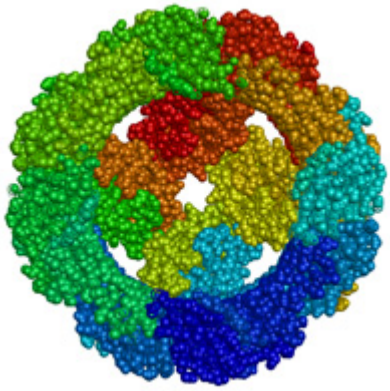
Deep-sea organism helps tumor-targeting scientists at MSU

March 03, 2006 -- By Evelyn Boswell, MSU News Service

BOZEMAN -- At the bottom of the Pacific Ocean lives a heat-loving organism that has become valuable to Montana State University researchers. Thriving far below the surface of the sea, the organism produces hollow protein cages that are so small that 7,000 would fit on the edge of a human hair.

Copies of that protein are now being used by MSU scientists who want to engineer them to deliver drugs to tumors, says MSU graduate student Michelle Flenniken. She wrote an article on their work that was published Monday, Feb. 27, in the scientific journal *Chemistry and Biology*.



This image illustrates a protein cage (in green) binding to melanoma cells grown in a dish. (Photo courtesy of Michelle Flenniken).

The deep sea organism is known scientifically as *Methanoccocus jannaschii*, Flenniken said. The MSU researchers obtained its DNA from a protein bank, then took it through a variety of procedures that produced the protein cages. Chemical changes turned the cages fluorescent green so they could be seen under a microscope. Genetic changes caused the cages to attach to tumor cells. In the end, the scientists had cages that glowed like the northern lights when they attached to tumor cells.

"Our goal is to deliver cancer drugs only to the tumor and avoid the 'healthy cells' that are also killed by existing anti-cancer agents," Flenniken said.

Flenniken is directed by MSU researchers Mark Young and Trevor Douglas who have been using ultra-miniature protein cages for a variety of purposes. Young is co-founder of MSU's Thermal Biology Institute. Douglas is director of MSU's Center for Bio-Inspired Nanomaterials.

"Proteins originating from extreme environments, including oceanic hydrothermal vents and the hot springs of Yellowstone National Park, are being explored for applications in biomedicine and nano-materials synthesis," Flenniken said.

"So far, we have demonstrated that the engineered protein cages can target cancer cells grown in a dish and that we can house anti-cancer agents within their interior cavity, but we haven't demonstrated their effectiveness in animals. That will come in future studies," Flenniken added.

The research described in Chemistry and Biology "opens exciting avenues for the incorporation and cell-specific delivery of cargo molecules, including magnetic resonance imaging (MRI) and therapeutic agents," Flenniken wrote in her paper.

Flenniken's research involves MSU's microbiology, plant sciences, veterinary molecular biology and chemistry/biochemistry departments, besides the Center for Bio-Inspired Nanomaterials and the Thermal Biology Institute. In addition to Young and Douglas, co-authors of Flenniken's paper were Deborah Willits, Ann Harmsen, Lars Liepold, and Allen Harmsen, all from MSU.