



Master's Degree Program in Desert Studies

Master's Degree Program in Hydrology & Water Quality

Ph.D. Degree Program

## The Albert Katz International School for Desert Studies



# The Albert Katz International School for Desert Studies

The Albert Katz International School for Desert Studies (AKIS) was established in 1999 as part of the Jacob Blaustein Institutes for Desert Research (BIDR).

The School offers a few graduate programs:

- A two-year Master's program in Desert Studies
- A two-year Master's program in Hydrology & Water Quality
- A four-year Ph.D. program (Details at: [http://in.bgu.ac.il/en/kreitman\\_school/Pages/default.aspx](http://in.bgu.ac.il/en/kreitman_school/Pages/default.aspx)).

The courses in all programs are taught in English by researchers from the BIDR and from other faculties at Ben-Gurion University of the Negev, and, occasionally, by leading scholars from the international community.

AKIS is located on the Sede Boqer Campus of Ben-Gurion University of the Negev. The campus is set within the arid Negev Highland region, some 50 km south of the city of Beer-Sheva. The School's research and teaching facilities are all located on the Sede Boqer Campus. Some fieldwork is done in research stations situated in various parts of the Negev. Our modern students' dormitories were designed according to the principles of climate and energy conscious architecture. We have accommodation for single as well as married students.

## Master's degree in Desert Studies

This innovative, multidisciplinary program in Desert Studies is structured to provide an integrated approach, offering students exceptional opportunities to pursue a combination of basic and applied research. Students are exposed to a wide range of disciplines complementary to their track of study.

### **The program offers the following tracks of study:**

1. Ecology of Drylands
2. Agriculture and Biotechnology of Drylands
3. Solar Energy and Environmental Physics
4. Environmental Studies
5. Irrigation and Plant Environment
6. Environmental and Aquatic Microbiology

### **1. Ecology of Drylands**

Deserts, far from being desolate wastelands, support an amazing variety of plants and animals, whose physiologies, morphologies, and behaviors are adapted to harsh conditions. Thus, deserts offer natural laboratories for studying natural selection in action. Moreover, deserts offer simple, transparent systems for studying the consequences of these selected traits for individuals, populations, and communities. Deserts often inspire new theories in ecology and provide the crucible in which we test them.

A wide variety of research projects are available to graduate students for thesis work.

#### **Physiological Ecology in Extreme Environments**

- Physiological limits to flight duration in migrating birds
- Drought-responsive genes in populations from desert habitats
- Phenotypic plasticity of developmental hierarchies in plants

#### **Plant–Animal Interactions**

- Coevolution of plant-animal interactions and plant defenses
- Effects of herbivore activity on plant communities



### Behavioral and Community Ecology

- Sexual selection in spiders
- State-dependent behavior and predator-prey foraging games
- Applying foraging theory to the study of biotic communities
- Ecological implications of plant communication
- Mechanisms of phenotypic plasticity in plants
- Future perception in plants
- Resource dynamics and phenotypic plasticity in plant communities
- Community-level implications of phenotypic plasticity in plants

### Conserving and Managing Biodiversity in Desert Ecosystems

- Conserving rare and isolated populations in naturally fragmented desert habitats
- Species diversity of spiders: a tool for detecting the effects of habitat degradation
- Habitat suitability indices and management strategies based on foraging theory
- Invasion ecology of colonial spiders

### Genetic Characterizations of Reintroduced and Introduced Populations

- Space-use patterns of GPS-collared Asiatic wild ass in the Negev Desert
- Estimating the population size of species using genetic and ecological techniques

## 2. Agriculture and Biotechnology of Drylands

Drylands constitute approximately 40% of the Earth's terrestrial surface, and are home to more than two billion people. These arid areas, including such diverse ecosystems as deserts, savannahs and tropical dry forests, are often characterized by population growth, over- exploitation, drought and desertification that lead to declines in crop productivity. The sustainable production of food in regions where traditional or conventional methods of agriculture are difficult or impossible to implement can be ensured by developing agrotechnologies and biotechnologies. This track of study provides students with the tools to address these issues by carrying out cutting- edge research in extensive and intensive agriculture.

Research Topics:

### Desert Plant Physiology, Ecophysiology, Biochemistry and Biotechnology

- Micropropagation and tissue culture
- Metabolic engineering for crop improvement
- Acclimation and adaptation to environmental stress
- Phytopharmaceuticals and secondary metabolites
- Genetics and epigenetics
- Ecophysiology

### Microalgal Biotechnology

- Indoor and outdoor microalgal intensive and extensive growth
- Design of efficient photobioreactors
- Basic and stress algal physiology overproduction
- Analysis and extraction of valuable secondary carotenoids and fatty acids
- Basic algal molecular biology and biochemistry
- Microalgal taxonomy and contamination management

### Agronomy and Agrometeorology

- Runoff agriculture and afforestation
- Irrigation and crop water use
- Agricultural systems modeling

### Aquaculture and Aquatic Animal Health

- Diseases in recirculating aquaculture systems
- Diseases in ornamental fish
- Development of natural therapeutants and immunostimulants

### Animal Production and Adaptation

- Livestock production in desert conditions
- Host-parasite relationships
- Biotic and abiotic effects on the behavioral and physiological responses of animals

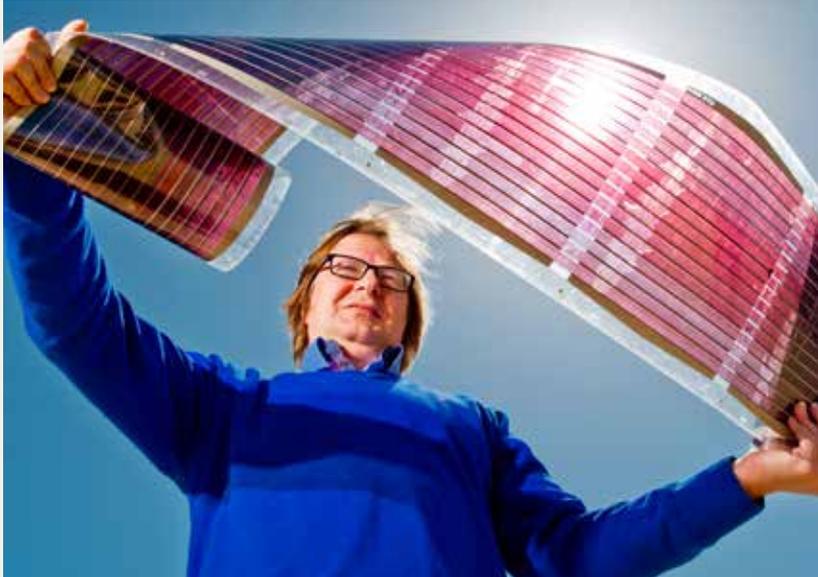
## 3. Solar Energy and Environmental Physics

Nature introduces many challenges to scientists and to human society. Among these challenges are the need to develop renewable energy resources and the need to improve our understanding of the complex environments around us. The solar energy and environmental physics track of study offers students the opportunity to gain advanced skills in theoretical and experimental physics. The research projects include applied and fundamental science.

M.Sc. students are offered the opportunity to engage in cutting-edge research in a wide range of fields, including:

### Physics of the Environment

- Climatology
- Geophysical fluid dynamics
- Non-linear waves in the environment
- Ecological pattern formation
- Dust dynamics and aeolian processes and forms
- Remote sensing of land cover and land use changes
- Non-linear dynamics in environmental physical chemistry
- Membrane electrochemistry and micro-fluidics in desalination and separation
- Bio-reactors modeling and algae growth
- Optimal management of natural resources
- Modeling the effects of noise and disorder on ecosystems' non-linear dynamics



### Solar Energy

- Photovoltaic (PV) device modeling and design
- Characterization and physics of solar cells
- PV systems and grid-matching
- Theory of organic PV
- Charge transport and generation in soft PV
- Nano-materials for PV devices
- Applied optics for solar concentrators
- Solar furnaces and synthesis of novel materials
- Flow batteries for solar energy storage

### 4. Environmental Studies

This track of study provides a unique academic perspective on the human and built environment in arid regions. Combining expertise in desert architecture and urban planning and the social sciences (sociology, anthropology, economics and policy studies), faculty and students examine the contemporary challenges of sustainable development, situating local case studies within regional and global contexts.

### Architectural Design in Desert Environments

- Bioclimatic design, thermal comfort and energy efficiency, passive heating and cooling, lighting and visual comfort, building envelope geometry and materials, design tools, evolution of desert building technologies
- Monitoring, Indoor Environment Quality (IEQ), Post-Occupancy Evaluation (POE), retrofit energy upgrade of existing building stock
- Embodied energy and Life-Cycle Assessment (LCA)

### Urban Design in Desert Environments

- Urban microclimate, microclimate of open spaces, pedestrian thermal stress and thermal sensation, sustainable and environmentally conscious design in arid zones

### Urban and Regional Planning

- Urban development patterns in deserts, urban land use, sparsely populated desert regions, planning and sustainability, sustainable population growth, inter-regional migration

### Disaster Management in Drylands

- Proactive emergency planning and crisis management in drylands, people and drylands in history, time-series analysis and risk assessment

### Pastoralism and Sedentarism

- Agnation in Mid-East societies, nomadic and static pastoralism, urbanization of Bedouin peoples, villages for shepherds, Bedouin markets

### Gender and Feminism

- Gender in cross-cultural perspectives, feminist theories and research methodologies

### Political Economy of the Rural Sector

- The political economy of agriculture, water politics, development projects in Less Developed Countries (LDCs)

### Social Analysis of the Environment

- Actor/network theory, technological diffusion, green building legislation, standards, behavioral issues and barriers



## 5. Irrigation and Plant Environments

This track of study focuses on the vital questions facing irrigators: when and how much to irrigate? The program provides tools with which to address the aforementioned questions within the special conditions prevailing in arid and semi-arid environments (e.g., high evaporative demand, saline water, low nutrient content). This track combines courses that deal with the fundamentals of soils, plants, water and atmosphere systems. In addition, the students explore different irrigation systems and study the feedback processes of irrigation systems with the soil and the plants.

### Potential research topics

- The influence of dripper discharge rate on the yield and quality of vegetables and fresh herbs irrigated with saline water
- The effect of irrigation water salinity on the yield and quality of pomegranate fruits and products
- Irrigation scheduling of date palm trees using heat dissipation sensors
- Deficit irrigation of olives and water stress management strategies
- Irrigation via compost-filled trenches, distinguishing between physical and chemical benefits

- Managing desalinated water for irrigation
- The effect of management strategies on root and salt distribution in the soils of olive orchards irrigated with saline irrigation water
- Calculating the costs and benefits of desalination for agriculture – a regional economic- agronomic-environmental case study
- The influence of intensive organic and conventional agriculture on groundwater quality
- The surface-active properties of soil-organic-matter
- The effect of treated-wastewater-derived solids and dissolved organic matter on the structure and surface properties of soils
- Water and solute transport in treated-wastewater-irrigated soils
- The impact of recycling biosolids as a soil amendment on soil structure and water availability for plants
- Water and energy budgets of row crops
- Separating evapotranspiration into soil evaporation and canopy transpiration
- Dew and water vapor adsorption in arid environments

## 6. Environmental and Aquatic Microbiology

Microorganisms are essential members of the arid soil environment. They shape the landscape through rock weathering and soil crust formation. They are the most important organisms in the biogeochemical cycling of carbon and nitrogen. They adapt to the rapidly changing environmental conditions of water availability, temperature, and UV radiations. Microorganisms possess enormous metabolic potential for biotechnological applications.

Our track introduces the students to the latest developments in environmental microbiology research in arid environments, using advanced molecular, biogeochemical and isotopic tools. This track of study includes an integration of classes and research activities that cover a wide range of environmental and ecological issues that encompass microbial activities:

- Nitrogen cycling in arid soils
- The role of desert soil crust in nutrient cycling
- The interrelationships between desert plants, soil bacteria and climate on biogeochemical cycling and desertification
- The microorganisms in desert plants' rhizosphere and phyllosphere



- The effect of rain events in the desert on microbial diversity, abundance and activity
- Bacterial diversity and its role in maintaining functional arid ecosystems
- The microbial inhabitants of desert rocks
- Bio-methane production from animal waste in arid environments
- Bio-remediation of soils and water bodies in arid environments
- Nutrient recovery from bio-waste
- Sources of greenhouse gases
- Biofiltration and mitigation of greenhouse gases
- Treatment and reclamation of marginal water (grey water)
- Water and wastewater treatment

## M.Sc. in Hydrology and Water Quality

Drylands constitute more than one-third of the land surface of the Earth, including most of the Middle East and Israel. Dwindling water supplies and deteriorating water quality impede the sustainable development of drylands and the well-being of their growing population. The aim of this program is to introduce the students to cutting-edge research and graduate education in water sciences (hydrology, water treatment and water quality), aimed at improving human well-being in drylands through technologies and policies for the sustainable use of water resources.

### **The program offers the following tracks of study:**

1. Water Resources
2. Desalination & Water Treatment
3. Environmental Microbiology and Water Quality

### **1. Water Resources**

Potential research topics:

- Identification & quantification of the sources of groundwater recharge
- Calculation & quantification of subsurface flow and transport mechanisms
- Management of regional and international transboundary groundwater reservoirs
- Transport of contaminants to and within groundwater reservoirs
- Optimization of water production and transfer systems
- Online monitoring of flow and transport of water and contaminants in unsaturated zones
- Modeling pollution transport in aquifers
- Shock waves in porous media
- Development of new concepts for modeling the nexuses of water-energy-food resources
- Colloid and nano-particle transport in fractured matrixes
- Revealing the surface stream-groundwater connections

## 2. Desalination & Water Treatment

Potential research topics:

- Improvement & development of new membranes for reverse osmosis and nano-filtration in seawater desalination
- Improvement of membranes for various types of wastewater and urban effluents after tertiary treatment
- Development of novel ion-conducting membranes
- Pre-treatment of water for reverse osmosis
- Development of methods to eliminate organic substances from industrial effluents and polluted groundwater
- Study of mechanisms in low/high-pressure desalination systems associated with reverse osmosis and nano-filtration
- Improvement of materials used in reverse osmosis
- Development of management practices and methods to reduce concentrate volumes
- Development of new techniques for the reuse of urban effluents
- Improvement of electrodialysis processes for the desalination of brackish water and for use in industry

## 3. Environmental Microbiology and Water Quality

Potential research topics:

- Bio-remediation of water and soils using biotechnology
- Decentralized/onsite wastewater treatment systems
- Biological activity and stream restoration
- Understanding of the ecology of flow systems in aquifers and underground water reservoirs
- Development of biological treatments for industrial and domestic effluents
- Upscaling of laboratory-scale treatment processes
- Compound specific isotopic analysis of organic pollutant biodegradation in water bodies
- Development of tools for pathogen detection in drinking water and effluents
- Investigating natural attenuation processes in groundwater
- Ecology of biological nitrogen transformation in water bodies





For more information please visit our website at  
<http://www.bgu.ac.il/akis>

**Or contact us**

Ben-Gurion University of the Negev  
Sede Boqer Campus, Midreshet Ben-Gurion, Israel 84990  
Tel: +972-8-6596733 | Fax: +972-8-6596985  
E-mail: [dschool@bgu.ac.il](mailto:dschool@bgu.ac.il)



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אוניברסיטת בן-גוריון בנגב  
Ben-Gurion University of the Negev