Biological Sciences

In addition to our international nuclear energy leadership and national security technology development responsibilities, we at INL are committed to managing a robust science portfolio built on collaboration. A crucially important part of that portfolio is in the biosciences — notably, in the business areas of environmental biotechnology, bioenergy and priority pathogen detection. We're committed to conducting world-class R&D, and look forward to partnering with others to realize beneficial biotechnology applications.

Key capabilities

Underpinning INL biotechnology R&D is field sampling technology development and application. For example, a technical challenge is to obtain high quality uncontaminated sediment samples thousands of meters below the earth's surface and determine the indigenous microbial activities.

We have invented and deployed sampling tools and techniques to obtain biological material (e.g., extremophiles) under unusual but prevailing natural environmental conditions. Determining the physiological and molecular characteristics of extremophilic microorganisms are important to many INL projects. Extremophile research spans environmental extremes and locations:

- Low pH – sulfide mining, acid mine drainage, Yellowstone National Park
- Heavy metal-rich – mining, industrial, Department of Energy sites
- High temperature – Yellowstone, industrial, geothermal sources
- Deep subsurface – Nankai trough, DOE sites, Polar regions
- Cold temperature – Fremont Glacier, Wind River, Polar regions
- High radiation environments – DOE spent nuclear fuel storage pools.

Our general objective in extremophilic research is to exploit both natural and man-made environments for microorganisms or their functions that can be used in harsh conditions (i.e., robust enzymes for bioprocessing, biomimetics, and fundamental understanding of life).

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Extremophile sampling at Yellowstone National Park.

The Energy of Innovation

INL
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Genomics plays a central role in INL biotechnology activities. We have established a high-throughput sequencing capability, including automated analysis of sequencing results and robotics to maximize throughput. We have also developed and applied portable field molecular determinations; for example, real-time PCR measurements for pathogens in wildlife or human antibody profiling for forensic applications.

Facilities

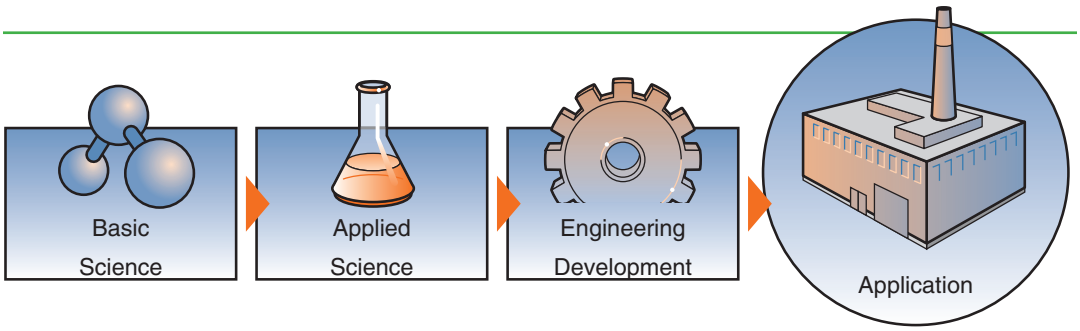
Biotechnology research is centered at the INL Research Center (IRC) in Idaho Falls, Idaho. Facilities include modern research laboratory space configured with special areas, including environmental chambers and engineering high-bay facilities. Laboratory equipment includes walk-in incubators, cold rooms, laminar flow hoods, and numerous autoclaves. These facilities house a variety of state-of-the-art instrumentation, including gas, ion, and high-performance liquid chromatographs; an inductively coupled plasma atomic emission spectrophotometer (ICP-ES); capillary electrophoresis mass spectrometer; transmission and scanning electron microscopes; automated DNA sequencers; nitrogen oxide analyzers; anaerobic chambers; a DNA synthesizer; shakers; instrumentation for measuring interfacial tension; x-ray fluorescence spectrometer; fermentors; and specialized bioreactors. Instrumentation is coupled with microcomputer processing control systems to automate sampling, data collection, and manipulation.

Expertise

More than 50 scientists and engineers work on fully integrated technical teams to efficiently address multicomponent research needs. Disciplines represented on these teams include molecular biology, biochemical engineering, biochemistry, hydrology, geochemistry, chemical and mechanical engineering, chemistry, metallurgy, microbiology, environmental engineering, and soil science. The interdisciplinary and team structure allows highly effective technology development, spanning the entire innovation cycle from bench to scale-up and application. Several of the scientists and engineers serve on committees of national and international technical organizations, industrial and government working groups, and scientific technical review panels. In addition, many staff maintain adjunct faculty status with regional universities, as well as teach and mentor graduate and postdoctoral students. Undergraduate and graduate students are given the opportunity to conduct biotechnology research, thus gaining access to scientist and engineer mentors, state-of the-art facilities, and valued hands-on research experience.

Technology application

An important INL biotechnology mission is to ensure optimal use of the technologies we develop. To succeed, we cultivate close working relationships between public and private sector engineers and scientists and INL researchers. Moving research through the innovation cycle is an overall objective. INL scientists and engineers identify technological needs through public and private sector contacts and ensure that research targets are consistent with anticipated uses. Research efforts are complementary and enabling rather than duplicative. Industrial representatives visit the INL Research Center to access user facilities and to collaborate on technology development.



For more information

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