CRYO2026 ABSTRACT CATEGORIES

1. FUNDAMENTAL PRINCIPLES OF CRYOBIOLOGY

KEYWORDS: thermodynamics, ice nucleation & growth, heat & mass transport, cryoprotectants, ice recrystallization, vitrification, cryoinjury, dry state, anhydrobiosis & lyophilization, mathematical & computational modeling of cryobiological processes

DESCRIPTION: As a convergent science, cryobiology integrates physics, chemistry, biology, engineering, and related disciplines. Foundational discoveries in these areas are essential for understanding and improving cryopreservation outcomes. This category welcomes studies that advance the fundamental principles underlying low-temperature biology and cryopreservation, including thermodynamics, physical chemistry, biophysics, phase transitions and phase diagrams, heat and mass transfer, etc. Specific topics of interest also include ice nucleation, growth, and inhibition; vitrification and devitrification; dry-state biology, anhydrobiosis, and lyophilization; cryoinjury mechanisms; cryoprotective agents; mathematical or computational modeling of cryobiological processes; and others. Together, these investigations provide the scientific basis for innovation in cryopreservation and low-temperature technologies.

2. NOVEL TOOLS, TECHNIQUES, & TECHNOLOGIES FOR APPLIED CRYOPRESERVATION

KEYWORDS: novel cooling/rewarming technologies, new approaches to slow-cooling or vitrification cryopreservation, supercooling, partial freezing, isochoric freezing, AI/machine learning for cryopreservation, high-throughput CPA discovery, cryoprinting, robotics & automation

DESCRIPTION: Advances in tools, processes, and technologies are essential for overcoming the fundamental biophysical and engineering constraints that currently limit cryopreservation efficacy, scalability, and reproducibility. Innovations in this domain will directly support translational goals in transplant and fertility medicine, regenerative therapies, biodiversity conservation, long-term biobanking, biotechnologies, etc. This category encompasses all emerging technologies and methodological innovations that expand the operational, mechanistic, and translational capabilities of cryopreservation, including novel cooling and rewarming platforms (e.g., slow-cooling systems, isochoric systems, partial-freezing systems, vitrification systems, electromagnetic or photothermal warming tools; ultrasonic warming tools); supercooling, vitrification, and metastability control; next-generation CPA formulations or delivery modalities; high-throughput or machine learning–driven frameworks for cryoprotectant discovery; integrated diagnostic or real-time monitoring; automation, robotics, or cryoprinting approaches that enhance precision and throughput in cryobiological workflows; AI-based prediction or optimization; and other disruptive methodologies that can solve longstanding practical or translational challenges.

3. REPRODUCTIVE MEDICINE AND FERTILITY PRESERVATION

KEYWORDS: preservation of sperm, oocytes, embryos, testicular and ovarian tissues, reproductive technologies

DESCRIPTION: Preservation of gametes, embryos, and reproductive tissues is fundamental to both human reproductive medicine, animal breeding, and the conservation of animal species. Advances in this area enhance clinical fertility preservation options, support assisted reproductive technologies (ART), and safeguard genetic diversity for agriculture, research, and biodiversity management. This category welcomes research addressing the biophysical, molecular, and technological challenges associated with the cryopreservation and vitrification of sperm, oocytes, embryos, and testicular or ovarian tissues. Topics include characterization of osmotic tolerance limits; mechanisms of oxidative, thermal, or cryo-induced damage; strategies to mitigate injuries; novel cryoprotectants, protocols, technologies for reproduction such as gamete selection and fertilization.

4. ORGAN & TISSUE PRESERVATION FOR TRANSPLANT MEDICINE, DRUG DISCOVERY, AND BEYOND

KEYWORDS: organ preservation, organ transplantation, cartilage, bone marrow, organoids, tissue slices

The ability to preserve complex biological systems — ranging from multi-cellular systems to whole organs — is important to enable distributed biomanufacturing, supporting ex vivo platforms for drug discovery and toxicology, and advancing transplantation and regenerative medicine. This category includes research focused on the cryopreservation, hypothermic storage, freezing, supercooling, vitrification, or long-term stabilization of complex multicellular systems, such as organoids, precision-cut tissue slices, bone marrow, engineered tissues, vascularized tissues, cartilage, organs, etc. Submissions may address mechanistic studies of injury pathways; strategies to preserve structural and functional integrity; optimization of perfusion, CPA loading/unloading, or cooling/rewarming protocols; quantitative assessments of viability, metabolism, and post-preservation performance; and novel technologies for maintaining the physiological function of complex biological systems. Pre-clinical and/or survival studies in transplantation are particularly welcomed.

5. PRESERVATION OF CELLS, THERAPIES, TRANSFUSION PRODUCTS, RESEARCH PRODUCTS, AND PHARMACEUTICALS

KEYWORDS: cell & gene therapies, blood preservation, vaccines, pharmaceuticals, infusible products, cell preservation

DESCRIPTION: Preservation of cells in suspension or other formats, cellular therapies, gene-therapy products, transfusion components, blood products, vaccines, infusible or injectable therapeutics, biological materials for research, and pharmaceutical formulations is essential for ensuring safety, potency, logistical flexibility, and global accessibility, providing a critical temporal bridge between upstream processing (e.g., expansion, editing, activation) and clinical or research utilization, enabling batch standardization, quality control, and transport across sites. This category invites research on cryopreservation, freeze-drying, stabilization, and cold-chain optimization for therapeutic cells (including immune cells, stem cells, and engineered cell products), viral vectors, gene therapy constructs, blood and plasma components, vaccines, pharmaceutical formulations, and any manner of cellular or tissue system used in research, medicine or biotechnology. Particular areas of interest include mechanisms of cryoinjury in cell systems; cryoprotectant formulation design and optimization; process engineering for scalable and closed-system contamination-free preservation; post-thaw functional and potency assays; and strategies that minimize application-site manipulation or maintain ready-to-use formulations.

6. CRYOSURGERY & THERAPEUTIC USE OF LOW TEMPERATURE

KEYWORDS: therapeutic hypothermia, cryoablation, cryosurgery, cryoimmunotherapy, targeted freezing, cold-based tissue destruction

DESCRIPTION: Cryosurgery leverages controlled low-temperature exposure to selectively destroy pathological or undesirable tissues while minimizing collateral injury. Cryosurgery/cryoablation is increasingly used for minimally invasive treatment of tumors, precancerous lesions, arrhythmogenic cardiac tissues, and other disease targets. Therapeutic hypothermia and related cold-based interventions further extend the clinical use of reduced temperatures to modulate metabolism, inflammation, and ischemia-reperfusion injury. This category welcomes research spanning the biophysics, engineering, and clinical translation of cryosurgery and cold-based therapeutics. Areas of interest include cryoablation technologies and probe designs; targeted and image-guided freezing strategies; mechanisms of cell and tissue destruction; immunological effects of cryoablation; therapeutic hypothermia applications; and emerging modalities that integrate cryosurgery with immunotherapy or adjunctive therapies. Submissions that deepen understanding, improve precision and safety, or demonstrate new clinical or translational applications of cryosurgery are especially encouraged.

7. BIOPRESERVATION OF FLORA & FAUNA: APPLICATIONS IN CONSERVATION, PLANT CRYOBIOTECHNOLOGY, AGRICULTURE, AQUACULTURE, AND FOOD SYSTEMS

KEYWORDS: plant cryobiotechnology, seed banks, shoot tips and meristems, clonal species, crop germplasm, forestry and horticulture, aquaculture, fish and shellfish gametes, insects, microbial and yeast cultures, cryo-conservation of threatened or endangered flora and fauna, food preservation, food safety, food processing, biodiversity and food security

DESCRIPTION: The long-term preservation of plant, animal, fungi, and microbial biological resources is critical for biodiversity conservation, sustainable agriculture, aquaculture, and resilient food systems. Effective biopreservation strategies safeguard genetic diversity, support breeding programs, maintain germplasm for endangered or valuable flora and fauna, and ensure safe preservation and transportation of perishable foods, and advances in this area have direct implications for environmental stewardship, global food security, and the sustainable management of biological resources. This category encompasses preservation strategies that support conservation, agriculture, aquaculture, food systems, and plant-based biodiversity resources. Example topics include cryopreservation and long-term storage of seeds, pollen, meristems, shoot tips, somatic embryos, and clonal or wild germplasm; preservation of aquatic, amphibian, or marine species (e.g., fish, mollusks, crustaceans, coral, toads) for breeding and stock maintenance or for biodiversity conservation; stabilization of microbial and fermentation cultures used in food production; technologies that contribute to food supply resilience, post-harvest and supply chain stabilization and food waste reduction; sustainable production systems; and genetic resource conservation. Submissions may address protocol development, mechanistic understanding, regeneration and viability outcomes, repository practices, and applications that enhance biodiversity, global food security, environmental stewardship, etc.

8. NATURAL ADAPTATION TO STRESS AND SURVIVAL IN EXTREME ENVIRONMENTS

KEYWORDS: anhydrobiosis/desiccation tolerance, cold/freezing tolerance, hibernation, osmolytes, plants, extremophiles, anti-freezing, organism cryopreservation

DESCRIPTION: Anhydrobiosis is the remarkable ability of certain organisms (e.g., tardigrades, nematodes, rotifers, crustaceans, and plants) to survive almost complete dehydration. Natural cold adaptation mechanisms include freezing avoidance and tolerance strategies in animals and plants. A reduction in water availability is a characteristic of both challenges and requires a coordinated series of events to prevent osmotic and oxidative damage while maintaining the native structure of biomolecules and cellular structures. Understanding how organisms naturally survive extreme environmental stresses provides fundamental insights and inspiration for advancing cryopreservation and biostabilization strategies. This category welcomes research that elucidates the physiological, molecular, and structural mechanisms underlying natural survival in extreme environments. Topics include, but are not limited to, anhydrobiosis and desiccation tolerance, freezing avoidance and tolerance, osmoprotective strategies, cold-adapted biomolecules, natural cryoprotectants, and organism-level cryopreservation. Studies that translate these insights into novel technologies, cryoprotective agents, or strategies for cryopreservation are especially encouraged.

9. PRACTICAL, LEGAL, ETHICAL, REGULATORY, AND MANAGEMENT CONSIDERATIONS IN BIOBANKING

KEYWORDS: legal considerations, ethical considerations, regulatory considerations, best practice, customer consent, biobank management, financial management, business models, cold chain logistics, labelling and tracking, data management, sample sharing, data sharing, safety and security, applications in biomedicine, pharmaceutical, drug/vaccine tests

DESCRIPTION: As a direct application of cryobiology and biopreservation, biobanking of biological samples has been playing an essential role in fundamental research and biomedical applications. Biobanking examples include seed banks, culture collections, genetic/biological resource centers, and human and veterinary biobanks. Specimens vary from whole organisms to tissues, cells, and extracts,

healthy or diseased, natural or engineering ones. Biobanking requires developing custom-designed preservation strategies and involves standard operating procedures, regulations, and ethical considerations. Topics in this field can include but not be limited to biopreservation technologies, legal, ethical, regulatory considerations, best practice, customer consent, biobank management, financial management, business models, cold chain logistics, labelling and tracking, data management, sample sharing, data sharing, safety and security, applications of biobanked samples in biomedicine, pharmaceutical, drug/vaccine tests, and others.

10. INTERDISCIPLINARY TOPICS IN LOW-TEMPERATURE SCIENCE

KEYWORDS: Astrobiology, Icy Worlds, Space Travel, Cold Regions Sciences and Technology, Frigid Zone Medicine, Data-driven Science, AI for Science, Molecular Design, Cryogenics

DESCRIPTION: This category provides a forum for innovative and interdisciplinary research in low-temperature science that does not fit into the other defined categories. It encompasses studies where fundamental discoveries in diverse fields that might intersect with cryobiology, including astrobiology, the exploration of icy worlds, space travel, and the survival of life in extreme environments. Contributions may also address novel theoretical frameworks, emerging technologies, or unconventional approaches that expand our understanding of biological, chemical, or physical processes at low temperatures.