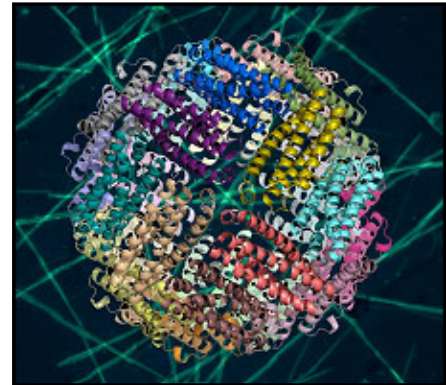


## Synchrotron Science & the Environment

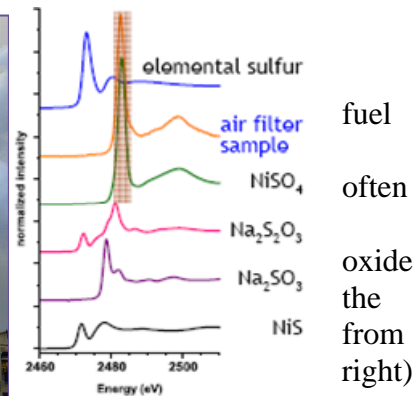
In today's world, it has become essential to understand the fate and transport of environmental contaminants in the soil, air, and water. To be effective, scientists need to understand exactly what toxin they are dealing with, in what kind of surroundings. Synchrotrons are one of the tools that researchers use to gather information in all these areas.

Diatoms in the oceans are responsible for half of the world's carbon sequestration. As diatoms grow, they absorb carbon dioxide. The availability of certain nutrients, like iron, determines the diatom's size, and, thus, the amount of carbon dioxide the diatom with absorb in its lifetime. Protein crystallography is helping researchers Michael Murphy and Angele Arrieta to determine the structure of an **iron storage protein, ferritin**, in pinnate diaoms—a group of phytoplankton. These diatoms are unique in their ability to store iron and thus to dominate low iron environments and phytoplankton blooms, which are caused by an excess of nutrients. Understanding the way ferritin enables these diatoms to dominate blooms, grow larger, and absorb carbon could aid in the sequestration of carbon dioxide.



<http://www.nature.com/nature/journal/v457/n7228/abs/nature07539.html>

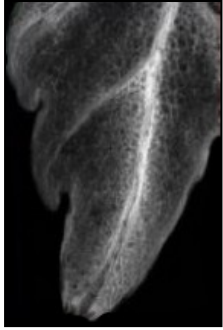
Synchrotron research allows scientists to examine the resulting emissions from fossil burning plants. These harmful emissions contain carbon, sulphur and nitrogen components. Examine resulting emissions nickel smelters (to the to identify and



measure the gases released. The air filter sample matches Nickel Sulphate, which is not a toxic substance. Synchrotron-based X-ray Absorption Near-Edge Structure (XANES) spectroscopy is increasingly being used to analyze and quantify the relative amounts of chemical species and oxidation states in natural environments and complex industrial process streams. Testing done at synchrotrons can measure the amount of gases being released and determine whether the amount is within environmental regulations.

[http://www.lightsource.ca/brochures/report2006/CLS\\_actrep05-06\\_all.pdf](http://www.lightsource.ca/brochures/report2006/CLS_actrep05-06_all.pdf) - page 93

-Also refer to Environmental Issues Lesson Plan



**Arsenic** is famous for being a deadly poison, but it is also an environmental problem. In some soils around the world, arsenic levels are too high to grow plants. However, a fern from Florida accumulates arsenic from the soil at a very high rate. Its hyper accumulation of arsenic might help to clean polluted land. Hard X-Ray Absorption Spectroscopy is helping researcher Ingrid Pickering to determine how and why the fern—*Pteris Vittata*—accumulates, transports, uses, and stores arsenic. More research may lead to the fern being used for phytoremediation—a process which uses plants to clean soils.

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In highly polluted waters, fish accumulate **mercury** which is passed up the food chain when the fish is eaten. Researchers are using synchrotron research to determine how mercury affects fish. Researcher Ingrid Pickering, using Hard X-Ray Fluorescence Imaging, looked at the accumulation of mercury in zebra fish as a way to help determine what happens when fish are exposed. The larvae were raised in water containing methyl-mercury before researchers mapped the locations of the mercury and other elements. The researchers found hotspots of mercury in the fishes' eyes—in rapidly dividing cells on the lens surface layer. This may explain the connection between mercury exposure and blindness in people. Pickering also mapped sulphur and zinc in the fish, trying to understand how elements are absorbed and used during the fishes' development. This research may help to further our understanding of developmental biology and mercury toxicity.

<http://www.pnas.org/content/105/34/12108>

