

Department of Biological Sciences
MCMICKEN COLLEGE OF ARTS AND SCIENCES

SUMMER RESEARCH OPPORTUNITIES
FOR UNDERGRADUATE WOMEN

APPLICATION DEADLINE: March 1, 2007

The Department of Biological Sciences is pleased to offer the following research project for the summer of 2007. Interested students are urged to contact the faculty member(s) directing the project that most interests them. By contacting the faculty member, you can discover more about the project, learn what your responsibilities will be and if possible, develop a timetable for the twelve-week research period.

Molecular Genetics at Geothermal Temperatures

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Project Description

A group of diverse and unusual micro-organisms called hyperthermophilic archaea thrive in geothermal environments at temperatures that rapidly kill all well-studied organisms. These prokaryotes represent a source of extremely thermostable enzymes for biotechnology, as well as molecular clues regarding the early evolution of cellular life. The Grogan lab has developed basic genetic techniques for two *Sulfolobus* species (see www.biology.uc.edu/faculty/grogan/grog.htm). We are now combining these methods with techniques of biochemistry and molecular biology to investigate basic genetic processes that support the functioning of these cells under extreme conditions. A WISE participant would have a choice of projects that investigate various molecular-genetic processes in *Sulfolobus* spp., including genetic recombination, DNA repair, and genetic engineering. Depending on the project chosen, the experimental techniques would include DNA purification and analysis, PCR, genetic selections for mutants or recombinants, biochemical and genetic assays, cloning, and related techniques.

Recombination

An unusual distance-frequency relationship has been seen in *S. acidocaldarius* conjugation, which suggests an abundance of non-reciprocal homologous recombination events.

Questions:

- What length of DNA is transferred in a typical recombination event?
- Does circular DNA recombine into the *S. acidocaldarius* chromosome?
- Is the process more efficient with a “gapped circle” than with an intact circle?

Genetic Fidelity

The genomes of hyperthermophilic archaea lack any genes predicted to encode mismatch-repair proteins, which correct errors made during the replication of DNA.

Questions:

Can genetic techniques be developed to follow the fate of mismatches in *Sulfolobus*?

Are DNA mismatches repaired in *Sulfolobus*?

Genetic Engineering in *Sulfolobus*

The novel genes and novel metabolism of hyperthermophilic archaea create a need for a general methods to inactivate, alter, or propagate genes *in vivo* to reveal their biological functions.

Questions:

What cloning vectors can be developed for *S. acidocaldarius*?

Do certain GC-rich sequences destabilize genes?