
PLASTIC V. PAPER: BATTLE OF THE BAGS

This lesson uses the case study of the choice to be made between plastic and paper bags, embedding learning on life cycle assessments (LCAs), product use cycles and the limitations of LCAs

LESSON OBJECTIVES

Students will be able to:

- Recall the key terminology associated with LCAs
- Discuss some of the limitations of life cycle assessments
- Consider product cycles for both paper and plastic bags

SUMMARY OF TASKS

Before undertaking this lesson, students should have been introduced to LCAs and the key terminology associated with them. This could be through the 'Life Cycle Assessment' lesson plan.

INTRODUCTION

- Ask students to complete the first part of the 'Plastic v. Paper' activity
- Come together as a class to recap the main stages in the product consumption cycle and LCAs

ACTIVITY

- Ask students to complete the second part of the 'Plastic v. Paper' activity in small groups

DISCUSSION

- Come together as a class to discuss the activity which has been completed and present some of the facts and figures included in the 'Plastics v. Paper' fact sheet. Student could be prompted to think about:
 - Materials which make up the bags
 - Differences in use and the number of times the bags can be used
 - Issues with disposal of the bags
- Watch the 'GCSE Chemistry - Life Cycle Assessments (LCAs) #58' video¹ (6 mins)
- Either in small groups or as a whole class ask students to discuss some of the points raised in the final part of the video about the limitations of LCAs. Students could be asked to consider:
 - How LCAs could be used in a misleading way by plastic bag producers
 - How LCAs could be used in a misleading way by paper bag producers

RESOURCES/ EQUIPMENT

- 'Paper v. Plastic: Battle of the Bags' fact sheet
- 'Paper v. Plastic: Battle of the Bags' activity
- 'Life cycle assessment' fact sheet

HOMEWORK/ EXTRA ACTIVITIES

- Ask students to research biodegradable plastic bags as an alternative and develop an LCA for this option.

¹ https://www.youtube.com/watch?v=ScY_Yb1V8AY

FACT SHEET: PLASTIC V. PAPER: BATTLE OF THE BAGS

FACT SHEETS HAVE BEEN DESIGNED FOR TEACHER USE TO AID CREATING OF TEACHING RESOURCES, OR THEY ARE FREE TO BE REPURPOSED FOR STUDENT USE.

There is no simple answer to the question of whether it is better to choose a plastic or paper bag when you are given the choice in the shop. It has made the national news.²

PART 1 - INTRODUCTION TO LIFE CYCLE ASSESSMENTS (LCAs)

Life Cycle Assessments look at all the resources which are used throughout the whole life cycle of a product – often from manufacturing, to transportation/distribution, use, recycling, and disposal - to consider the environmental impact of a product. Through an LCA you can compare several different factors such as the CO₂ produced, energy used etc.

To be able to compare two products, such as a paper bag to a plastic bag, you need to complete a *comparative LCA*. This is not an LCA, however highlights some of the processes which would need to be considered when collecting data for an LCA.

LIFE CYCLE STAGE	PAPER CARRIER BAGS	PLASTIC CARRIER BAGS
EXTRCTION OF RAW MATERIALS	From timber/wood – are the trees grown sustainably? Wood needs to be pulped and then processed – energy intensive process Lots of unusable waste from the pulping processes	From crude oil – non-renewable resource Oil undergoes fractional distillation, cracking and polymerisation Generally, all the oil is utilised, and there is very little waste – as all of it is somewhat valuable
MANUFACTURE	Paper is processed using machinery – the amount of energy required should be considered Water is also necessary during manufacture – and the amount needs to be considered There will be pollution created during manufacture	Plastic is processed using machinery – the amount of energy this requires should be considered Water is also necessary during manufacture – and the amount needs to be considered There will be pollution created during manufacture
DISTRIBUTION	Multiple stages of distribution in this process – but mainly the transportation of the bags from the location of manufacture to the place of use	There is more than one stage of distribution in this process – but mainly the transportation of the bags from location of manufacture to the location of use – often in cardboard boxes
USE	There is no direct environmental impact using the bag as it is intended Generally, not very strong so cannot be used multiple times – considered single use	There is no direct environmental impact using the bag as it is intended Generally, quite strong so can be reused multiple time Easy to store for reuse
DISPOSAL (END OF LIFE)	Recyclable They are biodegradable Non-toxic	They are not widely recycled and hence always end up in landfill They are not biodegradable Often end up in the environment

² <https://www.bbc.co.uk/news/business-47027792>

Paper Recycling and Life Cycle Assessments
Age Range: 11-18 years

PART 2 - PAPER BAG CONSIDERATIONS

- Paper production/manufacturing:
 - Produces around 70% more air pollution than plastic bag production.
 - Produces up to 50 times more water pollution than plastic bags.
 - Four times more energy required than making a plastic bag.
 - Three times the amount of water then making a plastic bag.
- Paper bags weigh approx. 8x that of a traditional plastic bag – which impacts the energy costs of transportation.
- Although paper bags can (and should) be recycled, if they end up in landfill the conditions are such that paper is not able to be recycled.
- Paper bags are bulkier than plastic bags, hence take up more room in landfill.

PART 3 - PLASTIC BAG CONSIDERATIONS

- The production of plastic bags starts with crude oil, a non-renewable resource – and the 100 billion plastic bags used each year requires 12 million barrels of oil.
- Seen to be a very large cause of litter – which is the case globally.
- Plastic bags cannot be recycled easily alongside other types of plastic recycling – so although it is claimed they can be recycled, in the most part they are not.
- Neither do they biodegrade in the environment and plastic has been observed to be leaching into oceans and water ways. The timeframes for plastic bags to degrade are not yet known as they have only been used for around 50 years - long term effects are not known.
- Although plastic bags can be reused, each disposable bag is typically used for less than an hour.

The choice between using a plastic bag or a paper bag is not straightforward, as there are many things to consider. This is where the use of LCAs can be helpful as they put numerical values to some of the processes and stages of use to draw clear conclusions on which product is more suitable and sustainable in each situation.

Beyond this you can also consider traditional paper bags against biodegradable plastic bags.

ADDITIONAL RESOURCES:

- Reading:
- i. <https://science.howstuffworks.com/environmental/green-science/paper-plastic1.htm>
 - ii. <https://www.ecoenclose.com/Paper-versus-Plastic-and-Bio-Plastic/>
 - iii. <https://www.independent.co.uk/voices/paper-bag-bad-environment-plastic-bag-ban-recycling-waste-a9380316.html>
 - iv. <https://www.planetwood.co.uk/blog/the-true-impact-of-plastic-bags-compared-to-paper-and-reusable-bags>
 - v. <http://www.wmnorthwest.com/guidelines/plasticvspaper.htm>
- Infographic: <https://www.washingtonpost.com/wp-dyn/content/graphic/2007/10/03/GR2007100301385.html?referrer=emailink>
- Video: https://www.youtube.com/watch?v=ScY_Yb1V8AY

ACTIVITY: PLASTIC V. PAPER: BATTLE OF THE BAGS

Instructions

Please see the web page for more information about LCAs and the Paper v. Plastic carrier bag example.

This activity is intended to aid students in recalling the key stages in the product consumption cycle and consider what processes would be important in an LCA for both paper and plastic bags.

This activity is intended to be used alongside the Paper v. Plastic: Battle of the Bags lesson plan.

Task

If you are based in a classroom, ask students to complete the activity in two stages:

1. Students should recall the five main stages in the Product Consumption cycle and add them in the correct order to the table below.
2. Then ask students to fill out the key considerations at each stage of the product consumption cycle which would impact the LCA for both paper and plastic bags.

If you are doing this activity at home similar instructions to the above classroom setting can be used. However, students may have more access to the internet to research and find key facts and figures which could be added to the table.

Students could be prompted to find out:

- *How much crude oil is required to make plastic bags?*
- *The difference in energy consumption for the manufacture of plastic and paper bags.*
- *The difference in pollution created during the manufacture of plastic and paper bags.*

Paper Recycling and Life Cycle Assessments
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PRODUCT CONSUMPTION CYCLE STAGE	PLASTIC CARRIER BAGS	PAPER CARRIER BAGS