Worksheet answers

You should be aware by now that dealing with chemical interventions in the environment is a very tricky business. The effects can be devastating to the environment and difficult to counteract. Sometimes effects are not immediately seen.

1. Many chemicals are used regularly in gardens, market gardens and farms. Chemicals may be applied in different forms that have different properties such as solubility in water. Research and complete the table below with the structure and solubility of some common materials.

substance	chemical formula of main active ingredient	release of active ingredient (slow or immediate)	solubility in water	potential problems with its use
superphosphate fertiliser	$Ca(H_2PO_4)_2$	*immediate*	*high*	*It displaces heavy metals in soils causing accumulation in runoff.* *Phosphate runoff causes algal blooms in local wetland areas.*
blood and bone	*N:P:Ca*	*slow*	*low*	*It is not a complete fertiliser, potassium needs to be added.* *Uptake is slow in plants.*
dynamic lifter	*N:P:K*	*immediate*	*moderate*	*Additional doses are needed at regular intervals.*
urea	$(NH_2)_2CO$	*immediate*	*high*	*It is not a complete fertiliser. Additional potassium and phosphorus are required.*
ammonium phosphate	$(NH_4)_3PO_4$	*immediate*	*high*	*Nitrogen-rich fertiliser runoff causes oxygen depletion in ocean coastal areas.* *Phosphorus runoff leads to eutrophication of wetland areas.*
DDT	$C_{14}H_9Cl_5$	*immediate*	*Insoluble (but high in organic solvents, fats and oils)*	*It accumulates in fat cells of animals and concentration of DDT increases as it moves up food chains in ecosystems where DDT has been sprayed.*
dieldrin	$C_{12}H_8Cl_6O$	*immediate*	*Insoluble*	*Dieldrin bioaccumulates as it is passed along food chain. It is toxic to animals and linked to human diseases such as breast cancer and Parkinson's disease.*

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2. The dilemma examined the introduction of fertilisers, DDT and human waste to the environment.

   - For each substance, write a paragraph to describe how its chemical constituents enter wetlands, and effects that they have on wetlands.

   Fertiliser is added to plants.

   How can chemicals from fertilisers enter wetlands?

   Chemicals that are not taken up by plants may enter wetlands through runoff.

   What are the results of this?

   Elevated concentrations of nutrients can cause excessive algal growth. This results in toxins and depleted oxygen levels in water as algae die and decompose.

   DDT is sprayed onto crops.

   How does DDT enter wetlands?

   DDT enters wetlands through bioaccumulation in food chains. DDT is soluble in fats and oils, so accumulates in the fatty tissue of animals where it persists for a long time before it breaks down.

   What are the results of this?

   Animals, particularly those further up the food chain, develop high levels of DDT in their fat cells. This can cause disruptions to reproductive processes of birds, resulting in thinning of eggshells and high death rates in chicks.

   Human waste is released into a river.

   What changes may occur?

   An increase in concentrations of nitrogen and phosphorus can provide a boost to algal growth. Disease-causing microscopic organisms can be transferred from human waste into the water.

   What are the results of these changes?

   When the algal bloom dies off and decays, toxins are released and oxygen is removed from the water causing fish kills and endangering any animals drinking the water. Humans who normally depend on the river for drinking water, bathing and recreation can be at risk from pathogenic microbes that cause deadly diseases such as cholera, dysentery and typhoid.

3. A company disposing of sewage released some of its waste illegally into a local river. It did not seem to cause any problem at first. They decided to release some more since they had not been detected the first time. An algal bloom was noticeable in the river a short time later. What factors influence the occurrence and severity of an algal bloom?

   Factors that influence the occurrence and severity of algal blooms include still water, high temperatures, low water flow conditions, and salinity.

   The first release may have been in winter and then the second release could have occurred in summer.

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4. In question one the solubility of various chemicals was compared. Ammonium phosphate fertiliser has a very different solubility compared with DDT and therefore has different effects in the environment. Which chemical has the longer lasting effect and why? Make reference to their solubilities in your answer.

   Ammonium phosphate has high water solubility, whereas DDT is virtually insoluble in water but has high solubility in fats and oils.

   As water passes quickly through ecosystems, ammonium phosphate has an almost immediate effect on the environment, allowing environmental problems associated with ammonium phosphate to be detected early.

   DDT slowly accumulates in ecosystems, with the highest accumulation occurring in animals at the top of the food chain. Effects of DDT accumulation take a much longer time to be recognised. As DDT has a half-life of 8 years in the fat cells of animal, it is present in ecosystems for a longer time, therefore having a longer lasting effect than ammonium phosphate.

5. How can scientists work with the community to prevent problems caused by chemicals entering the environment?

   Scientists can inform the community of issues related to different chemicals.

   They can provide education for the community on correct use and disposal of chemicals that can enter the environment.

   They can inform the community about alternative products that can be used with less harmful environmental outcomes.

   They can develop management plans, with community members, for local wetland areas and their surroundings.

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