

**Innovative informal and formal science Education Programs in Israel
from the Kosher Pickle to Albert Einstein**

Ronen Mir

Science Learning Centers, the Weizmann Institute of Science, Rehovot, Israel

Ronen.mir@weizmann.ac.il

Debby Mir

The Porter School of Environmental Studies, Tel Aviv University, Israel

debbymir@gmail.com

Abstract

From the Kosher Pickle to Albert Einstein - Spectacular science demonstrations have been developed to meet the need for connecting daily life phenomena with its scientific substance. Using daily objects one learns about Astrophysics, Atmospheric Physics, Newton's Laws, Gravity, Chemistry, Waves and Sound, Fire and Ballistics. The combination of Science and Religion is also shown through visualizations of Biblical scriptures.

Science Learning Centers, the Hemda model - Science Learning Centers are developed to host all High School students in the community (City or Region) who select advanced Physics or Chemistry. The students study these subjects at the Learning Centers in hands-on state of the art teaching laboratories. All other studies take place in their home schools. Informal Education best practices are implemented to make the studies more meaningful and enjoyable. Teams of teachers are recruited, trained and develop the curriculum together for the Centers. All learning takes place in the Regional Science Learning Centers, where the laboratories are equipped with State-of-the-art scientific experiments and demonstrations.

Connecting Science Education with Integrated Pest Management in Israeli Schools - "Green School" certification often increases pest problems: 1) reuse/recycling tires and wastes and hazardous wastes, 2) water collection, and 3) animal rights – protecting feral cats. Pest management in Israeli recognized Jewish and Arab schools and kindergartens depends on annual spraying for insects. The

Healthy School program is based on understanding chemical safety, safer alternatives and pest life cycles; and implementing integrated pest management (IPM) cooperatively with teachers and pupils.

From the Kosher Pickle to Albert Einstein

Spectacular science demonstrations have been developed to meet the need for connecting daily life phenomena with its scientific substance. Using daily objects one learns about Astrophysics, Atmospheric Physics, Newton's Laws, Gravity, Chemistry, Waves and Sound, Fire and Ballistics. The combination of Science and Religion is also shown through visualizations of Biblical scriptures.

The performances use lots of humor, surprising effects, and awe inspiring actions. The audience is an active participant contributing to the science demonstration. The participants take home ideas for safe experiments they can use to demonstrate science.

The demonstrations can be used to combine Science with: a) Live Music, depending on the availability of live musicians; and b) Biblical texts, depending on the audience interest

These demonstrations have been successfully performed in the US, South Africa, Ethiopia, Brazil and Israel, for science professionals and teachers, policy makers, grandparents and grandchildren programs, and school assemblies of all ages.

Science Demonstrations - Science demonstrations are older than science museums. They were brought to the forefront of entertainment from the XVI and XVII centuries onwards. Today they are used to convey messages about science and modern research in science museums and informal learning environments.

Connecting science to daily life - Too often Science is taught in schools and delivered to the public detached from their lives. Yet there is so much science in everything we develop and do; our entire existence is based on science. These science demonstrations visually demonstrates and explains the deep roots and explanations of everyday phenomena in science.

Making science accessible and fun - Everyone can do experiments. Studying about our world is interesting and can be a lot of fun. These science demonstrations are full of humor, delivering surprising effects using food, water, fire, wind and air.

Bringing informal learning to formal environments; Professional Teacher training - Pupils need to be included as active participants in the learning process. More questions than answers need to be raised,

as this is how science is performed. Using informal learning techniques the science shows help professionals develop effective learning strategies. These demonstrations are used for professional science educators and teacher training.

A typical list of experiments and their motivation is described in the table below.

Experiment Performed	Einstein Story
Electric Pickle Observe the light of a glowing pickle by running electricity through it.	As he was a late talker, his parents were worried. At last, at the supper table one night, he broke his silence to say, "The soup is too hot." Greatly relieved, his parents asked why he had never said a word before. Albert replied, "Because up to now everything was in order." Nobel Prize 1921 - Photo Electric effect.
Egg in a Bottle – Insert an egg into a bottle through its small neck, and take it out.	Einstein once declared that his second greatest idea after the theory of relativity was to add an egg while cooking soup in order to produce a soft-boiled egg without having an extra pot to wash.
Head Water – pour water over peoples' head, without getting wet.	"When I was young I found out that the big toe always ends up making a hole in a sock," Einstein once recalled. "So I stopped wearing socks."
Sodium Polyacrylate – pour water over a peoples' head, using diaper powder, without getting wet.	On one occasion, when a young couple at whose wedding he had been best man, brought their son - a little boy of eighteen months, to meet Einstein, the child took one look and burst into a screaming fit. The parents were speechless with embarrassment but Einstein's eyes lighted up. He smiled approvingly, patted the youngster on the top of his head, and crooned: "You are the first person in years who has expressed what you really think of me."
Fakir's Seat – seat on a chair of Nails.	"When I was doing Professor Albert Einstein's bust he had many a jibe at the Nazi professors, one hundred of whom had condemned his theory of relativity in a book. "Were I wrong," he said, "one professor would have been enough."
Sound Pipe – create sounds through swinging a pipe in the air.	On one of those days, when Einstein was tired, he lay on the sofa while a friend played on the mechanical piano. "Was it restful?" he asked as Einstein got up. "The sofa, yes," he replied. "The music, not too much."

	Too sugary."
Whistle – blow air into the whistle through soap solution creating a bubble.	A group of reporters from Boston asked Einstein, "What is the speed of sound?" "I don't know offhand," he replied. "I don't carry information in my mind that is readily available in books".
Fire Flute – create fire waves through propane gas and music.	ONCE Einstein sent this reply, along with a page full of diagrams, to a fifteen-year-old girl who had written for help on a homework assignment: "Do not worry about your difficulties in mathematics; I can assure you that mine are much greater."
Violin – play a musical piece on the violin.	Albert Einstein, who fancied himself as a violinist, was rehearsing a Haydn string quartet. When he failed for the fourth time to get his entry in the second movement, the cellist looked up and said, "The problem with you, Albert, is that you simply can't count."
Burning Money – burn paper money dipped in Ethanol, burn real money dipped in water-Ethanol.	EINSTEIN came to Princeton University in 1935 and was asked what he would require for his study. He replied: "A desk, some pads and a pencil, and a large wastebasket to hold all of my mistakes."
Galileo – drop different weights on to the ground.	Albert Einstein's wife was once given a guided tour of the Mount Wilson Observatory (in California), whose giant optical telescope was among the largest in the world. "One of the principal functions of all this sophisticated machinery," an astronomer explained, "is to determine the extent and shape of the universe." "Oh," she replied, "my husband does that on the back of an old envelope."
Galileo + Ruler – drop and project weights in the air.	ONE DAY during his tenure as a professor, Albert Einstein was visited by a student. "The questions on this year's exam are the same as last year's!" the young man exclaimed. "Yes," Einstein answered, "but this year all the answers are different."
2 Nuts + String – spin the light nut around a pencil, pulled by the heavy nut.	Asked once where his laboratory was, he held up his fountain pen!

Broomstick + ball – drop the apparatus in the air.	A reporter once asked: "Will they ever invent an anti-gravity machine?" "They already have," Einstein solemnly replied, "its called an elevator."
Rubber + Sun + Photon – send a golf ball around the heavy Sun, which sits in the center of a rubber sheet.	...as the joint meeting of the Royal Society and the Royal Astronomical Society was dispersing [this was 6 November 1919, when the results of the eclipse expedition that confirmed Einstein's prediction of the bending of light by gravity were announced], Ludwig Silberstein came up to him and said, "Professor Eddington, you must be one of three persons in the world who understands general relativity." On Eddington's demurring to this statement, Silberstein responded, "Don't be modest, Eddington," and Eddington replied that, "On the contrary, I am trying to think who the third person is."
3 Ball Launcher – launch a space craft up by raising and dropping a system of 3 weights.	Einstein once visited his colleague Niels Bohr at Bohr's summer house on the Danish coast. He was astonished to see, above the house door, a horseshoe, commonly supposed by locals to bring good fortune to the occupants of the house. "Niels," said Einstein, "surely you, as a physicist, don't believe that such a horseshoe does any good, or that it might alter the course of events?" "Of course not," Bohr answered. "But I have heard that it also works if you do not believe in it."
Arrow + Apple – blow and shoot an arrow to hit an apple target in the distance.	Einstein had once taken Marie Curie sailing with him in Geneva. When they got far out, she said, "I didn't know you were a good sailor". And he replied, "Neither did I". Then she said, "But what if the boat should overturn? I can't swim." And he said, "Neither can I."
Canon of Death – shoot a projectile using ethanol canon.	The story is that Albert Einstein's driver used to sit at the back of the hall during each of his lectures, and after a period of time, remarked to AE that he could probably give the lecture himself, having heard it several times. So at the next stop on the tour, AE & the driver switched places, with AE sitting at the back, in driver's uniform. The driver gave the lecture, flawlessly. At the end, a member of the audience asked a detailed question about some of the subject matter, upon which the lecturer replied, 'well, the answer to that question is quite simple, I bet that my driver, sitting up at the back, there, could answer it...'

Science Learning Centers – The HEMDA model

Science Learning Centers are designed to serve all High School students in the community (City or Region) who select advanced Physics or Chemistry. The students study these subjects at the Learning Centers in hands-on state-of-the-art teaching laboratories. All other studies take place in their home schools. Informal Education best practices are implemented to make the studies more meaningful and enjoyable. Teams of teachers are recruited, trained and develop the curriculum together for the Centers.

One of the Weizmann Institute's major success stories in youth science education is HEMDA, the Center for Science Education in Tel Aviv. Students who excel in science from most Tel Aviv high schools receive their physics and chemistry education at HEMDA in Tel Aviv outside of their schools. It was an experiment in regional science education; it's a prototype that would be the first of many similar regional science education centers across Israel. Today, the Tel Aviv center success - evidenced in matriculation grades and other measures -has recently given impetus to the formation of a second center, in Rehovot adjacent to the Weizmann campus. HEMDA Rehovot has a unique set of characteristics including its proximity to, and cross-fertilization with the Weizmann Institute of Science campus and the Davidson Institute.

Established in 2013, HEMDA Rehovot, with its 18 carefully designed "class-labs" and three preparation rooms is constructing a new building architecturally unique vis a vis other schools in Israel and likely in the world. Hemda classrooms are outfitted with laboratory space and appropriate infrastructure, Internet access and other classroom equipment. The facility houses all the lab equipment necessary for robust physics and chemistry curricula, and its budget allows for substantial investments to update and purchase state-of-the-art equipment, on an annual basis. This unique architectural design enables teachers to break through the typical classroom isolation of theory and bring science to life in lab experiments.

The Hemda Science Learning Center for Science Education in Rehovot serves high school students from Rehovot and Nes Ziona. 10 high schools are sending their advanced science students to the new Center for their regular curricular instruction in physics and chemistry – for approximately eight hours per week.

Physics and chemistry have many sophisticated concepts that require advanced laboratory requirements, and thus high-level instruction requires expensive lab set-ups. Science teachers are most effective and productive, and create a passionate learning environment, if they are part of community of science teachers who have daily contact and exchange ideas.

Connecting Science Education with Integrated Pest Management in Israeli Schools and Kindergartens

Pest management in Israeli schools and kindergartens is based on on-demand and annual pesticide spray applications for insects during summer vacations, and until recently using organophosphate pesticides. Communities, teachers and parents perceive this approach as safe and preventative with little thought to the source of pest outbreaks – the connection between outdoor and indoor education.

Currently green school certification and education practices are inadvertently increases pest incidences: 1) tire reuse and outdoor water collection breed mosquitoes; 2) waste collection for recycling feeds rodents and insects; and 3) feral cats contaminate sandboxes with wastes and parasites. Innovative research and intervention implemented since 2012 teaches local authorities, inspectors, teachers and pupils about pests – a creature in the wrong place – and how to reduce exposure to toxic chemicals.

The Healthy School programs are based on understanding pest health impacts, chemical safety and alternatives, life cycles and needs of pests (especially insects and rodents) and implementing integrated pest management (IPM). The program includes inspections, recommendations, workbooks, guidelines and oversight. As a result of the program the Zvulon rural district (kibbutzim, Arab villages, bedroom community) have decided to delegate pesticide spraying to a last resort and instead partner sanitation and pest professionals with management, teachers and pupils to control pests before there is a problem.

These programs are described in more details in references 2-7.



Figure 1: Science Demonstration – Birthday Egg into the Bottle



Figure 2: Science Learning Center built for Rehovot, Israel



Figure 3: Food and Hazardous Chemicals are not a Good Match

Bibliography

1. Arzi, H.J. (1998) Enhancing science education through laboratory environment, published in Fraser & Tobin, International Handbook of Science Education, pp 595-608, Dordrecht, Netherland, Kluwer Academic Publishers.
2. Mir, Debby (2014) Healthy Homes: Safe Chemical Choices and Integrated Pest Management for Kindergartens – guidelines and education manual, Ministry for Environmental Protection and Zvulon Regional Council (in Hebrew).

3. Mir, Debby (2013) Recommendations for National Policy and Programs to Reduce Children's Exposure to Sanitation Pesticides, Ministry for Environmental Protection - Pest Surveillance and Control Division.
4. Mir, Debby and Batya Fried (2012) Healthy Homes: Safe Chemical Choices and Integrated Pest Management – guidelines and education manual, Ministry for Environmental Protection and Zvulon Regional Council (in Hebrew).
5. Mir, Debby et al. (2011) Impact of population characteristics on Illinois childcare adoption of integrated pest management (IPM), *Journal of Public Health*, 20(4): 431-440
6. University of California (UC) et al. (2011) Integrated Pest Management: A Curriculum for Early Care and Education Programs, <http://apps.cdpr.ca.gov/schoolipm/childcare/toolkit/curriculum.pdf>
7. Mir, Debby et al. (2010) Impact of Integrated Pest Management (IPM) Training on Reducing Pesticide Exposure in Illinois Childcare Centers, *Neurotoxicology*, 31(5): 621-6