

Debate topic: Should plastic have a future?

Curriculum:
This resource can be used as an introduction to the topic of polymers (specifically the disposal of polymers) or as a revision tool once the topic has been covered. The resource is suitable to use for AQA, Edexcel, OCR.

Aim:
To understand different opinions of using plastic and the advantages and disadvantages of using plastic in everyday life.

Objectives:
Consider the pros and cons of using plastic from the point of view of different members of society.
Broaden understanding by suggesting that plastic is better than alternative materials such as paper and glass.
Reach a conclusion as to whether plastics have a future.

How this resource can be used:

1) Small group debate (50 minutes total):
Starter (5 minutes):
Begin by asking the class about their initial thoughts on the question ‘Should plastic have a future?’. Encourage the students to think of pros and cons of plastic and write these ideas on the board. Briefly decide which points are more important/relevant than others to come back to later.

Activity (30 minutes):
Divide the class into five groups. Give each group a character (a scientist, the head of a fizzy drink company, leading conservationist, the head of a supermarket, a member of the public) and provide them with the corresponding section provided in the resource. Give the groups 15 minutes to discuss the points given to them on their topic, encourage them to think of their own additional points and to rank each idea in order of importance. Now, one student from each group will join to form a new group, containing characters of mixed opinions. Again give 15 minutes for the mixed groups to debate/discuss/defend their ideas on their subject and to decide which points are the most important/relevant.

Presentations (10 minutes):
Invite one student from each of the mixed groups to present the points their group feel are most important after hearing all the arguments.

Plenary (5 minutes):
Refer back to the pros and cons the class came up with at the beginning of the lesson. Discuss how their opinions towards plastic has changed, if at all. Have their ideas changed with regards to the importance/relevance of their pros and cons list produced at the beginning of the lesson?

2) Whole class debate (50 minutes total):
Starter (5 minutes):
Begin by asking the class about their initial thoughts on the question ‘Should plastic have a future?’. Encourage the students to think of pros and cons of plastic and write these ideas on the board. Briefly decide which points are more important/relevant than others to come back to later.

Activity (15 minutes):
Divide the class into five groups. Give each group a topic (a scientist, the head of a fizzy drink company, leading conservationist, the head of a supermarket, a member of the public) and provide them with the corresponding section provided in the resource. Give the groups 15 minutes to discuss the points given to them on their topic, encourage them to think of their own additional points and to rank each idea in order of importance/relevance.

Presentations (10 minutes):
Invite one/two students from each group (or the whole group), to present their points/ideas to the rest of the class.

Discussion (15 minutes):
After each opinion has been presented, each group of ideas can be discussed as a whole class (alternatively, the students could return to their groups for the discussion). Encourage the class to debate/discuss each different group of opinions and to come to a conclusion as to which points are most important/relevant.

Plenary (5 minutes):
Refer back to the pros and cons the class came up with at the beginning of the lesson. Discuss how their opinions towards plastic has changed, if at all. Have their ideas changed with regards to the importance/relevance of their pros and cons list produced at the beginning of the lesson?

3) As a circuit activity (50 minutes total):
Starter (5 minutes):
Begin by asking the class about their initial thoughts on the question ‘Should plastic have a future?’. Encourage the students to think of pros and cons of plastic and write these ideas on the board. Briefly decide which points are more important/relevant than others to come back to later.

Activity (30 minutes):
Set up five areas of the classroom each with its own character (a scientist, the head of a fizzy drink company, leading conservationist, the head of a supermarket, a member of the public). Divide the class into five groups and assign a character to each group. Give 6 minutes for the group to discuss the points given in the resource, encourage them to think of their own additional points. After this time, ask each group to move around the classroom to the next character and repeat the activity. Repeat until all five topics have been covered.

Discussion (10 minutes):
At the end, bring the class together to discuss their thoughts on plastics. Encourage the class to debate/discuss each different group of opinions and to come to a conclusion as to which points are most important/relevant.

Plenary (5 minutes):
Refer back to the pros and cons the class came up with at the beginning of the lesson. Discuss how their opinions towards plastic has changed, if at all. Have their ideas changed with regards to the importance/relevance of their pros and cons list produced at the beginning of the lesson?

4) Cut and stick (50 minutes total):
Starter (5 minutes):
Begin by asking the class about their initial thoughts on the question ‘Should plastic have a future?’. Encourage the students to think of pros and cons of plastic and write these ideas on the board. Briefly decide which points are more important/relevant than others to come back to later.

Activity (20 minutes):
Ask the students to work in pairs. Give each pair a paper copy of the resource (five sections covering the opinions of a scientist, the head of a fizzy drink company, leading conservationist, the head of a supermarket, a member of the public) and ask them to cut out each point. Each point should be discussed and ranked in order of importance (rather than asking each pair to cover all five topics, assign different pairs different topics).

Presentations (10 minutes):
Invite each pair to state their most important/relevant point and why they have chosen it.

Discussion (10 minutes):
At the end, bring the class together to discuss their thoughts on plastics. Encourage the class to debate/discuss each different group of opinions and to come to a conclusion as to which points are most important/relevant.

Plenary (5 minutes):
Refer back to the pros and cons the class came up with at the beginning of the lesson. Discuss how their opinions towards plastic has changed, if at all. Have their ideas changed with regards to the importance/relevance of their pros and cons list produced at the beginning of the lesson?

Extension:
Before carrying out the activity, ask the students to think about the opinions each of the characters would have (a scientist, the head of a fizzy drink company, leading conservationist, the head of a supermarket, a member of the public), with regards to plastic use, as homework. This will help with developing their own ideas and arguments for debate and the points given resource can be used as a guide.

Questions for reflection:
Have their opinions changed with regards to using plastic?

How would society cope without plastic?

Feedback:
We are constantly looking for ways to improve these resources and would be very grateful if the teacher giving the lesson and the students involved with the activity, could provide feedback. The links can be accessed on a computer or a smartphone.

Teacher feedback:
<https://forms.office.com/Pages/ResponsePage.aspx?id=7qe9Z4D970GskTWEGCkKHhIKjMLK9DlHk3LxaBgd4N1UNU5LN1lWSTNBTjlOTUY0TjVDOUM1SkYxRS4u>

Or

<https://bit.ly/2PDG2e3>

Student feedback:
<https://forms.office.com/Pages/ResponsePage.aspx?id=7qe9Z4D970GskTWEGCkKHhIKjMLK9DlHk3LxaBgd4N1UMzJSMU1TVlg3N08zN0c4QTlNTFRGSDBNTy4u>

Or

<https://bit.ly/2UTx39f>

Further information:
[www.pepctplastics.com/resources/connecticut-plastics-learning-center/biodegradable-plastics/](http://www.pepctplastics.com/resources/connecticut-plastics-learning-center/biodegradable-plastics/)

[www.plasticoceans.uk](http://www.plasticoceans.uk)

[www.which.co.uk/reviews/recycling/article/what-are-supermarkets-doing-about-plastic](http://www.which.co.uk/reviews/recycling/article/what-are-supermarkets-doing-about-plastic)

[www.seaweedandco.com/seaweed-benefits-plastic/](http://www.seaweedandco.com/seaweed-benefits-plastic/)

Research at the University of Nottingham:
Work by Professor Steve Howdle:

* Biodegradable polymers for drug delivery:

D.Kakde, V. Taresco, K. Bansal, P. Magennis, S. Howdle, G. Mantovani, D. Irvine and C. Alexander, 2016. [Amphiphilic block copolymers from a renewable epsilon-decalactone monomer: prediction and characterization of micellar core effects on drug encapsulation and release](http://dx.doi.org/10.1039/c6tb01839d) Journal of Materials Chemistry B. 4(44), 7119-7129.

Many active drugs are insoluble in an aqueous environment, which makes it difficult to deliver the drug to its target. To overcome this, amphiphilic polymers (the drug delivery vehicles) were synthesised from a monomer found in castor oil and their overall efficiency was studied.

* Biodegradable polymers for bone scaffolds:

J. Kanczler, P. Ginty, J. Barry, N. Clarke, S. Howdle, K. Shakesheff and R. Oreffo, 2008. [The Effect Of Mesenchymal Populations And Vascular Endothelial Growth Factor Delivered From Biodegradable Polymer Scaffolds On Bone Formation](http://dx.doi.org/10.1016/j.biomaterials.2007.12.031) Biomaterials, 29(12), 1892-1900.

Tissue engineering is a promising method to regenerate and heal the damaged sites of bones. Biodegradable polymer scaffolds were prepared by supercritical CO2, whose physical properties were controlled by the synthetic conditions.

* New renewable polymers and materials:

M. Sainz, J. Souto, D. Regentova, M. Johansson, S. Timhagen, D. Irvine, P. Buijsen, R. Stockman and S. Howdle, 2016. [A facile and green route to terpene derived acrylate and methacrylate monomers and simple free radical polymerisation to yield new renewable polymers and coatings](http://dx.doi.org/10.1039/c6py00357e) Polymer Chemistry, 7(16), 2882-2887.

Many polymers, used in plastics, are made from oil which generates a large carbon footprint through the production process. Terpenes are monomers which are the building blocks of polymers and are usually obtained from fossil fuels. However, they can be extracted from wood waste and therefore, are a potential renewable source of monomers. Polymers from terpene derivatives were synthesised and studied.

M.Thomsett, T. Storr, O. Monaghan, R. Stockman and S. Howdle, 2016. [Progress in the synthesis of sustainable polymers from terpenes and terpenoids](http://dx.doi.org/10.1680/jgrma.16.00009) Green Materials, 4(3).

This article is a review of how terpenes and terpenoids, renewable monomers, are used to synthesise sustainable polymers.

K. Bansal, D. Kakde, L. Purdie, D. Irvine, S. Howdle, G. Mantovani and C. Alexander, 2015. [New biomaterials from renewable resources - amphiphilic block copolymers from delta-decalactone](http://dx.doi.org/10.1039/c5py01203a) Polymer Chemistry, 6(40), 7196-7210.

It is important that polymers used in biomedical purposes possess low toxicity and are biodegradable. A non-toxic, low cost, and easily accessible renewal monomer was used to synthesise drug delivering polymers with enzymatic catalysts.

A. Saeed, S. Dey, S. Howdle, K. Thurecht and C. Alexander, 2009. [One-Pot Controlled Synthesis Of Biodegradable And Biocompatible Co-Polymer Micelles](http://dx.doi.org/10.1039/b821736j) Journal Of Materials Chemistry. 19(26), 4529-4535.

Popular polymers for drug delivery such as poly(ethyleneglycol) (PEG) and ploy(lactic acid) (PLA) are used to deliver small molecules and proteins to the target. However, modification of these polymers are difficult. To overcome the barrier, biodegradable polymers containing PEG side chains were synthesised and studied.

Q. Hou, M. Walsh, R. Freeman, J. Barry, S. Howdle and K. Shakesheff, 2006. [Incorporation of Proteins Within Alginate Fibre-Based Scaffolds Using a Post-Fabrication Entrapment Method](http://dx.doi.org/10.1211/jpp.58.7.0003) Journal of Pharmacy and Pharmacology. 58(7), 1-8.

As the half-life of growth factors is short, it is important to control the release of such hormones from scaffolds within the body. To achieve such condition, bioactive proteins were entrapped within fibrous alginates and its release process and bioactivities were studied.

H. Woods, M. Silva, C. Nouval, K Shakesheff and S. Howdle, 2004. [Materials processing in supercritical carbon dioxide: surfactants, polymers and biomaterials](http://dx.doi.org/10.1039/b315262f) Journal of Materials Chemistry. 14(11), 1663-1678.

This article is a review of supercritical CO2 (scCO2), which is a unique solvent used for synthesis of polymers and nanoparticles. scCO2 is studied and used widely as it is freely available, inexpensive, and chemically inert for chemical synthesis.