Using polylactic acid

Polylactic acid is commercially manufactured in the USA and in Japan. It can be made into consumer items as diverse as disposable plates and cups, packaging and clothing. The lactic acid used to make it is derived from corn. The process used to make it involves both biotechnology and chemistry.

1. What are most plastics are made from? (What is the raw material?)

2. What is the raw material for making polylactic acid?

When the plastic polyethene is made, energy is used to make the ethene and to turn the ethene into polyethene. As ethene is a gas, it is usually piped from place to place.

When polylactic acid is made, the corn has to be transported from the field to the factory and the distances involved can be vast. The PLA (polylactic acid) plant in Nebraska is in the middle of a huge corn field to minimise transportation costs.

3. Look at the stages of the process for making polylactic acid shown above. Which of the stages uses energy? Where is this energy likely to come from?

To make a kilogram of polyethylene, 81 MJ worth of fossil fuels is required. This includes 29 MJ worth of raw materials and 52 MJ of fuels that are burnt to release the energy needed for the manufacturing process. To make a kilogram of polylactic acid, 56 MJ of fossil fuels is required. All of this is burnt to release energy.

When fossil fuels are burnt, carbon dioxide is released into the environment. When a fossil fuel is turned into plastic, the carbon dioxide is not released but is locked in the plastic and only released into the environment if that plastic is burnt or decomposes.

4. When polylactic acid and polyethylene are made, which results in the most carbon dioxide being released to the environment?
5. Why is this less of a problem than it might seem at first? (Hint: think about what the polylactic acid is made from).

6. Polylactic acid is about five times as expensive as polyethene. Why do you think this is?

The chemical industry is trying to make itself ‘greener.’ There are three main ways it is likely to do this:

- Use less oil
- Develop cleaner chemical processes
- Avoid damaging ecosystems.

It is also important to reduce any risk to employees working in the chemical industry and to the users of its products.

7. Which of the two products (polyethene and polylactic acid) uses less oil?

Although the oil saving is not much at the moment, it is hoped that in time the process for making polylactic acid will become more efficient and use less oil. This could be achieved by burning leftover parts of the corn to produce energy or by scientists spending a lot of time doing research to find a better way to make the product. Improvements have already been made that have significantly reduced the cost of polylactic acid.

However, businesses have to make money and there is no advantage for a manufacturer who develops an environmentally friendly product that is very expensive to produce. A manufacturer could spend a lot of money on research and not manage to find a way of using less energy. Consumers are not normally willing to pay more for an item just because it is ‘environmentally friendly.’

8. Do you think the government should do something to help companies who make ‘greener’ packaging? Packaging that is not degradable could be taxed, for example, or the government could pay for some of the research needed. Remember – this means that you will end up paying for it eventually! Things wrapped in plastic may become more expensive or taxes may go up, which could lead to your parents having less money to spend on you. Explain your answer.
One of the main benefits of polylactic acid is that it is biodegradable. Polyethylene is too, but it will probably take hundreds of years to biodegrade. Polylactic acid can be put into a compost heap and will degrade within a few months.

9. Where does most rubbish in Britain end up? What happens to it there?

10. Which products would it be best to make out of polylactic acid. How would you market those products?