THYME Project

Teesside, Hull and York - Mobilising Bioeconomy Knowledge Exchange

How to make money from orange peel

Teacher sheet

Learning objectives:

- Understand the drawbacks associated with disposal to landfill
- Understand that 'waste' materials can be processed to obtain valuable products and minimise environmental impacts
- Understand that organic waste products can be 1) composted and used as fertiliser 2) used in anaerobic digestion to generate electricity

1) Show the first slide. Refer pupils to the Exercise 1 worksheet and ask them to arrange the pictures in order and think about the resources needed at each stage. This should get them thinking about the supply chain.

Oranges are grown overseas, and then I assume are juiced and concentrated there, concentrate shipped to the UK, distributed by road and then rehydrated and bottled by companies like Britvic. The story would be different for oranges as a fruit, but then orange peel is never going to be recovered form organic waste. Pupils could be asked to think about the supply chain of oranges as fruits and compare the two.

2) Slide two shows one possible order of the supply chain and some of the resources needed at each stage of production.

3) Slide three shows orange use in the UK soft drinks supply chain.

4) Provide some fresh orange peel. Get the pupils to smell it, warm it in their hands, squash it and bend it back (safety goggles may be needed). Show a video on jets of fluid coming from citrus skin: https://youtu.be/BWQKwhO4axU. This video and hands on activity illustrates that there is 'stuff' in there that smells/tastes orangey. Give them a couple of minutes to come up with some suggestions as to where this "oranginess" might be used.

5) Slide 5 shows what is in waste orange peel and describes some uses for limonene. See if they got them all.

6) What happens to the peel? Slide 6 shows the perils of it being dumped to landfill. Get pupils to complete Exercises 2 and 3 on their worksheets. Follow with slides 7 and 8 with some statements to get some discussion going around landfill sites. Ask pupils to consider the statements on the 'What do you think' worksheets and see if they agree or disagree with them.

7) Composting and anaerobic digestion for electricity generation.

Slide 9 shows how these materials can be part of a circular process. Laboratories like the Biorenewables Development Centre have technology to convert wastes into useful high value products which can then be sold (refer to the "A greener orange" pamphlet for further information).

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AD KS3: https://youtu.be/WjYpibR9CVk

KS4: https://youtu.be/aULRryCVMyY

8) Last question: How is this work going to generate income for the UK - by licensing the technology to create value from wastes. Could be applied to other fruits that are grown in the UK. Get them to think of possible uses e.g. apples which also contain pectin and presumably ingredients that could produce apple aromas in other products like shampoo.

Resources:

BDC's own "A greener orange" pamphlet.

Powerpoint presentation.

Worksheets.

Answers

Exercise 1 – supply chain

51.8 Million tonnes world production predicted 2018/2019

3,045 k tonnes of oranges = 3 M tonnes reaches the UK market. 72% from Brazil, 17% from Spain, 11% from other countries

1.4 M tonnes of processing waste and by-products

Exercise 2. 20 Consequences of global warming:

1 – Disease and pandemics
2 – increased migration
3 – loss of breathable air from photoplankton
4 – less food and drinking water
5 – fires and wildfires
6 – increased volcanic eruptions
7 – loss of biodiversity

8 – conflict and wars
9 – toxic air pollution
10 – melting tundra and permafrost
11 – deforestation
12 – drought
13 – flooding
14 – loss of marine life
15 – changes in jet streams
16 – increased heat
17 – tsunamis
18 – increased sea level
19 – shrinking sea ice and sea shelf
20 – shrinking glaciers

Exercise 3 – Consequences of landfilling

1 (disease and pandemics), 4 (less food and drinking water), 5 (fires and wildfires), 7 (loss of biodiversity), 11 (deforestation), 9 (toxic air pollution), 14 (loss of marine life)

Further information: The UK recycling rate for Waste from Households (WfH; including IBA metal) was 45.7% in 2017, increasing from 45.2% in 2016. There is an EU target for the UK to recycle at least 50% of household waste by 2020.

UK biodegradable municipal waste (BMW) sent to landfill has fallen from approximately 7.8 million tonnes in 2016 (22% of the baseline 1995 value) to around 7.4 million tonnes in 2017 (21% of the baseline 1995 value). The UK is therefore still on track to meet the EU target to restrict BMW landfilled to 35% of the 1995 baseline by 2020.

The UK generated 222.9 million tonnes of total waste in 2016, with England responsible for 85% of the UK total.

604 landfill facilities in UK in 2016

Landfill – What do you think? Answers

1. **Landfills are usually holes left over from quarries. We don't have to dig new holes.**
    - Yes, this is true. Landfill is one use for ex-quarries.
    - Landfills do not necessarily have to be in holes. Landforms can be created. The ex-landfill in York is now so full it has become a landform and rises like a hill in the landscape.

2. **We have to put our rubbish somewhere.**
    - Yes, but there are alternatives to dealing with our rubbish such as reducing the amount of rubbish we produce, reuse, recycling & composting and different disposal methods such as incineration and energy from waste.

3. **Some of the waste will take hundreds, even thousands of years to rot away.**
    - Yes, materials such as plastic and metal will take hundreds or thousands of years to rot down.
    - Some wastes take much longer. Glass and rubble will take millions of years to rot away.
    - Some wastes will rot away quicker i.e. biodegradable waste.
    - Landfills can act as storage for materials. In the future it may become economically viable to mine old landfills and reuse and recycle the waste that has been 'stored'.

4. **Landfill is a cheap and easy option!**
    - Landfill used to be a cheap option, but it isn't anymore. Landfill Tax was introduced in 1996 and has increased every year to make it more expensive and therefore a less attractive disposal method. (From around £2 per tonne to around £90 per tonne over this time)
    - Landfills need to be engineered to store waste safely and securely. However, this technology is relatively simple compared to other waste disposal methods such as incineration, anaerobic digestion etc.

5. **Landfill produces a type of gas called methane which can be explosive and damages the environment.**
    - This is true. Methane is produced when biodegradable waste breakdown in the absence of oxygen.
    - Some gas will escape from a landfill. However, landfill operators put in systems to collect the methane. This can be burned off or used as an energy source.

6. **Many of the holes will soon be full.**
    - This is true. York's landfill was finally closed last year.

- Other holes could be found. However, landfill is becoming more expensive and the move towards more environmentally friendly ways of dealing with our waste are consequently making other methods of waste disposal more attractive.
- When a landfill is full it is finally covered with soil and can be landscaped for recreational use.

7. **We soon need to find new landfills to use.**
    - See above

8. **I don't want to live near a landfill, they are dirty, smelly and noisy**
    - Landfill operators put measures in place to reduce disturbance to local people. However Local Authorities and landfill operators still receive complaints from people living near landfills. Often they complain about:
        - Number of vehicles using site
        - Litter blowing off site and out of vehicles
        - Smells
        - Vermin that are attracted to 'free food'
    - It is understandable that people do not want to live near a landfill but they have to go somewhere! Waste has to be dealt with using one method or another. Would people prefer to live near an Energy from Waste facility? The solution? A world with no rubbish at all!

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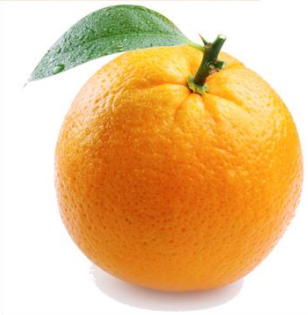
A thousand and one things to do with orange peel

Pupil Sheets

Exercise 1: Supply chain



1. Organise the supply chain

2. What resources do you need at every step of the supply chain?

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Exercise 2: 20 Consequences of global warming

What are the consequences of a global warming? Name each symbol

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Exercise 3

Consequences of landfilling

Identify the consequences of landfilling by using the symbols from exercise 2

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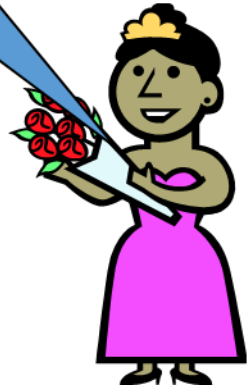
What do you think?

1. Landfills are usually holes left over from quarries. We don't have to dig new holes.

2. We have to put our rubbish somewhere.

3. Some of the waste will take hundreds, even thousands of years to rot away.

4. Landfill is a cheap and easy option!



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What do you think?

5. Landfill produces a type of gas called methane which can be explosive and damages the environment.

6. Many of the landfill holes will soon be full.

7. We soon need to find new landfills to use.

8. I don't want to live near a landfill, they are dirty, smelly and noisy.

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