Drug delivery and smart materials

Research is currently being undertaken to find out whether it is possible to use hydrogels and similar materials as a drug delivery system – a way to get drugs and medicines to where they are required in the body.

1. What methods are currently used to get drugs and medicines into the body?

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2. If a pill is swallowed, where does it go in the body?

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These methods can cause a number of problems. While all drugs are rigorously tested to make sure they are safe for the vast majority of people, many drugs cause bad reactions in a few people. The negative effects range from an upset stomach to serious allergic reactions. Chemists are now trying to develop a delivery system that will target a drug at the particular site where it is required. For example, if you have a bad cut on your leg and take antibiotic pills, the drug travels all round your body and not just to your cut leg. This increases the risk that the drug will cause problems. If the drug is only released at the cut then the likelihood of an adverse reaction is reduced. When the drugs are extremely strong, such as those used in chemotherapy to treat cancer, the possible side effects are wide ranging and include hair loss, severe stomach upset and lethargy. Targeting the drugs so that only the cancer cells are affected is a major goal in current research. Since drugs can be toxic to the body, the aim is to place them in a non-toxic carrier so they can pass through the body without causing any damage. The carrier needs to be smart so that it will release the drug at the required site and nowhere else. Chemists are investigating a wide range of potential carriers, including hydrogels.

The experiment you did with tea and hydrogel is a model of this type of drug delivery system. The drug is first loaded onto the carrier and then it is released at the right location.

3. In this model, which is the drug and which is the carrier?

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4. What happens to the hydrogel when it is soaked in tea solution? Give as much detail as you can.

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5. What happens to the tea in the hydrated crystals when they are soaked in salt solution? What happens to it if the crystals are soaked in distilled water? Explain your observations in as much detail as you can.

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In this model, the presence of the salt changes the behaviour of the 'carrier,' causing it to release the 'drug.' As more is understood about exactly how drugs work, research is focusing on how to deliver them in a way that ensures they make their active ingredients available at the time and place required by the body.

One type of substance being studied for use in carriers is microgels. These are similar to hydrogels but the particles are far smaller, often only up to 100 nm in diameter. This is an example of nanotechnology.

6. If the particles are very small, what effect will this have on the overall surface area of the carrier and on the rate at which the drug is released when the conditions are right?

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Hydrogels and microgels can also change shape and release a drug in response to a change in pH or temperature. Conditions such as temperature, saltiness or ionic concentration and pH can all be different in an infected or diseased area of the body than under normal conditions. If chemists can understand both how the disease operates in the body and how the microgels and hydrogels behave in different conditions it should be possible for them to target drugs accurately at the sites where they are required