



Reading Handout: The Great DDT Debate

Danger! Mosquitoes!

Did you know that one of the most dangerous animals on the planet is the mosquito? Many native birds became **endangered**, and some are now **extinct**, in part because of diseases transmitted to them by mosquitoes. And mosquitoes spread a lot of diseases among humans, such as encephalitis, yellow fever, the *West Nile* virus, and malaria.

Miracle Solution

Because of the problems that mosquitoes and other insects cause for humans, people were thrilled in 1939 when a Swiss chemist, named Paul Müller discovered a chemical that killed mosquitoes and other insect pests. This chemical has a complicated structure, and a LONG name: **dichlorodiphenyltrichloroethane**, or **DDT**.

Chemists have rules for nicknaming chemicals with long names, and they called this one DDT. Scientists had created the first DDT in German laboratories in 1874, but no one had any use for it until Müller discovered how good it was at killing insects. And unlike the pesticides people had been using, like arsenic and hydrogen cyanide, DDT was not very toxic to humans. It also had some wonderful advantages:

- It was a broad-spectrum insecticide that killed just about every kind of insect without hurting mammals (including people!).
- It was persistent, so one spraying lasted a long time.
- It was insoluble, so it did not dissolve in rain.
- It did not cost much money to make.

World War II started soon after Müller's discovery. Soldiers camping together had often died from diseases that mosquitoes spread from one soldier to another, and they often had problems with lice. But after they started "dusting" soldiers with DDT, many of the problems ceased. And when used in tropical areas, dense with mosquitoes, DDT drastically cut down the number of people dying from malaria.

Müller was given a Nobel Prize for his "*wonderful*" discovery.

Nothing's Perfect

When DDT started being used, Bald Eagles and Peregrine Falcons were already becoming quite rare. The Bald Eagle Act was passed in 1940, and most of the eagle shooting ended. People thought the eagles would quickly recover, but they did not. And by the 1950s, people were starting to notice something very ominous; virtually all the eagles people were seeing were adults. Young eagles take 4 to 6 years to assume their adult plumage, so this meant that few baby eagles had survived in at least 4 to 6 years.



Some people started noticing dead songbirds in their yards after trucks sprayed the air with DDT. A woman named Rachel Carson, started researching the effects of pesticides on humans and birds and wrote her famous book, *Silent Spring*, which was published in 1962.

People realized the many problems caused by insects, but most Americans also recognized how important birds are. They did not want to lose backyard songbirds. And when people found Bald Eagles and Peregrine Falcons dead, the carcasses showed dangerous levels of DDT in their fatty tissue and gonads—their organs of reproduction. Birdwatchers and scientists noticed that eagles that survived often did not perform their mating rituals properly, and many were infertile.

A Persistent Problem

DDT is a persistent pesticide, meaning the molecule stays together as a poison for a long time before breaking down into smaller, less toxic substances. DDT sprayed in yards, gardens, farm fields and mosquito swamps fell to earth. Rain did not dissolve it, but it did wash it down deep into the soil, and run-off carried it into lakes and streams. Worms feeding in the soil took it up in their bodies. Small creatures in lakes and streams took it up in their bodies. When larger animals such as fish ate these insects and worms, the DDT collected in their fatty tissue—this is called **bioaccumulation**. Fish, birds and mammals do not break down DDT easily, and it doesn't come out with their urine or poop—it simply remains in their fat. The more they ate, day after day after day, the more DDT collected, which meant that the DDT was becoming more and more concentrated in their bodies. This is called **biomagnification**.

Chemicals like DDT are often measured in parts per million. In an estuary off Long Island Sound, Rachel Carson learned that in the water, the DDT measured only three parts per trillion (that's only 0.000003 ppm!). That was so low that it did not seem dangerous at all. But tiny animals called **zooplankton** ate it and it concentrated in their fatty tissues, thanks to bioaccumulation and biomagnification, and the DDT in their bodies measured 0.04 ppm. It is still not so bad. But the animals that ate the zooplankton—minnows, concentrated it even more and the DDT in their bodies measured 0.5 ppm. Larger fish concentrated the DDT even more, their bodies having 2.0 ppm. Finally, osprey that ate these fish had the most concentrated levels of all, 25.0 ppm. No wonder osprey and eagles were disappearing!

Try This!

- Calculate how many times more DDT was in Osprey tissue than in the water.
- Be careful with all those zeroes!
- Approximately what levels of DDT do you think were in frogs in the Long Island Sound? In the gulls in the sound?
- How about in the earthworms in the soil along the shore?
- How much do you think was in the house sparrows and the robins in the area?

- Discuss why robins probably had more DDT than sparrows. (Hint-find out what those two species eat!)

Putting the Pieces Together

Dr. Joseph Hickey, professor of Wildlife Ecology at the University of Wisconsin, is considered the first one to figure out the link between DDT and birds' eggshells thinning. He figured out that it messed up the birds' ability to put **calcium** on the eggshells, so they were soft and squishy. This was how DDT was destroying eagle and osprey populations.

DDT was also killing some birds outright. Almost the entire population of robins disappeared from much of the Michigan State University campus when DDT was used to protect the trees from Dutch elm disease. Dr. George Wallace, the **ornithology** professor there, found that DDT seemed to be injuring the robins' ability to reproduce. Also, during migration, robins died in huge numbers on the campus, probably because migration used up the birds' fat supplies, flushing all the DDT that had accumulated over many months into the bloodstream very rapidly.

Meanwhile, **entomologists** were slowly realizing that of the billions of insects exposed to DDT, a few had managed to survive. These insects were resistant to DDT, and when they reproduced, most of their babies were also resistant. So DDT was actually producing more powerful insects than ever! There was an enormous public debate about DDT. Some government officials and chemistry industry executives ridiculed Rachel Carson and made fun of birdwatchers; other government officials and citizens decided that pesticides that broke down faster and were less harmful to non-target species were necessary. By 1968 some states had banned DDT and in 1972, the US government banned just about every use of it in America except in special cases when human health is at risk.

- Do you think the banning of DDT was the right decision?
- Do you think the ban on DDT put humans at risk?
- Do you think the ban on DDT helped the bird and fish populations rebound?
- Do you think the animal populations would have rebounded, ban or no ban?
- Do you think, in the future, DDT should be used to control the insect population if human health could be at risk?