Paper and Sustainability Background Information

Geography Studies 11-18

These notes accompany the PaperWorks Pack 3 whiteboard presentation:
https://www.paperworks.school/slides/geo.html
and are free to use within the classroom.

BACKGROUND INFORMATION

Introduction

These notes provide essential background reading for PaperWorks Pack 3 – Geography Studies.

Sustainable Development is defined as 'development which meets the needs of the present without jeopardising the needs of the future. In other words, developing in a way that does not exploit all of the resources available and leaving some for future generations.'

Students wishing to research background information can use the online study area at www.paper.org.uk/paperworks where they will find background information and facts & figures about the modern papermaking industry and links to the websites of many paper-related organisations.

The online presentation provides an insight into the UK Papermaking Industry. It is an energy-intensive industry which has adapted to become highly sustainable. Amongst the key issues facing the industry are those of energy and water which are explored in more detail in these notes.

The Paper Industry uses large amounts of energy and water in the production of paper. To maximise efficiencies, paper mills employ modern Combined Heat and Power systems (CHP) and recycles and returns much of the water used in papermaking.

Of the fibres used to make paper in the UK, over 70% comes from recovered paper recycled by households and businesses. The rest comes mainly from virgin wood fibre from trees grown in sustainably managed forests.

The presentation consists of an interview with the Operations Director of one of the UK's largest paper mills – Smurfit Westrock – in Birmingham. The mill takes recovered paper from the West Midlands area and turns it into the brown paper used to manufacture cardboard. Not only does it use recovered paper to create its product, it uses a CHP plant and recycled water in its papermaking process.

For younger students, this case study provides an invaluable stimulus to the study of sustainable development, whilst for GCSE and A level entrants it will help complete projects exploring contemporary geographic issues in globalization, sustainability and the impacts of industrial development.

Modern Papermaking Production

The Modern Papermaking Process

The papermaking process starts with plant material, usually trees, and changes it into the common everyday product we know as paper. The woody part of the tree, within the bark, is made up of tiny strands of cellulose (fibres) held together by a natural glue called lignin. The first part of the process is to separate the fibres into a pulp, a concentrated mixture of fibres in water, which is then remixed to form the paper.

Virgin Pulp Production

Virgin pulp is made from brand new trees. Trees are primarily harvested for construction. It is the remaining wood that is selected for paper production (forest thinnings and sawmill waste). To separate the fibres, bark is first removed and the wood chipped. There are then two ways in which the fibres can be separated: Chemically or Mechanically. The mechanical process uses heat and pressure along with rotating steel discs or grindstones. Not all the lignin is removed in this process. Chemical pulp is produced by "cooking" at a high temperature and pressure with added caustic and sulphur where all the lignin is dissolved away. The pulping methods produce pulps of differing properties for different paper grades.

Recycled Pulp Production

What is amazing about paper is that over 70% of the time it is made from *paper* not trees – used paper sent for recycling is recovered and reused to make new paper. This paper is called "Recovered Paper" or "The Urban Forest". The recovered paper is blended or pulped with chemicals to separate the fibres. If necessary, any ink can be washed or floated off. Debris is removed by washing and screening. It is important to note though that fibres can only be used between 4 and 7 times before they become too small and weak to produce paper and are washed out of the system. Some virgin pulp will, therefore, always be needed to replace those lost fibres.

Papermaking

All pulps have different properties and can be blended to give the right characteristics in the finished paper – newsprint needs to be opaque (difficult to see through) so you can see what you're reading, not the other side; grocery bags need to be strong, tissue soft and writing paper smooth. The fibres can be dyed or whitened if necessary, and other ingredients added to change the characteristics of the paper. The next step is sheet formation where the blended pulp is diluted in more water before being strained through a fine moving mesh. The resultant fibre web is pressed through rolls to squeeze out the water then passed over hot cylinders to dry before being wound onto a reel at the end of the paper machine.

Modern Papermaking Uses

It is easy to underestimate how many day-to-day products are made from paper. It's used in celebratory items such as Christmas crackers, birthday cards, present wrapping and tissue paper, and in essential items like toilet paper, packaging, currency, nappies, stamps and even insulation. Did you know that tea bags are made from paper too because paper is so strong and flexible?

Many occupations rely on paper materials as well. Doctors and Nurses need masks, caps and bowls, and car factory workers need roof liners and filters for cars. The list is endless.

Paper recovery and recycling

About half of UK paper mills use fibres from recovered paper, the other half use mainly virgin wood fibres from trees grown in sustainably managed forests.

Recovered paper is a plentiful source of papermaking fibres, and the amount of paper and board collected for recycling has nearly trebled over the last 20 years. Because paper fibres increasingly degrade in the recycling process, new virgin fibres often from recovered paper that has not previously been recycled are added during the papermaking process.

Without virgin fibres, from new trees, the paper cycle can neither begin nor continue.

The importance of paper

We have a digital version for just about anything now. From music and books to newspapers and games. While technology development is dynamic and exciting, many of us still enjoy the tactility, familiarity, history and accessibility of paper. Paper, unlike the latest mobile phone or computer game, will not go out of fashion. It is convenient, discrete, and you'll never have to worry about its battery life! The digital world is certainly not removing the need for paper.

Paper is here to stay and pupils should be aware of how the Paper Industry is contributing to environmental improvements.

Energy Issues in Papermaking

Making paper is intrinsically energy intensive, with electricity used to drive machinery, and heat to dry the paper once it's made.

Some mills will buy their electricity from the national grid and have boilers powered by gas to provide heat – very similar to houses.

Normally, energy costs make up around a third of the cost of making paper and so it makes sense both on economic and environmental grounds to reduce energy use in paper mills.

Indeed, between 1990 and 2010 the UK Papermaking Industry reduced energy use by 42% per tonne of paper and emissions of fossil carbon dioxide by 1.6m tonnes each year.

These efficiencies come, in part, from common sense measures as taken in all households like using more energy efficient appliances, turning off lights and being careful not to waste energy.

However, to achieve such massive savings mills have also made large investments to fundamentally change the way they work.

In the UK, over 70% of the paper is made using recovered paper recycled by households and businesses. Re-using paper of course makes common sense as well as being energy efficient – it's much more resource efficient and requires less energy to prepare the fibre as well as helping pay for recycling collections! Some paper mills only use recovered paper to make the new paper they sell – complete closed loop recycling in action.

To achieve even greater energy savings and slash carbon emissions, larger and more complex mills have often taken control over their energy use by building their own power stations to allow the heat, normally wasted in electricity generation, to be put to good use. These Combined Heat & Power (CHP) plants are more efficient in their operation, reducing energy costs and carbon emissions.

An increasing number of mills also make use of waste products to make energy. A number of CHP plants at paper mills are powered by waste wood – using such a renewable resource reduces the emissions of fossil carbon and as a consequence paper production can be zero carbon. In some instances, making paper can even be energy positive with excess electricity and heat exported from the site for use elsewhere. Some paper mills even make use of the paper fibres they can't re-use to make new paper by using them to make biogas used to make heat to help dry the new paper.

Water and Papermaking

Water plays a big part in the manufacture of paper and board, with the amount of water needed to make a tonne of paper varying from around 5 m3/tonne to over 100 m3/tonne for some very special grades of paper. The Paper Industry in the UK uses around 79,339,000 m3 of water each year.

It is very important to note that although the water is needed for manufacturing paper, less than 20% of this water is actually consumed within the product or lost through evaporation. Over 80% is used, cleaned and put back into rivers, estuaries or other watercourses.

Some of the water needed is for cooling down the machinery. This cooling water, once used, is collected and re-used. On the other hand, by far the most water is used as a carrier to take the paper fibres through to the paper machine. In the papermaking process, paper pulp is diluted with water to form a suspension of fibres in water. This suspension is jetted onto a moving wire on the paper machine. The paper sheet forms as a fibre mesh on the wire as the water drains through. The water is collected and re-used many times in the process.

Water is a key natural resource for the paper industry – we cannot make our products without it. The paper industry, therefore, has long understood the importance of water and the necessity to conserve its supply. Paper mills manage their water use, considering possible opportunities for water recovery and re-use. Targets are set and, with advances in technology, the amount of water needed has reduced.

Today, when looking at the sustainable use of water, we need to understand more about where and how the manufacture of paper impacts the availability of water, right through from raw materials to the final product. Water footprint looks at the amount of water needed throughout the production chain of paper. Water footprint divides the water into three different types – green, blue and grey. Green water represents the natural water cycle – the water evaporated by trees. Blue water refers to water withdrawn from rivers, lakes and aquifers. Grey water represents the amount of water needed to assimilate the remaining pollutants after cleaning process wastewater.

Results to date show that water for growing trees is the main contributor to the total water footprint of paper. In other words, most of the water needed to produce one sheet of A4 is used in the forest as part of the natural water cycle. According to a pilot study, 60% of paper's water footprint is green water, 1% is blue water and 39% grey water. Around 99% of the water footprint comes from the supply chain and the remaining 1% from the actual paper mill production processes.

Water Stewardship is another standard important for the sustainable use of water. This sets out to define how we manage water use and its re-use and, most importantly, return the water back to the environment.