One thing we have learnt this week – plastic breakdown

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You can hardly move at the moment for news of plastic and its role in the environment. As we have learnt plastic breakdown is a really huge problem. Could a group of researchers discovered a way of breaking down one very commonly used plastics? Poly(ethylene terephthalate) (PET) is a very common plastic used to make drink bottles and other materials such as clothes. Its structure is shown below. Its a polymer with thousands of the repeating units. pet A group in Japan discovered a new bacterium in waste recycling centre that could use PET as its main energy and carbon source. Bacteria need both of these and they do not have to be the same thing. Simple sugars such as glucose provide both in one molecule but sometimes the energy source (which is basically electrons) can be provided by inorganic molecules. It makes it simpler that the organism uses PET as both. The bacteria breaks the PET down to the several components of its monomer units. The group had to do a number of thing identify the enzyme(s) concerned and then sequence the protein(s) and then determine their 3D structure. An enzyme is a protein (there are exceptions to this rule) that speeds up a chemical process but is unchanged by it. Enzymes are highly efficient catalysts. Sequencing the protein is easy but determining its 3D structure is much more difficult. There are 3 ways but the preferred way is to fire x-rays at a protein crystal. X-rays have wavelengths of the order of atomic bonds. They are diffracted by the crystal atoms giving a complex pattern on a detector which must be interpreted by powerful computers. The 3D structure is important because it gives you information on the enzyme family it belongs to in more detail. Also it gives you the mechanism by which it works and may allow modifications and improvements. The group made some modified versions which worked better by mistake! They are now modifying it further to speed up PET breakdown. So far so encouraging. It looks like bacteria are evolving to break down some kinds of plastic. However this does raise some issues. First bacteria will prefer to break down simpler molecules if these are available. If you were to engineer the bacterium so it only could use PET as its carbon source (the obvious solution) then it still may revert to suing simpler carbon sources of which there are many in seawater. In addition its illegal to let GM bacteria loose into the environment at present. Another issue is that plastic ties up carbon that would otherwise be released into the atmosphere. The bacterium will produce CO2, water and biomass from the PET. This in one thing in a controlled recycling environment but different if let loose in the sea. Its important that the biomass is maximised and this then falls to the ocean floor where its carbon is tied up for the long term. These dilemmas are the product of our use of plastic. We have some very hard decisions to make fast. But short of going and capturing nano particles of plastic without capturing plankton (impossible at present) which would use a lot of energy anyway, this looks like the best solution to dealing with it so far. Neil

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