Exploring Science Extra

How Science Works

Christmas trees

4

ALWAYS LEARNING

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4 Exploring Science Extra

Introduction

Welcome to the latest Exploring Science Extra pack. As we approach the Christmas season, we're taking a look at the trees we use for our celebrations.

This pack includes a Student Knowledge Booklet and a Teacher's Guide containing suggested activities, some of which come with an Activity Sheet.

Each activity is linked to a unit from Exploring Science, making the pack easy to incorporate into your teaching. We hope that the activities will inspire and stretch students, whilst still developing key scientific skills.

Did you know?

Science GCSEs will be replaced by a new exam (probably called an EBC) for first examination in 2017. This may all sound like a long way off but actually it's the current Year 7 students that will be the first cohort to take these exams! It is, therefore, important for students to start developing the skills they will need for these exams now.

The ability to write longer-style answers is tested in the new GCSEs. It is likely that this ability for students to express themselves clearly and concisely in written answers will become more important, given that the EBCs will be based on terminal exams.

So, in this pack there is further help for students in structuring longer pieces of writing. In the last pack we looked at how to develop an argument and in this pack there are opportunities to plan, analyse and construct longer-answer style questions and answers.

Also, remember that each Exploring Science HSW unit ends with a 'Have your say box'. These boxes can be used in the same way as the ideas given in this pack for developing questions and planning long answers.

As ever, we value your feedback and ideas. So keep them coming! Tell your rep or contact us through the website
http://www.pearsonschoolsandfecolleges.co.uk/Secondary/GlobalPages/ExploringScienceExtra/ExploringScienceExtra.aspx

With all good wishes for the rest of the winter term,

Mark

Mark Levesley,
Series Editor

We would like to thank Chal Landgren, of the OSU Extension Service, Oregon US for kind permission to use his photo of aphid pests on page 4.

Members of the staff of CLEAPSS have read the practical notes and worksheets in this pack, however where there is a hazard, the *employer* is required to carry out a risk assessment under either the COSHH Regulations of the Management of Health and Safety at Work Regulations.

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1 A history of Christmas trees

The first Christmas trees

Long before Christmas was introduced as part of Christian celebrations, people in northern Europe celebrated the middle of winter with feasting, light and decoration. Plants that keep their leaves through winter (evergreens) were thought to be magical, protecting against bad spirits. So branches of conifer trees, holly and ivy were used to decorate houses.

Nobody really knows when the tradition of decorating a whole tree began. The earliest records are from the 1400s in what is modern-day Latvia and Estonia in northern Europe. Conifer trees were brought indoors and decorated with sweets and fruit as part of the Christmas festivities.

A *Decorating a Christmas tree with sweets has been a tradition for many centuries. Children were allowed to take the sweets and fruits as gifts on Christmas Day.*

When Christianity was introduced into a country, it absorbed many of the existing celebrations. The giving of gifts at midwinter, the Twelve Days of Christmas, and the Yule log are all thought to be leftovers of older European winter festivals.

B *The Christmas tree in Trafalgar Square, London.*

Developing the tradition

In the 1700s, bringing trees into the house and decorating them for Christmas became popular in parts of Germany. The trees were often decorated with burning candles to increase the amount of light indoors.

The tradition spread slowly. The first record of a Christmas tree in the UK is from the early 1800s when King George III's German wife, Queen Charlotte, brought the idea with her. The idea didn't become really popular in the UK until after 1840 when Queen Victoria married Prince Albert, who was also German and liked a Christmas tree each year. Many families copied the idea and brought a tree indoors to decorate at Christmas.

By this time the tradition had also spread to North America, through several German connections. In the early 1900s many American cities and towns put up large decorated Christmas trees in public spaces. This is now copied in many parts of the world, even where Christianity is not the main religion.

The Trafalgar Square Christmas tree is a gift to the people of London each year from the people of Oslo in Norway. The gift remembers the support that the British gave to the Norwegians in the Second World War, in their fight against the Nazi invasion.

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2 Choosing a Christmas tree

Many people prefer a natural Christmas tree. A real tree brings the smell of conifer woodland into the house, and often reminds adults of their childhood Christmases.

There are three groups of trees grown for the Christmas market; spruces, firs and pines. Each group has its own characteristics. Within each group there may be several species on offer. Here are some of the ones you might see, along with some of their advantages and problems.

Spruce

C *Close-up of a spruce twig.*

Norway spruce is one of the most popular Christmas trees. These trees grow well on many UK soils, which usually makes them the cheapest tree of any height. They can be pruned easily to create a good pyramid shape, and the strong branches are good for decorating. If they are not well-watered, they rapidly drop their needles, which can mean a lot of clearing up after Christmas.

Blue spruce is similar to Norway spruce, but with an attractive blue tinge to the needles. The needle points are very sharp, so it is not a good tree where there are children or pets. It is also more expensive than a Norway spruce.

Fir

Firs have blunter needles than spruce, and hold on to their needles better if they dry out. Nordman fir has become the most popular Christmas tree for this reason. It has dark green needles and strong branches. However, it is usually much more expensive than a Norway spruce because it grows more slowly and so needs more care until it is large enough for sale

D *Close-up of a fir twig.*

The Noble fir has a blue-green colour and bushy habit, so there are lots of branches for decoration. They are often more expensive than Nordman firs.

Pine

Not many people buy these because they don't usually grow in a pyramid shape. The trees also have much longer needles than spruce or fir, which can make it more difficult to hang decorations. Some people like their unusual shape, and particularly their strong pine smell. They also hold on to their needles better than the other trees.

E *Close-up of a pine twig.*

The easiest way to tell the difference between conifers is their cones, but trees sold at Christmas aren't usually old enough to have cones. So you will have to look at the needles to help you work out which species you have.

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3 Artificial Christmas trees

Natural trees have two big disadvantages – they can make a terrible mess if they start to drop their needles and, unless they still have roots, they have to be thrown away after the decorations are taken down. This can feel like a big waste of money.

The first artificial trees were made in Germany in the late 1800s, from goose feathers that had been dyed green. Artificial trees became much more popular during the last 50 years as cheap plastics were developed. Artificial trees not only became much cheaper than natural trees, they could also be put away with the decorations for use again the next Christmas.

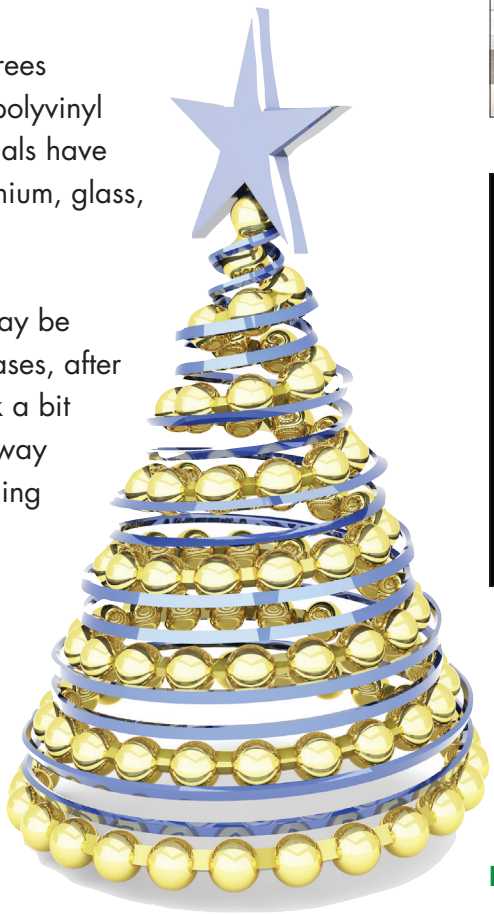
Most artificial Christmas trees today are made of PVC (polyvinyl chloride), but other materials have been used, such as aluminium, glass, ceramic, and even ice!

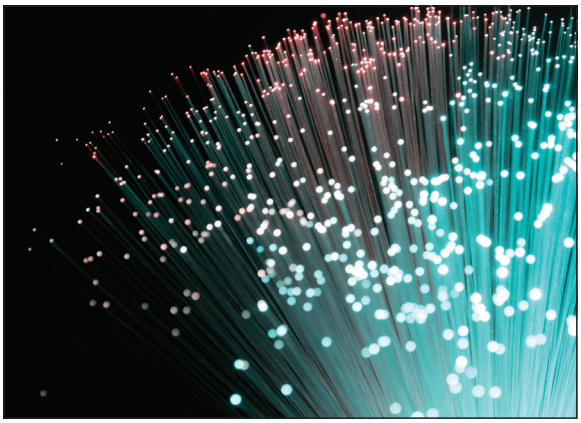
Although artificial trees may be re-used for a few Christmases, after a while they begin to look a bit tatty and so are thrown away and replaced with something new.

Every year there is a big debate about which is more environmentally friendly – natural trees or artificial trees. There are many arguments for both types.

F *Plastics can be made in any colour, so you can have a tree that matches other colours in your room …*

G *… or you can have a colour-coordinated Christmas.*





H *Colour changing fibre optics can be used to make an artificial tree so that there is no need for additional fairy lights*

I *Does a 'Christmas tree' need to be a tree at all?*

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4 Growing Christmas trees

J *Tree seedlings are mulched with a natural material, such as bark chips, to help stop weeds growing.*

Over 6 million natural Christmas trees are sold in the UK every year. Most of these trees have been grown by specialist growers on 'Christmas tree farms' or nurseries.

Seeds are planted in small pots and kept well watered and protected. The seedlings will be kept in pots until they are large enough to be planted out.

Before the seedlings are planted in the ground, the area is thoroughly cleared of weeds. This is so that weed plants don't compete with the young trees for water and nutrients in the ground. It also stops the larger weeds growing taller than the seedlings and shading them.

The ground is prepared by adding fertiliser and materials to improve drainage, as conifers do not like to be waterlogged. The acidity of the soil may also need to be increased, as conifers generally grow better in acidic soils.

It takes six or seven years for a Norway spruce to grow big enough to be sold as an average-sized tree. It takes longer for a large tree or for slower-growing species.

During this time, the young trees need to be looked after. They need to be pruned, so that they develop the perfect 'Christmas tree' pyramid shape, which will sell better than a ragged shape.

Growing many trees of the same kind in an area attracts pests more easily. So the trees also need to be protected from large herbivores such as deer and rabbits, and from insect pests such as aphids and beetles.

The insect pests attract many insect-eating birds, like bluetits, long-tailed tits, chaffinches and sparrows. However, the birds might not eat enough of the insects to prevent them damaging the trees, so the grower will need to spray the trees with chemical insecticide.

A grower will have different areas planted in different years, so that there is a new crop for harvesting as the next Christmas approaches. Then it's out with the chainsaw to cut down the trees, wrap them and transport them to the shops and garden centres where people will buy them.

K *The trees in a Christmas tree nursery need plenty of space to grow into the right shape.*

L *Aphid pests can spoil the look of a Christmas tree so people won't want to buy it.*

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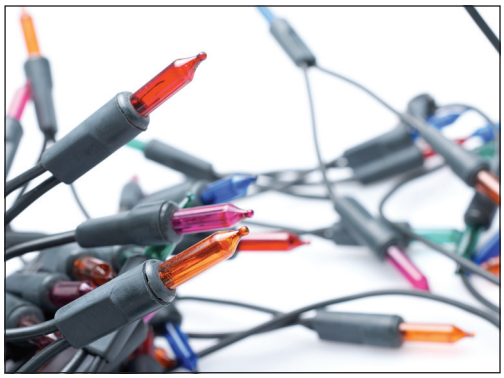
5 Christmas lights



M *Mini filament bulbs were used in Christmas decorations.*

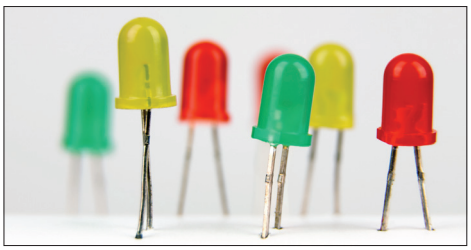
Most people decorate their Christmas tree with lights. Back in the 1700s they attached candles to the ends of the tree branches, but this was a bit of a fire hazard! Today we use electric lights … and often not just on the tree!

Until recently most bulbs used in Christmas decoration were filament bulbs. These were made in a wide range of colours by changing the colour of the glass around the filament. The light produced by the filament is a white light, but the glass colour filters out other colours in the white light so that only the light of the same colour as the glass passes through.

Filament bulbs are not very energy-efficient. Around 80% of the energy they receive is transferred into heat energy, which isn't useful. In fact, if bulbs get too hot, they can cause fires. To make the bulbs safer for Christmas decorations, the bulbs were kept small and low-powered.

From 2009 in Europe, filament bulbs began to be phased out and replaced by low energy bulbs. The ban on filament bulbs increased the rate of development of other types of lights, including LEDs (light-emitting diodes).

LEDs are small lights, which are ideal for making Christmas decorations. They transfer around 80% of the energy they receive as light energy and so are much cheaper to run than filament bulbs. They are also cooler to handle and safer to keep lit over a long period. The disadvantage is that they are more expensive to buy than other types of bulb. The good news is that they don't break as easily and so a set of LED lights can last many years.



N *LED bulbs can be made to glow in different colours.*

A string of lights can be wired in series or in parallel to achieve different effects. Some sets contain a flasher bulb that causes the other bulbs to switch on and off in a regular pattern. Some sets contain several strings of series bulbs, where the strings run in parallel, so that the separate strings can shine different colours or flash on and off in different patterns.

O *Large-scale Christmas light displays can use a lot of electricity and cost a lot to run, but they can also be spectacular.*

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4 Christmas trees

General note: If you are planning work on using Christmas tree lights, consider doing this in January when lights are often much cheaper in shop sales, or you can ask for old unwanted sets from Freegle/Freecycle, students and colleagues. This may be the only way to get hold of lights containing filament bulbs as these have mostly been replaced with the LED-type.

Identifying Christmas trees

***Exploring Science* link: 7D**

This activity gives students the opportunity to create an identification key for a range of different conifer species that are used as 'Christmas trees'.

Ask students to read page 2 of the Student booklet to identify some of the different species sold as Christmas trees. They should then carry out research on the internet, in gardening books or from some real samples, to identify the key features of each species. Suitable websites include:
http://www.bio.brandeis.edu/fieldbio/pkenlan/HTML/common_alpha.html
http://www.british-trees.com/treeguide

Using these features, they should try to construct their own identification key. There are various ways of doing this. They could try to find one feature that splits the group into two smaller groups, then another feature that splits a smaller group into two even smaller groups and so on. Worksheet 7Dc(6) in the Y7 Activity Pack can help with visual organisation of this. Alternatively, ask students to research some samples of identification keys on the internet, and to use these as a basis for their own identification key. For example: http://www.forestry.gov.uk/forestry/INFD-5G2KV3

The right kind of soil

***Exploring Science* link: 7E**

This is a simple practical activity to measure the pH of a range of soil samples. Activity Sheet 1 supports the activity.

Safety note: Soil samples should be collected before the lesson from areas where contamination with animal waste is not likely. Hands should be washed thoroughly with anti-bacterial soap immediately after handling soil.

Ideally, collect soil samples from different areas and test beforehand to make sure they produce a range of pHs from about 4 to 8. If you cannot collect a suitable range, then adjust some samples with a small amount of either calcium carbonate (produces a more alkaline soil) or ammonium sulfate (decreases pH) to produce a range of pHs for the lesson. Add a little of the chemical at a time, and mix thoroughly before testing using the method on the Activity Sheet, until you have the required pH. Wear eye protection when carrying this out.

The last part of this activity is an opportunity to plan how to adjust the pH of a large area of soil for growing Christmas trees. This can be done simply as an extension of the original method, by adding different amounts of the chemical to similar-sized soil samples and measuring the effect on pH. The challenge is then to apply that in a quantitative way to a large area of ground. This may be best done as a class or group discussion to consider not only the mathematics required but also issues such as the volume of soil that conifer roots occupy within that area.

Resources (per group/student): test tubes + bungs (one each per soil sample), tube rack, marker pen, barium sulfate, distilled water, soil samples, Universal indicator in dropping bottle, Universal indicator pH colour scale, spatulas, Activity Sheet 1, eye protection. **Extension:** calcium carbonate, ammonium sulfate.

Lighting up the tree

***Exploring Science* link: 7J**

This is a practical problem-solving demonstration. It gives students an opportunity to apply their knowledge of series and parallel circuits to explain how strings of Christmas tree lights are wired, and to explain the effect of a bulb blowing or being removed. Students could read the related information on light circuits on page 5 of the Student Booklet before the demonstration. They could also carry out research on the internet or in books before or after the demonstration to develop their understanding. Suitable web sites include: http://hippocampusphysics.blogspot.co.uk/2009/02/how-christmas-tree-lights-are-wired.html, http://people.howstuffworks.com/culture-traditions/holidays/christmas-lights.htm, http://www.ciphersbyritter.com/RADELECT/LITES/XMSLITES.HTM.

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4 Christmas trees

You will need several strings of low-voltage filament bulb lights that respond in different ways to a bulb blowing or being removed, such as none, some or all of the other bulbs are affected. (Longer strings often contain two or more series strings in parallel, so sections of bulbs will not light if one in that section has blown or been removed.)

Note that LED Christmas lights are not suitable for this activity, as they rarely break, often cannot be removed from the string, and do not have a 'shunt' inside the bulb which in filament bulbs completes the circuit when the lighting filament has broken.

Safety note: Do not attempt to remove a bulb from a string of lights while the lights are lit using mains electricity.

If possible, start with a 'simple' set, where all bulbs behave in the same way to a 'blown' bulb. Plug the string of lights into the mains to show that all the bulbs work. With the mains electricity switched off and the plug removed from the mains socket, remove one bulb from the string. Plug the set in again and switch on, and ask students to record the result (no bulb should light). Encourage discussion either in small groups or as a class to explain the result. This should revise series circuits.

Replace the bulb and show that the circuit is complete again by lighting the set. Repeat the exercise with different sets of strings, where different proportions of bulbs don't light when a single bulb is removed or has 'blown'. This should help students revise parallel circuits, as a set of bulbs on each circuit within the string will behave in the same way but independently of other sets. Ask students to draw the appropriate circuit for each string of bulbs.

Many strings of filament bulb lights have a shunt at the base of each bulb. Its job is to ensure that the other lights will still illuminate if the filament inside one bulb ‘blows’. You may need to practise this beforehand but it may be possible to twist a bulb slightly, in order to twist the wires to the bulb and cause a short-circuit without breaking the bulb shunt. Ask students to predict the effect of this, using their knowledge of circuits to explain their answers. Switch the set on and ask students to record the result (the twisted bulb should not light, but all the others should). Again encourage discussion to explain the result. Tell students about the shunt and its purpose. They should understand that the shunt carries the current through the bulb so that the series circuit is not broken even if the main filament in the bulb has broken.

Resources: Several strings of decorative Christmas tree lights of different kinds that contain filament bulbs; replacement bulbs.

Series or parallel

***Exploring Science* link: 7J**

Ask students to think about series or parallel lights for use on a Christmas tree, using page 5 of the Student Booklet for information (which could be supplemented by internet research). Ask students to design a long-answer question about these different arrangements of bulbs, using one of the command words on the top of Skills Sheet 61 *Planning long answers (comparing)*, which is in this pack. Decide on one question and then help students to use SS61 in order to write a long answer.

Resources (per student): Skills Sheet SS61.

Building a food web

***Exploring Science* link: 8D**

In this literacy-based activity, students can use a range of sources to gather information for building a food web. Some information is provided in the Student Booklet. More-detailed information is presented in Activity Sheet 2 in the form of a blog. Students could also research additional information from garden books or the internet by searching for pests of typical Christmas tree species such as Norway spruce and Douglas fir, and then for predators of the pests.

Encourage students to use suitable strategies for identifying and recording useful information, such as skimming and scanning for plant and animal names, highlighting key words, and recording in lists, tables or concept maps. Skills Sheet 59 *Taking notes from science writing* provides support for this.

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4 Christmas trees

When students have at least 10 species that belong to a coniferous tree community, ask them to use the species to construct a food web. Before they begin, remind students to identify the level in a food chain that each organism belongs to, and to arrange their food web with producers at the lowest level and the top predators at the highest level on the page. If they are unsure, also remind students that arrows are drawn in the direction from the food to the consumer. When they have finished their food webs, encourage discussion in pairs or small groups to compare and contrast different webs.

Resources: Activity Sheet 2, Skills Sheet SS59.

The true cost of Christmas trees

***Exploring Science* link: 8F**

This activity is linked to work on recycling, but also covers aspects of life cycle assessment (7I) and the impact of farming on the environment (9C), and so could be used at any of these stages with appropriate adjustment for the main focus of learning.

In the activity, students either prepare a written argument or prepare to take part in a debate. For either task, challenge students to write lists of benefits and drawbacks of plastic Christmas trees and real Christmas trees. Then share Activity Sheet 3 with them, so that they can compare their ideas with another set of ideas. Further information could be researched from books or on the internet. A suitable site is:
http://www.guardian.co.uk/lifeandstyle/2005/dec/06/shopping.ethicalmoney.

If students are going to write written arguments, use Skills Sheets SS61 (from this pack) to help them design a question on this topic and then plan their answers using tables. They can then use Skills Sheet SS60 (from the previous Exploring Science Extra pack) to help them write their answers. If students are going to have a debate, they should use SS41 (found in the Year 7 Activity Pack).

Resources: Activity Sheet 3: Skills Sheets SS41, SS60, SS61.

Coloured Christmas lights

***Exploring Science* link: 8K**

Christmas light decorations are a good opportunity for students to explore the effect of colour filters on what we see from coloured lights. This can be done quite simply by providing students with a string of different coloured Christmas lights and a range of colour filters, and asking them to observe, record and try to explain what they see.

Safety note: Students should not attempt to remove a bulb from a string of lights while the lights are lit using mains electricity.

Alternatively, ask students to compare how incandescent lamp bulbs and LEDs are used in Christmas lights to produce different colours. They should start by looking at individual bulbs and LEDs, and should discover that lamp bulbs produce white light that is then adjusted to produce colour using a colour filter. Ask students to explain why the resultant colour is what we see.

In contrast, LED lights produce light of a particular colour (at a particular wavelength). To make colour-changing LED bulbs, three LEDs of different colours can be enclosed in the same 'bulb'. A switching of electricity through each LED produces the range of colours that we see. Give students the opportunity to investigate the effect of mixing colours of light. The internet activity on http://www.omsi.edu/tech/colormix.php could be used to support this. Alternatively students will need three torches and a range of coloured filters.

Suggest that a manufacturer wants to make a bulb that changes through the colours of the rainbow. Challenge students to work out which three colours of LED light would be needed, and how the lighting of each LED would need to be changed to produce the colours of the rainbow.

This work could be extended by asking students to explain how a string of lights of changing colours could be produced. Examples can be seen on the Internet for use as stimulus, such as:
http://www.youtube.com/watch?v=-nvdNrK1Z8k.

Resources (per student or group): strings of coloured filament Christmas tree lamps and of LED lights, selection of different coloured filters, three torches.

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4 Christmas trees

GM Christmas trees

***Exploring Science* link: 9A**

Students could use what they know about the characteristics of organisms and genetic modification to suggest how they could produce their perfect Christmas tree. Ideas, such as a tree that glows without the need for lights, could be researched on the internet. A suitable site for this is: http://www.telegraph.co.uk/topics/christmas/8215302/The-science-of-Christmas-we-could-grow-our-own-fairy-lights-say-the-tree-wise-men.html

Students could then suggest how they would create the GM tree, and how they could use cloning to produce many identical trees for sale.

Alternatively, ask students to think about a spruce Christmas tree that has been genetically modified so that its needles never fall off (even when it is totally dry) and that automatically grows in a pyramid shape. Ask students to design a long-answer question about these trees, using one of the command words on the top of Skills Sheet 61 *Planning long answers (comparing)*, which is in this pack. Decide on one question and then help students to use SS61 in order to write a long answer. Page 2 of the Student Booklet provides information about spruce trees.

Resources (per student): Skills Sheet SS61

Alternative Christmas trees

***Exploring Science* link: 9H**

Ask students to work in groups to design an 'alternative' Christmas tree using new materials. They should start by brainstorming a range of ideas and what effect they are trying to achieve with a new material. Some ideas are provided in the Student Booklet, but others could be researched from the internet or Christmas magazines to stimulate discussion.

The group should then decide on one particular idea and develop that to identify the materials used to make the 'tree'. The materials do not need to be similar to anything that currently exists, but students should identify the characteristics required by the material and suggest some of the starting materials that could be used to make it.

Each group could present their design to the class and a vote taken on the idea that uses the most exciting idea for a new material.

Electricity problems with fairy lights

***Exploring Science* link: 9I**

This activity gives students an opportunity to use their maths skills to carry out various calculations relating to the use of filament bulbs and LED lights in Christmas decorations. It also asks students to draw Sankey diagrams for the energy transfers by each type of light.

Some students may need support with some of the calculations. The answers are:

1 LEDs are 4 times more efficient than filament bulbs.
3 Filament $0.5 \times 60 \times 60 = 1800$ J; LED $0.06 \times 60 \times 60 = 216$ J
4 Filament £49.99; LED $3 \times$ £24.95 = £74.85
5 Filament: $1800 \times 10 \times 12 \times 300 = 64\,800\,000$ J = 64.8 MJ;
LED: $216 \times 10 \times 12 \times 300 = 7\,776\,000$ J = 7.8 MJ
6 LEDs use less power than filament bulbs and are easier to use without breaking. So they will cost less to use over many years.

Resources (per student): Activity Sheet 4

Which bulbs?

***Exploring Science* link: 9I**

Ask students to think about filament bulbs and LED bulbs for use on a Christmas tree, using page 5 of the Student Booklet for information (which could be supplemented by internet research). Ask them to design a long-answer question about these different bulb types, using one of the command words on the top of Skills Sheet 61 *Planning long answers (comparing)*, which is in this pack. Decide on one question and then help students to use SS61 in order to write a long answer.

Resources (per student): Skills Sheet SS61

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1 The right kind of soil

All kinds of Christmas trees are conifers, and most conifers grow better in soil of a pH of 5.5 or lower. You are going to test some soil samples for pH, to decide which soil would be best for growing Christmas trees.

Safety

Wash your hands thoroughly after handling soil samples. Wear eye protection.

Apparatus

test tubes, bungs + rack
marker pen
barium sulfate
distilled water
soil samples
Universal indicator in dropping bottle – FLAMMABLE
pH scale
spatulas

Method for testing soil pH

A Label one test tube for each soil sample.

B Use a spatula to place a small amount of barium sulfate into each test tube.

C Use a clean spatula to measure twice as much soil as barium sulfate into the first test tube.

D Using a clean spatula each time, repeat step C for each soil sample.

E Fill each test tube to about 3/4 full with distilled water.

F Add 5 or 6 drops of Universal indicator to each test tube.

G Insert a bung into the top of each tube and shake each tube well until everything is well mixed.

H Leave the tubes to stand in the rack until the solids settle. This should leave a clear, coloured liquid at the top of the tube. Record the colour for each soil sample.

I Compare the colour of the liquid with a pH chart and record the pH for each soil sample.

Recording your results

1 Draw up a table to display your results.

Considering your results/conclusions

2 Use your results to decide which soil would be most suitable for growing Christmas trees in. Remember to explain why you think that sample would be best.

3 Christmas tree growers can adjust the soil pH by adding other chemicals, such as lime (calcium carbonate) to increase the pH, or ammonium sulfate to reduce pH. Choose one of your soil samples that has the wrong pH for growing Christmas trees, and plan how you would work out how much lime or ammonium sulfate to add (e.g. to a square metre of ground) so that the soil has a pH that is ideal for growing Christmas trees.

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Jemma's wildlife blog

Jemma's wildlife blog

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Posted by Jemma 10 December 2011

Just had a brilliant day at my friend Joe's Christmas tree farm, looking out for all the wildlife I could spot. Must admit, I wasn't too hopeful at the start, when Joe showed me the area they had just planted. The ground was completely cleared apart from the tiny tree seedlings, so that the seedlings could get a good start without being smothered by lots of weeds. When the trees are older, this isn't such a problem as they are tall enough to get all the light they need. The area had a high fence around it, to keep out the deer and rabbits – Joe said deer loved the tender shoots of the seedlings and would eat the lot given the chance. Looking round this area, we hardly saw a thing except a few birds flying over.

Things were a lot better in the older plantations. I hadn't realised the trees take 6–7 years to grow large enough for sale as Christmas trees – even longer if you want a big one. All that time Joe has to keep a close eye on them to make sure nothing is causing damage. Joe's greatest fear is woolly aphids – tiny things you can easily miss. They make a white woolly coat to protect them while they sit and suck sap out of the tree through a mouth tube that's like a minute syringe. If there are enough of the little pests, it can cause needle-drop, make twigs go brown and even make the top of the tree all bunch up. Nobody wants to buy a Christmas tree like that!

There are lots of other insect pests too, like moth caterpillars that eat through shoots and buds. But while we were out on our walk, Joe and I spotted some of the 'good guys'. There were ladybirds and spiders on the prowl for juicy aphids to eat. There were also lots of hoverflies hanging around. We watched them feeding on the pollen of some of the weed flowers nearby, but Joe explained that their young stage, the larvae (that look like little green caterpillars), are also great eaters of aphids. So that's why he lets the weeds grow when the trees are big enough.

I'm glad I had my birdwatching binoculars with me, as we had a great time watching a small family of blue tits working their way up and down the tree branches hunting out insects to eat. There were a lot of chaffinches too, some of them after insects in the trees but others collecting seed off the grasses around the trees. The birds all scattered very suddenly as a sparrowhawk zoomed through like a missile just over our heads. It was so quick that it managed to grab a chaffinch as it went through the trees. Later we spotted a small ring of feathers where the hawk had stopped to eat its kill.

I also spotted a buzzard overhead – the largest bird of prey in the area. Joe said it was on the lookout for small rabbits and mice that are its favourite prey. It wasn't lucky while we were there, but maybe it did better when we went back to Joe's house for a cuppa and left the place in peace.

As I said, a great day wildlife watching. I hope Joe manages to keep all those pests at bay so I can get the perfect tree for my Christmas decorations this year!

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3 The true cost of Christmas trees

Is it better to buy a real tree each Christmas and throw it away at the end of the festive time, or to buy an artificial plastic tree that 'lasts a lifetime'?

There are many more costs to producing Christmas trees than the price we pay for them in the shops. Before answering this question we need to consider all the costs we can find. Here are some costs – you may find others in your research.

Plastic trees

- Many materials may be used for making artificial trees, but most trees are made from PVC (polyvinyl chloride), a plastic. This plastic is made from oil, a fossil fuel that is a non-renewable resource.
- Artificial trees don't usually 'last a lifetime'. However, they are usually used for several years until they start to look a bit old and tatty. Then they are thrown away.
- Most artificial Christmas trees are produced in distant places such as China. This means they must be transported to the UK for sale. Transport costs include the use of fuels for transportation, as well as additional plastic and cardboard for wrapping.
- PVC is a plastic that can easily be recycled for use in other plastic products.
- Plastic that is disposed of in landfill tips may take centuries to break down, and may release toxic chemicals during the decay process. Plastics that reach water systems are a major source of pollution in the oceans.

Real trees

- Conifers are generally slow-growing trees. It can take 6–7 years to grow a typical 2-metre high 'Christmas tree'. Many of the trees we buy at Christmas have been grown in the UK.
- Trees need to be fed with fertiliser to encourage healthy growth. Artificial fertiliser is produced from chemicals often starting with non-renewable resources that are mined. Fossil fuels provide the energy for making artificial fertilisers. Natural fertilisers (such as manure and compost) may not be available in large enough quantities.
- Trees need to be protected from browsing animals, such as deer and rabbits. They also need to be treated with pesticides if they are attacked by a large number of pests. Pesticides are made from chemicals, often starting with oil.
- Most people buy a cut tree, which will only last a few weeks even if cared for properly. After that, the needles start to drop off the tree. Container-grown trees will not drop their needles if cared for properly and can be used the next year if they have been looked after properly.
- If real trees are disposed of in landfill tips, the wood will take many years to decay. The decay process may produce methane gas, which is flammable and can cause tip fires if not controlled properly.
- Many councils will shred real trees and turn them into compost and mulch for use in parks and gardens. This natural use returns nutrients to the soil. However, you may have to take your tree to the council disposal site rather than have it collected by the council refuse collection service. Some people don't bother with this and just dump their old tree on rough ground.

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4 Which type of light?

Christmas tree lights may use mini filament bulbs or LEDs (light-emitting diodes).

The table shows some data about the two types of lights.

	Mini filament bulbs	**LED lights**
Energy efficiency	20% light	80% light
Electric power per bulb	0.5 W	0.06 W
Cost of a string of Christmas lights	£49.99 for string with 300 bulbs	£24.95 for string of 100 LEDs

Use the data to answer the following questions.

1 The electrical energy is transferred by the bulb or LED to the surroundings as light energy (the useful energy) and heat energy (wasted energy). Compare the efficiencies of the two types of lights.

2 Use the information on energy efficiency to draw a Sankey diagram for each type of light.

Look at the power used by each type of light. This is the amount of energy (measured in joules, J) transferred by the light into light energy and heat energy every second. (1 watt is the same as a transfer of 1 joule every second, or 1W = 1 J/s)

3 Calculate the number of joules of electrical energy transferred in one hour by each type of light.

4 A family has a large Christmas tree that they want to decorate with 300 lights. Use the data in the table to calculate the cost of buying enough lights of each type.

5 Use your answer to calculate the cost of running 300 lights of each type over the Christmas period, that is for 10 hours a day over the 12 days of Christmas. (*Hint:* to make large numbers easier to handle, joules (J) can be converted to kilojoules (kJ) by dividing by 1000 or even megajoules (MJ) by dividing by 1 000 000.)

6 Filament bulbs break quite easily if they are not handled carefully. However, a broken bulb can be replaced easily with a new one. LED lights are much less likely to break. Use this information and your answer to question 5 to suggest why LED decorative lights are rapidly replacing the mini filament type.

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SS61 Planning long answers (comparing)

Some questions require you to compare things in a longer piece of writing.

What does the question mean?

These questions will start in one of these ways:

Compare: Point out the similarities/differences or benefits/drawbacks of two things.

Evaluate: Point out the good/bad points about an idea (or two ideas) and use these points to say whether overall you think an idea is good or bad.

Discuss or 'Explain why': Use an argument in support of or against an idea. See Skills Sheet SS60 for how to structure an argument.

How to think about the question

Plan your answer. Try using a table for good/bad points or similarities/differences.

For example:

Evaluate the advantages and disadvantages of using hydrogen rather than petrol as a fuel for cars.

Advantages of hydrogen	*Disadvantages of hydrogen*
Lots of water to make hydrogen from	*Expensive to produce (uses electricity)*
Hydrogen engines only produce water	*Difficult to store*
Hydrogen engines don't release greenhouse gases	*Fossil fuels may need to be burnt to make electricity to make hydrogen*

You use a paragraph or two to compare these points. Then you say if, on balance, you think hydrogen is a better fuel. Grammar, punctuation and spelling are important!

A problem with petrol is that it's made from crude oil, which may run out. Hydrogen is made using water, and that won't run out! However, it is expensive to make and fossil fuels may be used in power stations to make the electricity to make the hydrogen. These release greenhouse gases. At least though, if we all used hydrogen cars our cities would be less polluted. Hydrogen is hard to store but scientists should find a better way to store it. So, I think that it's better than petrol.

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