Technical Note

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A research and training center model – the Weizmann Institute of Science

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Abstract: The Weizmann Institute of Science is one of the world's leading multidisciplinary basic research institutions in the natural sciences and mathematics. It is located in Rehovot, some 40 km west of Jerusalem, Israel. The Weizmann Institute has already a considerable history of fundamental research and discovery achievements, all driven by curiosity and creativity that led to remarkable appreciation. Inherent to its being an active research center, the Weizmann Institute has, already from its inception, been playing a major role in educating a substantial proportion of Israel's scientific leadership.

Öz: Weizmann Bilim Enstitüsü, İsrail'de Kudüs'ün 40 km batısında Rehovot'ta bulunan, doğa bilimleri ve matematik alanında dünyanın önde gelen multidisipliner araştırma enstitülerinden biridir. Enstitü, merak ve yaratıcılıkla sürdürülen oldukça önemli temel araştırma ve keşiflerin yapıldığı başarılarla dolu tarihsel bir geçmişe sahiptir. Weizmann Enstitüsü, aktif bir araştırma merkezi olmasının yanında, kuruluşundan itibaren İsrail bilimine öncülük eden eğitimin önemli bir parçası olarak rol oynamaktadır.

Keywords: education; multidisciplinary basic research institutions; open-air science museum; research and training center model; Weizmann Institute of Science.

The Weizmann Institute of Science is one of the world's leading multidisciplinary basic research institutions in the natural sciences and mathematics. It is located in Rehovot, some 40 km west of Jerusalem, Israel. It was initially established as the Daniel Sieff Institute in 1934, being a research center, mainly in organic chemistry. In 1949, it was renamed for Dr. Chaim Weizmann, the first President of the State of Israel and founder of the Institute (Figures 1 and 2). Dr. Weizmann was a renowned chemist and ardent Zionist. It was his vision of the establishment of a Jewish state in the Land of Israel and his long-sighted understanding of the crucial role of higher education and scientific research in the evolving young state. These also led to Dr. Weizmann's leading role in the foundation of the Hebrew University of Jerusalem already in 1925. Dr. Weizmann understanding and appreciation of the essential role of developing higher education and science in an emerging state inspired and provided the frame for the Weizmann Institute. Its structure has been inspired by research centers already existing and operating successfully in the early 20th century such as those of Kaiser Wilhelm Society (the forerunner of the Max Planck Society of today). Namely, centers built on identifying original promising scientists and providing them with optimal research conditions. This was expected to lead to excellence in fundamental scientific research and establish a center striving to achieve the highest levels. This has and is being done at the Weizmann Institute by identifying promising young scientists and providing them with the possibility of pursuing their creative research ideas in a free and supportive environment.

The Weizmann Institute of Science is located on a campus that covers a 1.1 sq km (280 acres) area in Rehovot. Its scientific structure consists of five faculties: Mathematics and Computer Science, Physics, Chemistry, Biochemistry and Biology, encompassing 18 departments, including a Science Teaching department (Table 1).

Importantly, the faculties and departmental structures are primarily providing administrative frames while interdisciplinary research is promoted as a dominant feature, and is indeed a characteristic of the Institute. For example, scientific questions of the life sciences are currently also investigated by mathematicians and physicists all the way to molecular biologists.

The Feinberg Graduate School provides the frame for the large body of students pursuing their research toward M.Sc (~400) and Ph.D. (~700) as well as postdoctoral researchers (~370). It consists of five research schools: Physical, Chemical, Biochemical, Biological and Mathematics & Computer Sciences. These offer more than 200 frontal- and lab-courses. Annually, about 180 M.Sc. and 140 Ph.D. degrees are awarded. Moreover, the majority of

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Table 1: Faculties and departments of the Weizmann Institute of Science.

Biology	Biochemistry	Physics	Chemistry	Math and Computer
Biological Regulation	Bio-Molecular Sciences	Condensed Matter Physics	Chemical and Biological Physics	Theoretical Mathematics
Immunology	Plant Sciences	Particle Physics	Environmental Sciences and Energy Research	Computer Sciences
Molecular Cell Biology	Molecular Genetics	Physics of Complex Systems	Materials and Interfaces	
			Organic Chemistry	
Neurobiology			Structural Biology	

the postdoctoral students are from foreign countries all gaining advanced research experience in the Institutes labs, supported by local and international scholarships.

Figure 1: Building on the Weizmann Institute campus.

The research of the Institute is led by close to 280 principle investigators, faculty members, running their individual laboratories that are involved in more than 1,000 active projects. Significantly, the vitality and creativity of the research are ascertained in several ways. Annual evaluations by international peer reviews and by continuous recruitment of young scientists. On average 10 new members have been hired annually in recent years.

All these research groups occupy 251 buildings of labs and support services, including specialized physical, chemical and biological support facilities, ranging from sophisticated cellular and organ imaging to advanced computing facilities. Conveniently, on-campus housing is also provided for faculty, students and visiting scientists.

The Weizmann Institute has already a considerable history of fundamental research and discovery achievements, all driven by curiosity and creativity that led to remarkable appreciation. One outstanding example is the crystallization and X-ray diffraction-based structure-determination of the ribosome recognized with a Nobel Prize in Chemistry in 2009

Figure 2: A laboratory in the Weizmann Institute.

Table 2: Weizmann Scientists' collaborations by country.

USA 415	Switzerland 205	India 113	Turkey 49
Germany 341	Japan 197	China 94	Argentina 45
France 315	Spain 144	Mexico 59	Portugal 42
UK 269	Belgium 116	Brazil 54	Singapore 24
Italy 226			

for Prof. Ada Yonath. Another illustration is the pursuit after the molecular nature of immune response, specifically examining why a certain membrane protein is involved in causing an autoimmune disease such as multiple sclerosis? 30 years of hard work by Profs. Michael Sela and Ruth Arnon led to the leading treatment for that disease by the drug Copaxone®, that also helped build Israel's thriving pharmaceutical and biomedical sector.

All this led the Weizmann Institute being ranked as the sixth in the *Nature* Index of world-wide institutions according to the impact of their academic research on innovation by measuring how their publications are cited by patents held by third parties.

International collaboration

An important element in the success of the Institute's research is the very broad and extensive collaboration of its researchers with colleagues around the world, as illustrated in Table 2.

Teaching and explaining science

Inherent to its being an active research center, the Weizmann Institute has, already from its inception, been playing a major role in educating a substantial proportion of Israel's scientific leadership. However, also rather early on, attention has been given to advancing science literacy of the public at large and, more importantly, in schools. These intense activities were carried out by dedicated independent science education arms of the Institute:

(1) The Department of Science Teaching that is entrusted with several specific responsibilities, such as teacher training and the development of teaching curriculum of different fields of science, from mathematics to biology. It also is in charge of the Rothschild MSc Program where by high-school teachers can obtain this degree.
(2) The Davidson Institute of Science Education is entrusted with developing activities of familiarizing the public at-large with the natural sciences. This broad and demanding role is done by a large number of schemes. Currently, the Davidson Institute operates more than 70 programs for outstanding students, for students from underprivileged backgrounds, and underachievers. It also trains teachers, runs online education programs, and holds science literacy events for the public.

One program gets 1,000 school children engaged in hands-on experiments in physics and chemistry. Another important activity is the International Summer Science Institute; since 1969, every summer, about 80 highly talented, recent high-school graduates from around the world participate in this month-long program. The program is conducted entirely in English and involves intensive lab work, lectures, tours of the country and social activities. Another unique activity is the Clore Garden of Science Museum, the first open-air science museum in the world where visitors are requested to touch, experiment and play with over 90 exhibits.