light intensity approached 50 units.
Matching graphs

Biology resource 2