CURRENT RESEARCH PROJECTS

2000

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The Weizmann Institute of Science

Rehovot, Israel

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For contact information (e−mail, phone, address) to all scientists at our Institute, press here

Table of Contents

About the Weizmann Institute of Science

The Weizmann Institute of Science, devoted to research and to graduate−level education in the natural and exact sciences, was inaugurated in Rehovot, Israel, in 1949. At that time, the Institute incorporated the Daniel Sieff Research Institute, which had been established in 1934. The Institute bears the name of Dr. Chaim Weizmann, scientist and statesman. Dr. Weizmann was the first President of the Weizmann Institute of Science; he was also the first President of the State of Israel.

The Institute includes 17 research departments (in five Faculties: Mathematics and Computer Science, Physics, Chemistry, Biochemistry, and Biology). The Department of Science Teaching, separate from the five Faculties, is incorporated within the Feinberg Graduate School. Thirty four research centers have also been established thus far: The Belle S. and Irving E. Meller Center for the Biology of Aging, The Nella and Leon Benoziyo Center for Neurosciences, The Murray H. and Meyer Grodetsky Center for Resarch of Higher Brain Functions, The Carl and Micaela Einhorn−Dominic Institute for Brain Research, The Yad Abraham Research Center for Cancer Diagnostics & Therapy, The Robert Koch Minerva Center for Research in Autoimmune Diseases, The M.D. Moross Institute for Cancer Research, The Willner Family Center for Vascular Biology, The Joseph and Ceil Mazer Center for Structural Biology, The Energy Research Center, The Fritz Haber Center for Physical Chemistry, The Helen and Milton A. Kimmelman Center for Biomolecular Structure and Assembly, The Sussman Family Center for the Study of Environmental Sciences, The Helen and Martin Kimmel Center for Archaelogical Sciences, The Gerhard M.J. Schmidt Minerva Center for Supramolecular Architecture, The Albert Einstein Minerva Center for Theoretical Physics, The Joseph H. and Belle R. Braun Center for Submicron Research, The Minerva Center for Nonlinear Physics of Complex Systems, The Nella and Leon Benoziyo Center for High Energy Physics, The Mel Dobrin Center for Nutrition, The Avron Willstä tter Minerva Center for Research in Photosynthesis, The Charles W. and Tillie K. Lubin Center for Plant Biotechnology, The Dr. Josef Cohn Minerva Center for Biomembrane Research, The Harry and Jeanette Weinberg Center for Plant Molecular Genetics Research, The Leo and Julia Forchheimer Center for Molecular Genetics, The Y. Leon Benoziyo Institute for Molecular Medicine, The Crown Human Genome Center, The Carl F. Gauss Minerva Center for Scientific Computation, The Arthur and Rochelle Belfer Institute of Mathematics and Computer Science, The Minerva Center for Formal Verification of Reactive Systems, The Dolfi and Lola Ebner Center for Biomedical Research, The Kekst Family Center for Medical Genetics, The Center for Genomic Disease Modeling and The Aharon Katzir−Katchalsky Center. The major scientific services units are: Biological Services, Chemical Services, Physics Services, Division of Information Systems, Research Services Division, Experimental Animals Center, and the Solar Facilities Unit.

The present scientific complement numbers about 665, including 366 scientists on staff, 135 long−term visiting scientists and post−doctoral fellows, and 164 research assistants directly serving the research programs. Approximately 791 graduate students are studying at the Feinberg Graduate School; they perform their research work in the laboratories of the Weizmann Institute.

With a technical staff of 763 and administrative and service personnel numbering 379, the total complement is approximately 2598.

Faculty of Mathematics and Computer Science

Dean: David Harel

Department of Computer Science and Applied Mathematics

Shimon Ullman, Head

The principal interests of the department lie in the areas of computer science and applied mathematics. Research in computer science includes the study of computational complexity, the development and analysis of algorithms, cryptography, proof theory, parallel and distributed computing, logic of programs, specification methodologies, the formal study of hybrid systems, combinatorial games, biological applications, brain modeling, visual perception and recognition, robotics and motion control. Research in applied mathematics includes dynamical systems, combinatorics, numerical analysis, the use of mathematical techniques to elucidate phenomena of interest in the natural sciences, such as biology and geophysics, and on the development of new numerical tools for solving differential equations, computing integrals, providing efficient approximations to complex continuous models, and solving other mathematical problems.

The departmental computer facilities include a multiple−CPU server, SGI, Sun and DEC workstations, and NCD X−terminals. The vision and robotics laboratories contain state−of−the−art equipment, including an Adept four−axis SCARA manipulator, an Eshed Robotec Scorbot ER IVV manipulator, Optotrak system for three−dimensional motion tracking, and a variety of input and output devices.

Home Page: http://www.wisdom.weizmann.ac.il

R. Basri

Developing new methods for object recognition and classification.

Designing algorithms for perceptual grouping and segmentation.

Applying methods from computer vision to visual robot navigation.

Home Page: http://www.wisdom.weizmann.ac.il/~ronen

A. Brandt

Multi−level computational methods, scientific computation.

Home Page: http://www.wisdom.weizmann.ac.il/~achi

Home Page: http://www.wisdom.weizmann.ac.il/research.html

U. Feige

NP−hard combinatorial optimization problems, computational complexity, algorithms, cryptography, random walks, combinatorial optimization.

Home Page: http://www.wisdom.weizmann.ac.il/~feige

T. Flash

Robotics, motor control and learning, movement disorders, computational neuroscience, virtual reality.

Home Page: http://www.wisdom.weizmann.ac.il/~tamar

O. Goldreich

Probabilistic proof systems, pseudorandomness, foundations of cryptography, complexity theory.

Home Page: http://www.wisdom.weizmann.ac.il/~oded

S. Goldwasser

Probabilistic proofs, cryptography, computational number theory, complexity theory.

Home Page: http://www.wisdom.weizmann.ac.il/~shafi

D. Harel

Computability, logic of programs, visual formalisms, database theory, software engineering, statecharts.

Home Page: http://www.wisdom.weizmann.ac.il/~harel

M. Irani

Analysis and interpretation of visual motion, video information analysis and applications, computer vision, image processing.

Home Page: http://www.wisdom.weizmann.ac.il/~irani

D. Michelson

Numerical analysis, differential equations, dynamical systems.

Home Page: http://www.wisdom.weizmann.ac.il/~daniel

M. Naor

Randomness in computation, cryptography, concrete complexity and combinatorial algorithms.

Home Page: http://www.wisdom.weizmann.ac.il/~naor

D. Peleg

Distributed computing, communication networks, graph algorithms, approximation algorithms.

Home Page: http://www.wisdom.weizmann.ac.il/~peleg

A. Pnueli

Temporal logic, specification, verification (deductive and algorithmic), development and synthesis of reactive, real−time and hybrid systems, verification of hardware designs, and optimizing compilers, translation validation.

Home Page: http://www.wisdom.weizmann.ac.il/~amir

R. Raz

Circuit complexity and communication complexity, proof theory and probabilistic checkable proofs, lower−bounds, quantum computation derandomization.

Home Page: http://www.wisdom.weizmann.ac.il/~ranraz

V. Rom−Kedar

Transport and mixing in fluid flows.

Structure of highly chaotic systems (smooth billiard potentials).

Structure of near−integrable Hamiltonian systems.

Home Page: http://www.wisdom.weizmann.ac.il/~vered

A. Shamir

Cryptography, cryptanalysis, electronic money, smartcard security, internet security, complexity theory, the design and analysis of algorithms.

Home Page: http://www.wisdom.weizmann.ac.il/~shamir

E. Shapiro

Biomolecular computing, computing with protein machines, biochemical and computational theories related to the origin of life.

Home Page: http://www.wisdom.weizmann.ac.il/~udi

S. Ullman

Vision, image understanding, brain theory, artificial intelligence.

Home Page: http://www.wisdom.weizmann.ac.il/~shimon

Department of Mathematics

Amitai Regev, Head

The principal research interests of the department lie in the two general areas of mathematical analysis and it applications, and of algebra, mainly representation theory, algebraic geometry, and number theory. Topics covered in analysis include structure of finite and infinite dimensional spaces, operator and matrix theory, function theory on the plane, graphs and Riemann surfaces, spectral theory, several aspects of probability and some applications of statistics, linear and nonlinear ordinary and partial differential equations, harmonic analysis, dynamical systems, control theory in its various manifestations, optimization, game theory, approximation and complexity of functions, numerical analysis, singularity theory, and robotics. The algebraic direction includes some aspects of algebraic geometry, representation theory, quantum groups, number theory, automorphic forms, ring theory, and enveloping algebras. Although the approach taken is primarily that of theoretical mathematics, some of the research leans towards possible applications.

Home Page: http://www.wisdom.weizmann.ac.il

Z. Artstein, S. Yakovenko, Y. Yomdin

Dynamical systems.

Home Page (Z. Artstein): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=zvika

Home Page (S. Yakovenko): http://www.wisdom.weizmann.ac.il/~yakov

Home Page (Y. Yomdin): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=yomdin

Z. Artstein

Optimization and control theory.

Home Page (Z. Artstein): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=zvika

I. Benjamini, A. Dvoretzky, G. Schechtman, O. Schramm

Probability and geometry.

Home Page (I. Benjamini): http://www.wisdom.weizmann.ac.il/~itai

Home Page (A. Dvoretzky): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=aryeh

Home Page (G. Schechtman): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=gideon

Home Page (O. Schramm): http://www.wisdom.weizmann.ac.il/~schramm

V. Berkovich

p−adic analytic geometry.

Home Page: http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=vova

V. Berkovich, S. Gelbart

Number theory.

Home Page (V. Berkovich): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=vova

Home Page (S. Gelbart): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=gelbar

V. Berkovich, S. Yakovenko

Algebraic geometry.

Home Page (V. Berkovich): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=vova

Home Page (S. Yakovenko): http://www.wisdom.weizmann.ac.il/~yakov

A. Dvoretzky, G. Schechtman

Banach spaces.

Home Page (A. Dvoretzky): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=aryeh

Home Page (G. Schechtman): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=gideon

H. Dym

Inverse problems.

Home Page (H. Dym): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=dym

H. Dym, V. Katsnelson, M. Solomyak

Operator theory.

Home Page (H. Dym): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=dym

Home Page (V. Katsnelson): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=katze

Home Page (M. Solomyak): http://www.wisdom.weizmann.ac.il/~solom

H. Dym, V. Katsnelson, Y. Yomdin

Classical analysis.

Home Page (H. Dym): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=dym

Home Page (V. Katsnelson): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=katze

Home Page (Y. Yomdin): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=yomdin

S. Gelbart

Automorphic forms and L−functions.

Home Page: http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=gelbar

S. Gelbart, A. Joseph, A. Regev

Group representations.

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Home Page (A. Joseph): http://www.wisdom.weizmann.ac.il/~joseph

Home Page (A. Regev): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=regev

A. Joseph

Lie algebras and enveloping algebras, quantum groups.

Home Page: http://www.wisdom.weizmann.ac.il/~joseph

Y. Kannai

Mathematical economics, statistical analysis of occurrence of asthma in children.

Home Page: http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=kannai

Y. Kannai, M. Solomyak

Partial differential equations.

Home Page (Y. Kannai): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=kannai

Home Page (M. Solomyak): http://www.wisdom.weizmann.ac.il/~solom

V. Katsnelson

Harmonic analysis.

Home Page: http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=katze

V. Katsnelson, S. Yakovenko, Y. Yomdin

Complexity of functions and approximations.

Home Page (V. Katsnelson): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=katze

Home Page (S. Yakovenko): http://www.wisdom.weizmann.ac.il/~yakov

Home Page (Y. Yomdin): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=yomdin

A. Regev

Non−commutative ring theory.

Home Page (A. Regev): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=regev

S. Yakovenko

Singularity theory.

Home Page: http://www.wisdom.weizmann.ac.il/~yakov

S. Yakovenko, Y. Yomdin

Limit cycles of vector fields, analytic theory of ordinary differential equations.

Home Page (S. Yakovenko): http://www.wisdom.weizmann.ac.il/~yakov

Home Page (Y. Yomdin): http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=yomdin

Y. Yomdin

Numerical algorithms.

Home Page: http://www.wisdom.weizmann.ac.il/cgi−bin/people?single=yomdin

Faculty of Physics

Dean: David Mukamel

Department of Condensed Matter Physics

Shimon Levit, Head

The department was formed in October 1993 as a result of the reorganization of the physics faculty. Presently the scientific activity of this young department is mainly concentrated around the experimental and theoretical research in quantum solid state but also includes a growing group of theoretical astrophysicists.

The newly established Braun Center for sub micron research is an integral part of the department. It is a modern and well equipped center which allows to conduct experiments on sub micron semiconductor structures as well as normal and high temperature superconductors.

I. Bar−Joseph

Optical spectroscopy of the two−dimensional electron gas in zero and strong magnetic fields.

Near field spectroscopy of semiconductor heterostructures.

Electron−hole complexes in quantum wells: Dynamics and steady state properties.

A. Finkelstein

Effects of the electron−electron interaction in low dimensional and disordered systems.

Metal−insulator transition in 2D conductors.

Magnetic fluctuations in high − Tc superconductors.

Y. Gefen

Quantum dots: Electron electron interaction and dissipation.

The quantum Hall effect.

Interference and tunneling in quantum mechanics.

Y. Gefen, Y. Imry

Dynamical effects, dissipation and thermodynamics in small quantum systems.

M. Heiblum

III−V semiconductors & their MBE growth.

Low dimensional mesoscopic structures.

Ballistic transport, interference and dephasing.

Temporal behavior via high frequency measurements.

Y. Imry

Effects of interaction on localization and on single−electron resonances, dephasing of Quantum interference in mesoscopics.

Y. Imry, Y. Gefen

Mesoscopic physics: Spectral correlations, persistent currents, fluctuations, quantum interference effects on transport, including the localized phase.

Y. Levinson

Electron−electron scattering in low dimensional mesoscopic systems.

Nonequilibrium current noise and dephasing in mesoscopic systems.

S. Levit

Quantum Hall effect: Integer and fractional; Chern−Simon' mean field theory; tunneling of anyons; edge states and excitations; composite bosons and fermions.

Non perturbative methods in Quantum Chromodynamics; random colormagnetic fields; matrix models with free random variables.

Quantum Chaos (small disordered systems) and Interactions.

Statistics of quasiparticle levels and wave functions in interacting quantum dots. Spin effects. Random matrix theory, supersymmetry and replica methods for the description of such systems.

Controlled decoherence of mesoscopic systems. Coupled dephasor−dephasee pairs.

Controlled decoherence of various quantum phenomena such as tunneling, Fano resonances, Berry phases, quantum pumps, Anderson localization, etc.

M. Milgrom

Departure from Newtonian dynamics as an explanation of the dark−matter problem in galactic systems.

High energy astrophysics: x−ray sources, gamma−ray sources.

D. Shahar

Experiments on materials at ultra low−temperatures.

Fractional and integer quantum Hall effect and related phenomena.

Quantum phase transitions: General transport studies and mesoscopics of the metal−insulator, superconductor−insulator and other transitions.

A. Stern

Quantum Hall effect and composite fermion theory. Electronic transport in strong magnetic fields.

Low density two dimensional electronic systems.

Carbon nanotubes.

V. Usov

Physical processes in very strong magnetic fields.

Physical processes in relativistic electron−positron plasma.

Physical processes at the surface and astrophysical appearance of strange−quark−matter stars.

The theory of nonthermal radiation from compact astronomical objects (pulsars, white dwarfs, gamma−ray bursters etc.).

Hydrodynamics and high−energy physics of colliding stellar winds in binary systems.

E. Waxman

High energy astrophysics:

Gamma−ray bursts: Origin and underlying physics.

Ultra−high energy cosmic−rays.

High energy neutrinos from astrophysical sources.

A. Yacoby

Electrostatic imaging of the quantum Hall effect and the 2D metal−insulator transition.

Transport in quantum wires.

Interference and dephasing of composite Fermions.

E. Zeldov

High−temperature superconductivity.

Vortex dynamics.

Vortex matter phase transitions.

Magneto−optical imaging.

Department of Particle Physics

Itzhak Tserruya, Head

The Department of Particle Physics is engaged in both experimental and theoretical research, in various directions. These include elementary particle physics, relativistic heavy ion physics, field theory, string theory, molecular physics, nuclear physics, plasma physics, and radiation detection physics.

Home Page: http://www.weizmann.ac.il/physics/particles.html

O. Aharony

Supersymmetric gauge theories.

Non−perturbative effects and formulations of string theories.

Relations between field theories and string theories.

Non−gravitational string theories.

A. Breskin, R. Chechik

Basic phenomena, related to radiation detection, including charge transport and multiplication in gases, photoemission and secondary electron emission.

Novel particle and photon detection techniques for particle physics, x−ray diffraction. Bio−medicine, surface analysis.

Digital mammography, early detection of cancer, radiation damage to DNA.

E. Cheifetz

Response and noise of storage phosphor imaging plates for low and high energy photons.

Electron emission induced by ion bombardment in diamond like, metallic, and oxidized surfaces.

Y. Frishman

Non−abelian gauge theories.

From current to constituent quarks.

Confinement and screening.

D. Gepner

Rational conformal field theory and solvable lattice models.

S.A. Gurvitz

Final state interaction in inclusive reactions.

Multi−dimensional and resonant tunnelling.

Quantum transport in mesoscopic systems and the measurement problem.

H. Harari

Physics of neutrinos.

M. Hass

Nuclear polarization via multifoil techniques: signs of quadrupole moments and magnetic moments of exotic mirror nuclei.

Nuclear electromagnetic moments at high spin: nuclear shape determination and magnetic moments in the superdeformed region.

Remeasurement of the cross−section of the 7Be(p,g)8Be reaction, which is of critical importance in the solar−neutrino discrepancy.

Accelerator mass spectrometry (AMS) measurements of nuclear reactions relevant to astrophysical processes.

U. Karshon

Heavy quark production at the HERA e−p collider.

Gluon density in the proton and partonic structure of the photon.

Tests of QCD dynamics in high energy e−p collisions.

M.W. Kirson

Algebraic models of many−body systems.

Theoretical investigation of nuclear structure.

The interacting boson model for nuclei.

M. Kugler

Physical properties of solitons solution.

Bundles of DNA Molecules.

H.J. Lipkin

Quantum mechanics of flavor oscillations.

Mössbauer effect with synchrotron radiation sources.

Nuclear and particle physics phenomenology and history.

Y. Maron, V. Bernshtam, V. Fisher, Y. Ralchenko, A. Starobinets

Dynamics of plasmas subjected to high energy deposition, shock waves, ionization fronts, kinetics and transport in nonequilibrium plasmas, magnetic field penetration, particle flows, turbulent electric fields, nonthermal electron energy distributions.

Z−pinches and plasma switches, spectroscopic diagnostics of plasmas in the visible to x−ray region.

Atomic calculations, cross sections and probabilities, field ionization, Stark and Zeeman effects.

G. Mikenberg, E. Duchovni, E. Gross, L. Levinson, D. Lellouch

Search for the standard−model and SUSY Higgs−bosons at LEP.

Detector development and study of physics for LHC.

Search for Supersymmetry at LEP.

Search for Higgs bosons and SUSY particles at LHC.

Trigger and data acquisition for LHC experiments.

Reconfigurable computing.

Y. Nir

Neutrino masses.

CP violation.

Dynamical Supersymmetry breaking.

I. Tserruya, I. Ravinovich

Study of ultra−relativistic heavy−ion collisions using the CERES detector at CERN and the PHENIX detector at RHIC (Relativistic Heavy−Ion Collider) at Brookhaven National Laboratory.

Electron pair production in relativistic heavy ion collisions: search for quark−gluon plasma and chiral symmetry restoration.

"Hadron blind" RICH (Rich Imaging Cherenkov) detectors, pad chambers.

D. Zajfman, O. Heber, Z. Vager

Molecular astrophysics.

Cooling of molecular ions, ion trap dynamics.

Molecular physics using storage rings.

Molecular structure using Coulomb explosion imaging and laser−induced photodetachment.

Z. Zinamon

Theoretical study of the stopping of energetic charged particles in plasma.

Thermodynamic and transport properties of dense, strongly coupled plasmas.

The interaction of fast cluster−ions and large molecule−ions with matter.

Department of Physics of Complex Systems

Yaron Silberberg, Head

The Department of Physics of Complex Systems has research programs in applied physics, including optics (holography, image processing, non−linear effects in optical fibers, electro−optics, planar optics and ultrafast optics, atomic lithography and laser cooling, and trapping of atoms). In condensed matter, research is concentrated on theory and experiment (in particular micromagnetics, equilibrium and non−equilibrium statistical physics, crystal and thin film growth, clustering of data, protein folding, liquid crystals, colloids, complex fluids, flame and wet front propagation, and membranes). Experimental and theoretical hydrodynamics concentrates on spatio−temporal chaos, Rayleigh−Benard convection, and turbulence. String theory and conformal field theory, quantum chaos, and in physics of bio−systems are also studied.

Home Page: http://www.weizmann.ac.il/physics/complex/complex.home.html

N. Davidson

Laser cooling and trapping of atoms and Bose Einstein Condensation.

Atomic optics, interferometry and chaos.

Quantum tunneling and reflection of ultra cold atoms.

E. Domany

Computational Physics

1. Protein folding.
2. Clustering of Data.
3. Equilibrium and non−equilibrium statistical mechanics.

Home Page: http://www.weizmann.ac.il/~fedomany

G. Falkovich

Intermittency in Turbulence.

Home Page: http://www.weizmann.ac.il/home/fnfal

A.A. Friesem

Optical Information Processing.

Diffractive Optical Elements and Planar Optics.

Photonic Devices.

D. Kandel

Dynamics of atomic steps on crystalline surfaces.

Epitaxical growth of strained films.

Statistical mechanics of membranes with embedded inclusions.

E. Moses

Neuronal Chips.

EEG and Brain Activity.

Motors and Cell Division.

High Resolution Imaging in Cells.

Home Page: http://www.weizmann.ac.il/~fnmoses

D. Mukamel

Collective phenomena in systems far from thermal equilibrium.

Coarsening processes and slow dynamics.

Modulated structures in liquid crystalline films.

Denaturation transition in DNA molecules.

A. Schwimmer

String theory.

Conformal field theory.

Dynamics of gauge theory.

Y. Silberberg

Nonlinear optics and soitons.

Ultrafast optics and coherent control.

Nonlinear microscopy.

Home Page: http://www.weizmann.ac.il/~feyaron

U. Smilansky

Quantum chaos.

Chaotic scattering.

Semi−classical quantization.

J. Stavans

Physics of membranes.

Single−Molecule Biological Physics.

Home Page: http://www.weizmann.ac.il/~festava

V. Steinberg

Elastic turbulence and turbulent mixing in polymer solution flows.

Interaction of critical fluctuations with convection near the onset and convective turbulence in Rayleigh−Benard convection in a gas near the gas−liquid point.

Dynamics and conformation of a single polymer molecule in complex flows.

Physics Services

Israel Bar−Joseph, Head

Accelerator Laboratory (Prof. M. Hass, in charge)

Operation of the 14 MV Pelletron accelerator and the 2 MV VDG accelerator.

Electronics and Data Acquisition (Dr. L. Levinson, in charge)

DAQ solutions to research problems.

Electronics design and construction.

Repair of sophisticated electronic instruments.

Real−time DAQ software.

UHV, cryogenics and thin films (Dr. M. Rappaport, in charge)

Consultation and design for experimental systems.

Thin films deposition: evaporation, sputtering, electron−gun, rolling.

Mechanics workshop (Y. Asher, in charge)

Faculty of Chemistry

Dean: Itamar Procaccia

Department of Chemical Physics

Daniella Goldfarb, Head

Research in the Department covers a broad spectrum of topics, including many subjects of current interest in chemistry and physics. Areas of research include theoretical studies of turbulence, the physics of fractals, properties of glass, chaos (classical and quantum mechanical), tunneling and dissipative phenomena, kinetics, and dynamics in surface condensed phases and ultrafast processes. Other areas include experimental and theoretical diffusion studies of the interaction of coherent light with matter, nonlinear optics, laser−induced processes in van der Waals molecules, coherent control of chemical reactions, cooling of molecules and theoretical quantum optics in dispersive media and in microcavities. A different area of active research is the study of the structure and properties of large molecular systems, and the interaction of electrons and molecules with organized thin films. Molecules on semiconductor surfaces are studied by combination of lasers and STM. A strong magnetic resonance group is active within the department, working on fields such as solid state NMR, MASS NMR of semiconductors, liquid crystals and proteins, porous materials, as well as pulsed EPR and electron−nuclear double resonance on metalloenzymes and porous solids. The department encourages interdisciplinary approaches to science, and there is much collaboration among members of the department and scientists and students from other faculties such as physics and the life sciences.

Home Page: http://www.weizmann.ac.il/chemphys

I. Averbukh

Atomic and molecular wavepackets.

Quantum state reconstruction.

Coherent near field optical microscopy.

A.I. Burshtein

Photogeneration of ions and radicals in liquid solutions and exciplex formation.

Hopping and reversible reactions of charged particles.

Magnetic field effects in charge separation and photoconductivity.

Home Page: http://chemphys.weizmann.ac.il/~anatoli/home.html

D. Goldfarb

Study of mesoporous and microporous materials by pulsed EPR/ENDOR.

Studies of the structure of paramagnetic active sites in metalloenzymes and model compounds by pulsed ESR and pulse ENDOR.

High field EPR/ENDOR spectroscopy.

Home Page: http://chemphys.weizmann.ac.il:80/~cfjaap/daniella.html

G. Haase

Light−induced chemical processes at well−defined semiconductor single−crystal surfaces, are studied using scanning tunneling microscopy (STM), atomically−resolved photovoltage imaging, and laser−induced desorption in ultrahigh vacuum.

Home Page: http://chemphys.weizmann.ac.il/~cihaase/index.html

G. Haran

Single molecule spectroscopy of adsorption and diffusion in zeolite−like materials.

Long−time spectral diffusion of single chromophores in proteins as a marker for protein conformational dynamics.

Protein folding studied on the level of the individual molecule.

Home Page: http://www.weizmann.ac.il/chemphys/cfharan/index.html

G. Kurizki

Quantum optics of cold atoms .

Superluminal effects in optics.

Quantum and nonlinear optics in photonic band gap structures.

Control of quantum states and decoherence.

Home Page: http://www.weizmann.ac.il/~cfkozh1/quantum.html#head

V. L'vov

Anomalous scaling in hydrodynamic turbulence.

Anisotropy of turbulence.

Shell models of turbulence.

http://chemphys.weizmann.ac.il/~lvov/home.html

R. Naaman

Molecular controlled semiconductor electronic devices.

Laser induced processes in van der Waals molecules: Photochemistry and reaction dynamics.

Electron transfer through organized organic thin films.

Penetration of electrons through chiral molecular monolayers (in collaboration with Z. Vager from the Department of Particle Physics).

Home Page: http://chemphys.weizmann.ac.il/naaman.html

Z. Olami

Front propagation in porous media; the effect of disorder and defects; growth in disordered media.

Dynamics and geometry of glasses.

Flame propagation, pole dynamics noise, fractalization.

E. Pollak

Reaction rate theory in condensed phases, quantum theory of tunneling in dissipative systems, classical and quantum mechanical energy transfer in dissipative systems.

Theory of electron transfer reactions, Cooling and thermometry of polyatomic molecules in excited electronic states, Theory and control of activated surface diffusion, Quantum Monte Carlo methods and inversion of the Laplace transform.

http://chemphys.weizmann.ac.il/~pollak/home.html

Y. Prior

Alignment, orientation and coherent trapping of atoms and molecules in laser fields.

Strong field nonlinear optics, four wave mixing and incoherent noise spectroscopy.

New approaches to diamond film growth and their *in situ* laser diagnostics.

http://chemphys.weizmann.ac.il/~prior/home.html

I. Procaccia

Turbulence.

Fractals and scaling in nonequilibrium physics.

Complex growth problems.

Home Page: http://chemphys.weizmann.ac.il/~procaccia/home.html

M. Shapiro

Quantum theory of elementary exchange reactions, quantum chaos and intramolecular dynamics.

Control of chemical reactions using coherent light, experiments on coherent control with nonlinear optics.

Quantum information and computing.

Theory of photodissociation and photo recombination processes, theory of laser catalysis, strong field effects.

Home Page: http://chemphys.weizmann.ac.il/~Shapiro/home.html

D.J. Tannor

Control of chemical reactions with tailored femtosecond pulses.

Laser cooling of molecules.

Quantum theory of dissipation and chemical reactions in solution.

Semiclassical theory of reactive scattering.

Home Page: http://chemphys.weizmann.ac.il/~tannor/home.html

S. Vega

NMR studies of semiconductor CdS nanoparticles.

CPMAS solid state NMR for interatomic distance measurements in organic materials and polypeptides.

MQMAS of 17O, 23Na and 27Al nuclei in solids.

NMR of multispin systems, theory and experiments.

http://chemphys.weizmann.ac.il/~vega/home.html

Department of Environmental Sciences and Energy Research

Aldo Shemesh, Head

This Department, established in 1990, is dedicated to understanding the complex inter−relationships among the major earth systems and between the human need for energy and the consequent impact on the earth's environment. This requires knowledge of all the interdependent ecosystems that together constitute the "environment," as well as a commitment to improving the manner in which energy is utilized by humans.

The Department's research activities have several areas of focus. One is in the field of physical oceanography and hydrology. A second is in the use of stable isotopes for paleoclimatic reconstructions and biosphere−atmosphere interactions, and a third is in the field of atmospheric chemistry. Research in solar energy is conducted in a dedicated facility, the Solar Tower, on campus. The Department is distinguished by the fact that many collaborations exist among faculty members from quite different backgrounds. Such collaborations are viewed as essential in the fields of environmental and energy sciences. The interdisciplinary nature of the Department is well reflected in the academic training of the research students. Their backgrounds vary enormously from physics to biology and geology. We encourage the participation of students who are interested in not only investigating in depth a specific subject, but who are also interested in a broader, more integrative approach to science.

Home Page: http://www.weizmann.ac.il/ESER

E. Aharonov

Fluid flow in deformable and reactive porous media.

Granular media, applications to landslides and Earthquakes.

Multiscale processes in Earth sciences: modeling and theory.

B. Berkowitz

Fluid flow and chemical transport in groundwater systems.

Percolation, scaling and statistical physics models of structural and dynamic processes in geological formations.

Nuclear magnetic resonance imaging of fluid flow and dissolution patterns in rock fractures.

Home Page: http://www.weizmann.ac.il/ESER/People/Brian

J. Karni

Energy transport in particles seeded flows at high temperature.

Development of directly irradiated solar receivers.

Spectral, angular and temperature dependence of radiation properties of high temperature materials.

A. Kribus

Convection and radiation heat transfer in complex small−scale media: modeling and numerical simulation.

High temperature solar receivers: thermodynamics, heat transfer, and technology development.

High concentration solar energy optics.

Home Page: http://www.weizmann.ac.il/ESER/People/Kribus/Avi.html

Y. Rudich

The chemistry of organic aerosols: reactivity with atmospheric radicals and oxidants.

Chemical identification of organic compounds in atmospheric aerosols.

Atmospheric fate of hydroxy nitrates: solvation, reactions and photochemistry.

Home Page: http://www.weizmann.ac.il/ESER/People/Yinon−Rudich/home.html

A. Shemesh

Stable isotops and paleoceanography of the Southern Ocean.

Biogenic opal and its use in marine and continental paleo−climate reconstructions.

Oxygen and carbon isotopes in corals.

E. Tziperman

El−Niñ's dynamics and chaos.

Large−scale oceanic circulation: the thermohaline circulation, climate stability and variability, ocean and climate modeling.

Global Climate dynamics: glacial−interglacial oscillations.

Combining oceanographic data and models through four dimensional variational data assimilation using the adjoint method.

Home Page: http://www.weizmann.ac.il/ESER/People/Eli

D. Yakir

Environmental influence on the exchange of trace gases between plants and the atmosphere.

Environmental influence on trace gases exchange from soils.

Climatic influence on the natural abundance of carbon, oxygen and hydrogen isotopes in plants' organic matter.

Home Page: http://www.weizmann.ac.il/ESER/Yakir/home−page.htm

A. Yogev

Solar pumped lasers for Space Optical Communication and Space Power Transmission.

Photosynthesis with concentrated spectrum selective Solar Light.

Solar fuels.

Department of Materials and Interfaces

Meir Lahav, Head

The scientific research of the department focuses on the understanding and design of functional materials with unique physical and chemical properties. This includes a broad range of materials, such as solids with extended bonding displaying cooperative properties (superconductors and semiconductors); solids and liquids with mainly molecular bonding, such as complex fluids and molecular crystals; ultra−thin organic, inorganic and biological films and assemblies; size−quantized nanoparticles and fulleroids; molecularly functionalized semiconductors; metals and polymers, including polymer brushes and polymers for cloud seeding; and composites displaying unique mechanical properties. Biopolymer mechanics and molecular transport phenomena in the cell; imitation of biological transport strategies. Planned self−assembly of novel nanostructures on scanning−probe−patterned organic monolayer templates. Dr. Igor Lubomirsky who joined the department opened an activity in the field of ferroelectric materials. The macroscopic properties of these materials depend upon the nature and structure of their internal interfaces, the regions where different phases in a material come together. Several groups in the department are developing novel theoretical and experimental methodologies for probing liquid−liquid, solid−liquid, solid−solid, solid−gas and liquid−gas interfaces. These include nuclear reaction analysis, force measurement techniques at Ångstrom surface separation, micromechanical testing techniques, electrochemistry, grazing angle X−ray diffraction and X−ray reflectivity using bright and collimated light from synchrotron sources, second harmonic generation, scanning probe microscopy and spectroscopy, grazing angle infrared spectroscopy, and unique applications of X−ray photoelectron spectroscopy.

Home Page: http://www.weizmann.ac.il/materials

D. Cahen

Molecule−based optoelectronics: (with R. Naaman and A. Shanzer) Molecular control over opto−electronic materials and devices How can electrons get across and along molecules; electron information transfer / transport across /along molecules and molecular assemblies.

Solar Cells: (with G. Hodes) Materials interface chemistry and physics of photovoltaic materials.

Materials and Defect Chemistry of Opto−Electronic Materials; (with K. Gartsman) nm−scale tailoring of optoelectronic materials and devices.

Home Page:http://www.weizmann.ac.il/materials/DAVID/david.html

M. Elbaum

Single−molecule manipulations using optical tweezers.

Dynamics of DNA uptake into the cell nucleus.

Structure and function of the nuclear pore complex (with Z. Reich): application of atomic force microscopy and advanced optical spectroscopies.

Anomalous diffusion in polymer networks and living cells (with R. Granek). Organization of forces driving cell movements (with A. Bershadsky): optical force measurements and particle tracking studies; influence of cell biochemistry on biophysical forces. Novel surface−patterning lithographies.

e−mail: michael.elbaum@weizmann.ac.il

R. Granek

Dynamics of active biomembranes and biopolymer networks. The effect of active transport on the motion of tagged particles in living cells (with M. Elbaum).

Undulation instability in lamellar phases under shear and the formation of onions.

Shear rupture of onions and emulsion droplets.

Spontaneous emulsification.

e−mail: rony.granek@weizmann.ac.il

G. Hodes

Electrochemical and chemical deposition of semiconductor dot QD films.

Surface vs. bulk properties of QDs.

Charge transfer in QDs.

Thin film photovoltaic cells.

J. Klein

Experimental studies of surface structure and interactions, and of the behavior of confined simple and polymeric fluids.

Surface−forces−measurement techniques at angstrom surface separations; polymers as molecular lubricants; properties of thin liquid films including aqueous electrolytes and polyelectrolytes.

Nuclear reaction analysis investigations of polymer interfaces. Interfacial structure and phase equilibrium between incompatible polymers; studies of transport and self−diffusion in bulk polymers.

Wetting and stability of thin films; use of polymer surfactants to modify surface and interfacial behaviour.

e−mail: jacob.klein@weizmann.ac.il
Home Page:http://www.weizmann.ac.il/fluids/klein/klein1.html

M. Lahav, L. Leiserowitz

Chirality in Two−Dimensions (2−D) at Interfaces: spontaneous resolution in two dimensions on liquid and solid surfaces; generation of homo−chiral peptides under prebiotic conditions. Amplification of chirality at interfaces by self−replicating processes; molecular imprinting processes at interfaces. Design of processes for large−scale resolution of enantiomers by crystallization (with I. Weissbuch).

Ordered hybrid organic/inorganic composites for opto−electronics.Chemical approach for the design of organized composites of inorganic Q−particles and organic molecular wires (with E. Lifshitz Technion).

Design of auxiliaries for crystal growth. Control of crystal polymorphism, etching, twinning, etc.; growth of crystals at interfaces and from monolayers; Structural studies of 2−D and 3−D solid and liquid surfaces and interfaces: Grazing incidence X−ray diffraction, Fresnel reflectivity, atomic force microscopy, electron microscopy, grazing angle I.R. spectroscopy (with I.Weissbuch).

Stereochemical studies on crystal nucleation of Cholesterol in 2−and 3−D at the water interface.

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e−mail: leslie.leiserowitz@weizmann.ac.il

G. Levin

Surface modification of polymeric films to form selective layers for gas separation.

Expandable coating of disposable video imaging capsule for the gastrointestinal system (with Lev Bromberg).

"SMART" ion−selective gel that is sensitive to temperature, pH, light, and redox reactions.

e−mail: gideon.levin@weizmann.ac.il

I. Lubomirsky

Properties of Ultra−Thin Self−Supported Crystalline Oxide Films.

Infrared focal plane array based on freestanding pyroelectric films.

Oxygen ion transport in thin freestanding films.

e−mail: igor.lubomirsky@weizmann.ac.il

S. Reich

Localized high Tc superconductivity was obtained on Na+ doped surface of WO3 crystals.

Cs+ and Rb+ surface doping is used to induce surface superconductivity in various crystallographic phases of WO3.

e−mail: shimon.reich@weizmann.ac.il

I. Rubinstein

Self−assembled organic monolayers on metal substrates.

Coordination−based monolayers, multilayers and dendrimers (with A. Shanzer).

UV/Vis spectroscopy of organic monolayers on ultrathin gold films (with A. Vaskevich).

Biological systems on metal surfaces (with B. Geiger, L. Addadi, J. Sperling).

Surface charging in X−ray photoelectron spectroscopy (XPS) as a probe for mesoscopic systems (with H. Cohen).

Metal−filled porous alumina membranes as patterned surfaces (with A. Vaskevich).

Electrodeposited semiconductor quantum dots (with G. Hodes).

Metal underpotential deposition (UPD) in non−aqueous solutions (with A. Vaskevich).

e−mail: israel.rubinstein@weizmann.ac.il

Home Page: http://www.weizmann.ac.il/weg

S. Safran

Statistical physics of complex fluids: self−assembly of surfactants and amphiphilic polymers, elastic instabilities of biological cells, microemulsion structure and phase behavior, membranes with inclusions, electrostatic fluctuations, effects of surface modification on freezing.

Home Page: http://www.weizmann.ac.il/fluids/safran1.html

J. Sagiv

Studies on novel types of artificial organic−inorganic hybrid superlattice structures with intercalated metal or semiconductor nanoparticles, including collaborative work on characterization by synchrotron X−ray scattering, scanning probe microscopies and X−ray photoelectron spectroscopy (with R. Maoz).

Self−replicating multilayers. (with R. Maoz).

Planned surface self−assembly of nanoscopic organic−inorganic architectures using a scanning probe initiated process of non−destructive nanoelectrochemical patterning of stable self−assembled monolayers (with R. Maoz, S. Cohen).

e−mail: jacob.sagiv@weizmann.ac.il

R. Tenne

Inorganic fullerenes: new materials with cage structure.

Photovoltaic materials: transition metal dichalcogenides.

Interfaces of diamond films.

e−mail: reshef.tenne@weizmann.ac.il

Home Page: http://www.weizmann.ac.il/msg/

H.D. Wagner

Interface micromechanics in composite materials, including characterization by micro−Raman spectroscopy.

Mechanics of single− and multi−wall carbon nanotubes, nanofibers and their composites.

Mechanics of biological composites (with Steve Weiner and Lia Addadi).

e−mail: daniel.wagner@weizmann.ac.il

Home Page: http://www.weizmann.ac.il/wagner

Department of Organic Chemistry

David Milstein, Head

The areas of research in the Department of Organic Chemistry include synthetic and mechanistic organic and organometallic chemistry, novel reactions for organic synthesis, bond activation by metal complexes, polymeric reagents and catalysis. Bioorganic chemistry includes the studies of plant antiviral agents, the molecular mechanism of action of rhodopsin, artificial ion carriers and molecular sensors. Biological chemistry includes studies on structure,function, and mode of action of biologically active peptides and proteins; thermophilic enzymes; enzymes involved in DNA repair, DNA and RNA processing; studies of ordered, compact states of nucleic acids; and biomedical applications of EPR and NMR. Computational chemistry deals with the prediction of molecular properties by first principles (ab initio) and semiempirical quantum mechanical calculations.

M.D. Bachi

Organic synthesis through free radical reactions.

Synthesis and reactions of endoperoxides− new antimalarial drug candidates.

Synthetic methods based on sequential reactions and on temporary connection.

Y. Burstein

Thermophilic enzymes

1. Isolation, characterization and cloning of enzymes from extremophilic microorganisms.

2. Structure,function and thermal stability relationship studies of extremophilic enzymes.

3. Crystalization and determination of the three−dimensional structures of extremophilic enzymes.

The thymic peptide hormone THF−γ 2: Chemistry, biology and clinical application.

M. Fridkin

Regulatory peptides

1. Chemical, bioactivity and clinical studies of peptides, i.e., neuro−hormones, immunomodulating, antibacterial and antiviral peptides.

2. Synthesis of peptides by conventional, and novel solid−support techniques.

3. Novel methodologies towards long−acting and targeted drugs.

G.(J.M.L.) Martin

Computational Chemistry

1. High−accuracy ab initio thermochemistry: method development and applications.

2. Application of density functional methods to organometallic systems, with special reference to catalysis.

3. Ab initio prediction of rotation−vibration spectra beyond the harmonic approximation.

D. Milstein

Organometallic chemistry and catalysis

1. Bond activation by electron−rich transition metal complexes.

2. Rational design of homogeneous catalysis and synthetic methodology based on transition metal complexes.

3. Impact of molecular order on catalysis and reactivity.

A. Minsky

Cellular organization of biomacromolecules

1. High−resolution structural studies of ordered cellular biomacromolecules and chemical properties of ordered DNA phases and DNA−protein complexes.

2. Packaging and ordered phases of DNA in living systems (viruses, bacteria, sperm cells).

3. Effects of stress (starvation, drugs, cold−shock) on DNA and protein organization within cells.

R. Neumann

Catalysis and oxidation − Green chemistry

1. Catalytic oxidation, activation of molecular oxygen, hydrogen peroxide, nitrous oxide and ozone − Green chemical transformations.

2. Polyoxometalates as novel catalysts for oxidation reduction and acid catalyzed reactions.

3. New organo−polyoxometalate materials.

A. Shanzer

Supramolecular chemistry

1. Biomimetic ion binders, diagnostic tools in imaging technologies (fluorescent probes) and potential therapeutic agents. Synthesis, using classical and combinatorial chemistry methods and evaluation.

2. Synthesis and properties of molecular based devices; molecular sensors, switches and logical gates for application in nanotechnology.

3. Surface bound functional assemblies.

Home Page: http://www.weizmann.ac.il/Organic_Chemistry/shanzer/Shanzer_Group.html

M. Sheves

Molecular mechanism for the function of retinal proteins

1. Spectroscopic properties of retinal proteins.

2. Molecular mechanism for visual pigments photochemistry.

3. Protein−chromophore interactions in bacteriorhodopsin.

J. Sperling

Chemical and biological aspects of protein−nucleic acid interactions

1. Nuclear ribonucleoprotein complexes and their role in the post−transcriptional regulation of gene expression: Biochemical characterization and structural studies using high−resolution electron microscopy.

2. Mechanisms and protein factors involved in pre−mRNA processing.

3. Development of strategies for tagging nucleic acids with gold clusters for their use in structural biology, Biotechnology and micro−electronics.

A. Warshawsky

Polymer−supported reagents, drugs, catalysts, diagnostic agents

1. Multi−functional metal chelators; synthesis and their role in biological and agricultural systems.

2. Specific metal binding and their application in catalysis, energy conservation and ecology.

3. Polymers and nano−particles in cancer, and diagnostics.

Department of Structural Biology

Lia Addadi, Head

Structural Biology is an increasingly important and exciting area. It encompasses all the range of structural research on biological systems. At the Weizmann Institute, this research is part of the Faculty of Chemistry. The current projects utilize the main methodologies available for biological structural studies, such as X−ray crystallography, NMR, electron microscopy, molecular biology and many others. Modern and sophisticated instrumentational facilities are available, most of which are state−of−the−art. Studies are being performed on the molecular structures and structure−function relationships in biological macromolecules, such as proteins, DNA chains and their complexes, and saccharides. Efforts are directed towards the design of potential drugs. Whole intracellular assemblies and organelles, such as the ribosomes, which contain tens of macromolecules, are being investigated. The powerful techniques of site−directed mutagenesis and thermodynamics are being used to characterize, in detail, the interactions that stabilize proteins and their activity. Antigen−antibody complexes are being studied, by multi−dimensional NMR methods. Biomineralization, ie controlled mineral deposition by organisms to form skeletal tissues is being investigated, from the molecular interactions between proteins and crystals to the ultrastructure and properties of the tissue. Finally, DNA related research includes theoretical and experimental studies on the three−dimensional structure of DNA, and the many hierarchical levels of repetitive structures that are encoded into it.

L. Addadi

Mechanisms of crystal nucleation and modulation of crystal growth and properties in biomineralization (bone, mollusk shells, echinoderms) (L. Addadi, S. Weiner).

Antibodies that recognize crystal surfaces and 2−dimensional organized patterns (L. Addadi).

Mechanism of cell adhesion using crystal substrates (L. Addadi, in collaboration with B. Geiger).

S. Weiner

Biomineralization: mechanisms of mineral formation and growth in biology (L. Addadi and S.Weiner).

Structure − mechanical function relations in mineralized tissues (bone and teeth) (S. Weiner and H.D. Wagner).

Archaeological science: minerals and molecules in the sediments of the archaeological record.

J. Anglister

NMR studies of the principal neutralizing determinant of HIV−1 and its interactions with virus neutralizing antibodies.

NMR studies of Bungarotoxin and its interaction with the acetylcholine receptor.

The three dimensional structure of the extra cellular domain of the receptor for interferon α (in collaboration with Dr. Gideon Schreiber, Dept of Biological Chemistry).

D. Fass

Structure and function of proteins involved in retrovirus entry into cells.

Structure and function of proteins regulating intracellular membrane−fusion events.

A.J. Gilboa

X−ray crystallographic and thermodynamic investigation of the interaction of saccharides with the protein, concanavalin A (with F. Frolow, Tel Aviv University).

Ultrahigh resolution study of the transition metal−binding site of concanavalin A by means of EPR and cryogenic X−ray crystallography (with D. Goldfarb, Chemical Physics).

Structure of furanosides :High resolution X−ray, neutron diffraction and quantum mechanical studies (with J.M.L. Martin, Organic Chemistry and F. Frolow, Tel Aviv University).

X−ray crystallographic study of bacterial cytochrome b1 (bacterioferritin) (with F. Frolow, Tel Aviv University).

A. Horovitz

Allostery in the structure and function of GroEL and CCT chaperonins.

LFER analysis of allosteric transitions in proteins.

Chaperonin−mediated protein folding.

K.A. Muszkat

CIDNP and NMR studies of proteins: conformations, protein−protein interactions, binding, and protein folding under physiological conditions.

CIDNP and NMR studies of antigenic and immunogenic peptides and their conformations. CIDNP studies of transient conformations of proteins and peptides.

Synthesis of cyclic peptides incorporating Y−E epitopes.

M. Safro

X−ray analysis of phenylalanyl−tRNA synthetase from Th. Thermophilus and its complexes with functional ligands: tRNA, PheAMP, etc.

Human phenylalanyl−tRNA synthetase: cloning, expression, 3−D−structure, drug−design.

Crystal structure of cytoskeletal proteins: vinculin, E−cadherin (in collaboration with B. Geiger).

I. Sagi

Structural −Dynamic studies of Metalloenzymes .and Protein−Nucleic Acid Interactions

Our research covers a wide range of areas with the common themes of dynamic structure−function investigations. The principle areas of investigation are mechanism of action of metalloenzymes and protein−nucleic acid interactions. Our objective is to study the mechanism of catalysis by direct structural determination of the competent intermediates that evolve in the course of reaction in real time. We study the reaction mechanism of these enzymes by developing and using molecular biology, protein chemistry, X−ray spectroscopy, and microscopy. Our biophysical and X−ray methods are modified for following dynamical changes in enzymes and nucleic acids that are taking place during the course of reaction. Ongoing projects include: (1) Mechanism of catalysis and inhibition of metalloproteinases (MMPs) and alcohol dehydrogenase. (2) Protein−nucleic acid interactions of RNA/DNA helicases.

Z. Shakked

X−ray and solution studies of DNA oligomers.

Structural and biochemical studies of proteins involved in transcriptional regulation.

J.L. Sussman

X−ray structural analysis and molecular biology studies on proteins from the nervous system, including acetylcholinesterase (AChE), human, torpedo, drosophila, and krait; butyrylcholinesterase; neural cell adhesion proteins with sequence similarity to AChE; and paraoxonase.

Structure based drug design studies on AChE and beta−secretase, including studies of complexes with transition state analogs; potential drugs for the treatment of Alzheimer's disease; and snake neurotoxins.

3D structural studies of halotolerant proteins from unicellular alga Dunaliella.

Application of ultra rapid X−ray diffraction methods to study the enzymatic mechanism of AChE in real time.

3−D structure analysis and prediction of protein structures; and design and construction of a large object oriented relational data base for 3D structures of biological macromolecules found in the protein data bank.

E.N. Trifonov

Origin and evolution of the genetic code.

Loop fold structure of proteins (with I. Berezovsky).

Evolution of protein structure (with I. Berezovsky).

A. Yonath

Ribosomes: structure analysis by X−ray crystallography.

Antibiotics of protein biosynthesis.

Molecular Genetics and biochemistry of ribosomal RNA and proteins.

Chemical Services

Mordechai Sheves, Head

Laboratories Operated by Chemical Services

Magnetic resonance laboratory that includes 250, 400−AMX, 400−DMX and 500 MHz and 800 MHz NMR systems and a Biospec imaging NMR facility (person in charge: Dr. P. Bendel).

X−ray crystallography laboratory and X−Ray powder diffraction laboratory (person in charge: Dr. L. Shimon and Dr. E. Wachtel).

Chemical analysis laboratory that includes GC−MS, high resolution mass spectrometer, LC−MS system, acid amino analyzer and microraman spectrometer (person in charge: Dr. A. Tishbee).

Laboratory for surface analysis that includes FTIR, atomic force microscope and an XPS machine (person in charge: Dr. S. Cohen).

Electron microscopy unit that includes two scanning and three transmission electron microscopes and a general elemental analysis facility (person in charge: Dr. K. Gartzman).

Molecular modeling unit that offers diverse modeling services to many groups in the chemistry and biology faculties (person in charge: Dr. M. Eisenstein).

Electron spin Resonance unit that equipped with a Bruker ER200 D−SRC Spectrometer (9.5GHz, X band) (person in charge: Dr. L. Weiner).

Solar Research Facilities Unit

Amnon Yogev, Scientist−in−Charge Michael Epstein, Head

The Unit possesses a 3−MW solar tower, one of the four research solar towers existing in the world. Experiments at a megawatt scale can be performed in the tower at five levels, using highly concentrated solar energy.

A new optical system was constructed and annexed to the present tower. This system is known as the beam−down optics and comprises a 70−m^2 reflector, shaped as a hyperboloidal section, which can direct the solar radiation arriving from the heliostats field down to an experimental target, placed on a suitable structure on the ground. This new addition, which started its operation recently, will enable to accomplish new megawatt−scale experiments at the Unit. This unique optics will be one of its kind.

The current experiments in the tower are variegated. Among them, the following are to be mentioned: high−temperature solar receivers to heat pressurized air to be used directly in a gas turbine for generating electricity; solar reforming of low hydrocarbons to produce synthesis gas; solar−pumped lasers; concentrated PV; carboreduction of metal oxides to produce the metal element; thermal cracking of hydrocarbons; and hydrogen production.

Some of these experiments are carried out in collaboration with local and foreign industrial and research institutes.

Faculty of Biochemistry

Dean: David Mirelman

Department of Biological Chemistry

Haim Garty, Head

The research activities of the Department of Biological Chemistry span several topics in the life sciences with overlapping interests. The common tread is the study of proteins and in particular membrane proteins with key biological functions. The department has more than 30 research groups whose activities evolve around the following five foci of interest:

1. General issues related to protein folding, interactions with ligands and protein−protein recognition.

2. Structure and function of ion channels, pumps and other proteins that transport solutes across the cell membrane.

3. Mechanisms by which proteins and lipids are transported from their point of synthesis, sorted, and inserted into various organelles.

4. Signal transduction processes in bacteria, vertebrate, and invertebrate organisms, as well as molecular pathogenesis.

5. Protein interactions with DNA to control stability, repair and expression of genetic information.

A variety of methodologies are being utilized, with an emphasis on biochemistry, biophysics, and molecular genetics. Additional information can be obtained in the department's Home Page.

Home Page*: http://www.weizmann.ac.il/Biological_Chemistry*

E. Bibi

The signal recognition particle (SRP) system in *Escherichia coli:*

1. FtsY, the essential prokaryotic SRP−receptor: its role in biogenesis of membrane proteins.

2. Identification and molecular cloning of cellular factors involved in targeting insertion and assembly of membrane proteins.

Multidrug transporters (Mdr) in *Escherichia coli:*

The multidrug transporter MdfA: what makes it an Mdr?

Bioenergetics and substrate recognition properties of the purified MdfA.

R. Dikstein

Transcription regulation in high eukaryotes: functional analysis of the basal transcription factor TFIID subunits (TAFs).

1. Functional and genetic analysis of B cell specific TFIID subunit.

2. Molecular mechanism of TAF activity.

3. The role of specific TAFs in cell fate determination (i.e., cell cycle progression, cell survival and cell death).

4. Biochemical properties of TAFs.

S. Edelstein

Studies on vitamin D metabolism and action.

Development of new drugs for metabolic bone diseases and osteoporosis.

M. Eisenbach

Chemotaxis of bacteria and human spermatozoa

1. Signal transduction in bacterial chemotaxis: Molecular mechanisms of behavior, sensing, and response.

2. Pre−contact sperm−egg communication in humans and role in fertilization.

3. Molecular mechanism of function of the bacterial flagellar motor.

Z. Elazar

Molecular mechanisms of intracellular protein traffic

1. Isolation and characterization of novel proteins regulating targeting and fusion between transport vesicles and their target membranes.

2. Involvement of small GTP binding proteins of the Rab−family in vesicular transport.

3. Regulation of autophagocytosis in yeast and mammalian cells.

M. Fainzilber

Our research interests are in the field of molecular mechanisms underlying functional selectivity and development of complexity in the nervous system, with focus on plasticity and regeneration of excitable tissues. Specific projects include:

1. Comparative genomics and evolution of secreted cysteine−rich neuroactive factors.

2. Molecular mechanisms of axonal communication and neuronal regeneration.

3. Signaling and trafficking of neurotrophin−receptor complexes.

A.H. Futerman

The neuronal cell biology of lipids

1. The relationship between the synthesis and supply of membrane components and the rate of neuronal growth.

2. Membrane, vesicle, and lipid transport in polarized cells.

3. The molecular mechanisms of sphingolipid storage diseases (Gaucher, Niemann−Pick and Tay−Sachs disease).

H. Garty

Structure and regulation of epithelial channels

1. Structure−function relationships of epithelial Na+ channels.

2. Kinases mediating hormonal regulation of epithelial ion−transport.

3. Cloning of aldosterone−induced genes and elucidating their role in kidney function.

C. Gitler

The role of protein−vicinal dithiol to intra−protein disulfide conversion in redox regulation and oxidative stress

The role of multimedia in science teaching. Analysis of motivation to learn and play.

S.J. Karlish

Active Na and K transport in the kidney .Molecular structure, function and regulation of Na/K−ATPase.

Molecular mechanisms involved in generation of essential hypertension.

Z. Livneh

1. Molecular analysis of the formation of mutations in bacteria and in mammals.

2. Analysis of novel DNA polymerases specialized in lesion bypass and mutagenesis.

3. Mechanisms and biomedical applications of DNA repair.

S. Malkin

1. Photoacoustics, photothermal radiometry and fluorimetric methods in photosynthesis − Biophysical, physiological and agrotechnical aspects.

2. Photophysical and electron transfer events in photosynthesis: Laser photoacoustic study.

3. Dynamic fluorescence imaging of leaves, protoplasts and chloroplasts, using high resolution light microscopy.

4. Model systems for the interaction of chlorophylls and carotenoids, particularly in mimicking the "non−photochemical quenching" process.

D. Mirelman

Molecular pathogenesis of the human intestinal parasite *Entamoeba histolytica*

1. Molecular biology and genome organization in the lower eukaryot *Entamoeba histolytica*.

2. Selective inhibition of expression of virulence genes by Antisense RNA.

3. of action of Allicin from Garlic and its potential applications for therapy.

R. Miskin

The plasminogen activator/plasmin system in the brain.

Gene activation by DNA damage.

Reduced eating and increased longevity: a transgenic model.

U. Pick

Structure and function of salt−resistant proteins.

Iron uptake by an algal transferrin.

Cold acclimation and cold−induced proteins in Dunaliella.

H^+ and Na^+ transporters in the halotolerant alga Dunaliella.

Regulation of massive β−carotene synthesis in *Dunaliella bardawil* and its industrial utilization.

Z. Reich

Nuclear pore complex (NPC)−mediated macromolecular transport

1. Transport mechanics, dynamics and energetics.

2. Nuclear pore proteins: molecular and biophysical characterization.

3. Nuclear import of exogenous DNA: implications for human gene therapy.

E. Reuveny

Structural and functional studies of ion channels:

1. Biophysical analysis of the gating and permeation using electrophysiological approaches (patch clamp).

2. Regulation of cellular distribution and signaling specificity by ion channels−associated proteins using biochemical approaches.

3. Conformational dynamics of ion channels associated with activation using novel fluorescence−based measuring techniques.

4. The role of the G protein coupled potassium channel in insulin secretion.

G. Schreiber

Protein−protein interactions, from basic biophysical understanding to protein design and structure−function relation.

1. Rational design of faster associating and tighter binding protein complexes.

2. Evaluation of direct and cooperative contributions towards the strength of non−covalent interactions using multiple−mutant cycles for the interaction of ?−lactamase and its inhibitor BLIP.

3. Structure−function studies of the interaction of interferon and its receptors, towards understanding the biophysical basis of heterogeneous receptor activation by a family of hormones.

Y. Shai

Membrane−protein interaction and molecular recognition within the membrane milieu. Implication to the function and structure of membrane proteins.

1. Assembly and organization of pore forming toxins and ion channels in membranes: Studies with isolated fragments and intact proteins.

2. Molecular mechanism of membrane fusion and its inhibition: Studies with HIV and Sendai Virus.

3. Molecular basis for cell selectivity by cytolytic antimicrobial peptides.

Y. Shechter

Mechanism of insulin action: Post−binding events in insulin action

1. Post−receptor agents mimicking insulin.

2. Effect of vanadium *in vivo* and *in vitro.*

3. Role of protein tyrosine kinases and protein phosphotyrosine phosphatases in insulin effects.

4. Inhibitors of tyrosine kinases.

M. Shinitzky

1. Tumor vaccines prepared by application of hydrostatic pressure.

2. Characterization of antigens implicated in mental disorders.

3. Physiological signaling by cyclic glycerophosphates and their analogues.

M. Walker

1. Role of specific transcription factors in expression of the insulin gene in pancreatic beta cells and in control of pancreatic development.

2. Novel beta cell specific genes: isolation, characterization and use as potential tools in diagnosis and therapy of diabetes.

D. Wallach

Regulation of cell death and tissue damage

1. Proteins involved in the signaling for the cell−killing (apoptotic), growth−stimulatory, and inflammatory functions of cytokines of the tumor necrosis factor (TNF) family, and in the regulation of these functions.

2. In vivo models for the functions of the signaling mechanisms activated by ligands of the TNF family and for their pathological aberrations.

3. Natural antagonists to ligands of the TNF family, for protection against the deleterious effects of these cytokines in autoimmune and infectious diseases.

M. Wilchek

Study and application of molecular biorecognition

1. Avidin−biotin system: Studies of the strong binding using chemical, physical and biological methods; new applications of the system.

2. Affinity chromatography: Studies to improve purification of protein by developing new carriers, new activation methods and new principles.

3. Affinity therapy: Development of methods to couple drugs and toxins to biological carriers, such as antibodies, and their delivery to target cells.

U. Zor

A role for Ca2+ and reactive oxygen species (ROS) in cellular activation

1. The role of reactive oxygen species (ROS) in tyrosine phosphorylation and MAPK activation in differentiation and growth following skin inflammation.

2. The role of NADPH oxidase and ROS formation in activation of cytosolic phospholipase A2 (PLA2).

3. The role of Mg2+ and ROS in acute myocardial infarct (AMI) in human.

Department of Molecular Genetics

Ben−Zion Shilo, Head

Research in this department focuses on the utilization of molecular genetics for the study of diverse biological processes, including the study of viruses, control of cell growth and death, cytokines and receptors, human genetic disorders, gene expression, intracellular trafficking and development. One major theme is the use of genetics of model organisms and cell culture genetics, to dissect the role of genes in the context of the whole animal. Another focus of the department is on genomics and bioinformatics. Utilization of quantitative approaches is crucial for analysis of the wealth of information provided by the completed genome sequences and the accumulating gene expression data from DNA arrays.

N. Barkai

Developing new computation tools for analyzing large−scale gene expression data ("DNA chips").

Quantitative study and modeling of morphogen gradients in Drosophila.

A. Elson

Analysis of the role of protein tyrosine phosphatase Epsilon (PTPε) in mouse physiology and tumorigenesis using PTPε−knockout mice. Special emphasis on role of PTPε in myelination of axons in the central and peripheral nervous systems.

PTPε action at the molecular level: Identification of substrates and interactors of PTPε, and understanding the details and consequences of their interaction with PTPε.

J.E. Gerst

Use of yeast and nematodes as model systems to understand how eukaryotic cells deliver proteins and lipids to and from the cell surface: Molecular dissection of the late secretory pathway.

1. Role of SNAREs (vesicle fusion proteins) and SNARE regulators in exocytosis and endocytosis.

2. Role of phosphorylation in SNARE assembly and membrane fusion.

3. Biogenesis of secretory vesicles and the mechanism of their docking and fusion.

O. Gileadi

The mechanism of transcription in yeast: Genetic and biochemical analysis.

Transcription factor TFIIH: A possible link between transcription, DNA repair, and the cell cycle.

Y. Groner

Molecular genetics of Down syndrome.

Transgenic and Knock−out mice models for gene dosage effect of Down Syndrome.

The Human Leukemia Associated Transcription Factor RUNX1/AML1 and Down syndrome leukemia.

C. Kahana

Characterization of the regulation and role of polyamines during growth of mammalian cells

1. Regulation of ornithine decarboxylase expression.
2. Polyamines and apoptosis.

Identification and characterization of regulatory and structural components of the polyamine transport system.

1. Characterization of the proteolytic machinery.
2. Characterization of ornithine decarboxylase sequences that mediate its recognition by the proteolytic machinery.

Identification and characterization of functional domains of mammalian ornithine decarboxylase.

Characterization of ornithine decarboxylase degradation.

A.M. Kaye

Control of expression of the gene for creatine kinase B by hormones and growth factors.

Action of new selective estrogen receptor modulators against breast cancer and osteoporosis.

Use of engineered mutants of parathyroid hormone as anabolic agents for bone growth and repair.

A. Kimchi

Deciphering molecular networks underlying apoptosis and other basic biological processes.

1. Structure/function studies of DAP genes − a set of pro−apoptotic proteins isolated by a functional approach to gene cloning.
2. Implication of DAP genes in cancer development and in the control of cellular events such as protein translation initiation, and cytoskeletal organization.
3. Function−based gene "hunting" and the development of novel strategies to identify the basic principles of complex molecular networks.

D. Lancet

Genomic and evolutionary analyses of molecular recognition systems.

1. Identification and molecular cloning of members of the olfactory receptor multigene family, including studies of their genome organization, evolution and polymorphisms in humans.

2. Computer analyses of structural models of olfactory receptors and other transmembrane proteins and of receptor affinity distributions.

3. Bioinformatics analysis of long−range DNA sequences and development of whole−genome databases.

4. Computer simulations of selection and evolution in current living organisms and at the origin of life.

P. Lonai

The role of FGF signaling in mammalian development.

FGF growth factors and their tyrosine kinase receptors contribute to most steps of development. They are active in wound healing, angiogenesis and osteogenesis, as well as in congenital bone anomalies and cancer.

We pursue two lines of research. One investigates cellular and molecular mechanisms that underline the morphogenic effects of FGF signaling through in vitro models, whereas the second uses gene targeting. We create point mutations of FGFR splice variants to provide in vivo models for limb, lung and bone development.

1. Our working hypothesis connects the FGF system with basement membrane formation. Basement membranes separate epithelia and mesenchymes and mediate their interaction, which is a developmental mechanism of central importance. We find that FGF signaling regulates the synthesis of laminin−1 and collagen IV through protooncogenes of the Pi 3−kinase pathway. These proteins form the mat−like framework of the basement membrane.

2. We created mouse models for human achondroplasia, craniosynostosis and tetra−amelia (limb and lung development defects). These strains can be used to test pharmacological agents to cancer and achondroplastic dwarfism. They also demonstrate the cooperation of different FGFR and may shed light on the mechanism of epithelial mesenchymal interactions.

S. Pietrokovski

Developing computational methods for using and identifying protein motifs and applying them for the analysis of particular protein families.

1. Developing advanced methods for comparing protein motifs.

2. Applying protein motif comparisons for functional and structural predictions and to database annotation.

3. Analysis of inteins ("protein splicing" elements) and homing endonucleases.

O. Reiner

Functional Analysis of Genes Involved in Lissencephaly.

Formation of the brain structure in human is a complex process. One of the most striking features of the human brain is characteristic convolutions. These convolutions are lacking in a severe human brain malformation known as lissencephaly (smooth brain). Lissencephaly patients have a severe mental retardation. So far, two genes have been found to be mutated in lissencephaly; LIS1 located on chromosome 17 and Doublecortin (DCX) an X−linked gene. Among our current projects:

1. Identification of genes that are downstream to Lis1 mutation using microarray technology.

2. Study of LIS1 and DCX function through characterization of protein−protein interactions, and overexpression in tissue culture.

3. Analysis of the developmental function of LIS1, DCX and Doublecortin−like−kinase using gene targeting in the mouse.

M. Revel, J. Chebath

Interleukin−6 Chimera, a superactivator of the gp130 receptor system: role in nerve myelination, neuroprotection and in the development of neuro−glial cells from embryonic tissues and stem cells.

Transdifferentiation of neural crest cell derived melanoma into myelinating Schwann cell. Genes controlling cell growth, differentiation, melanogenesis and synthesis of myelin proteins.

Applications of IL−6 Chimera and Interferon−beta in neurology, hematopoiesis, and oncology.

M. Rubinstein, D. Novick

Interleukin−18 binding protein: Structure and Function.

M. Rubinstein

Role of leptin in angiogenesis and fertility.

Regulation of HIF−1α expression and activation.

L. Sachs

Molecular control of hematopoiesis and leukemia

1. Cytokine and apoptosis gene networks in development and cancer.

2. Control of apoptosis, cell multiplication and differentiation.

3. Clinical applications of hematopoietic cytokines and apoptosis genes.

E. Schejter

1. Functional elements of the cytoskeleton in the early Drosophila embryo. We have identified and characterized mutant alleles of the gene *centrosomin*, which encodes an essential component of embryonic centrosomes. Our analysis suggests that conventional microtubule organizing centers are not required for progression of mitotic division cycles. However, centrosomes act as essential instructive elements governing reorganization of cortical microfilaments in the early embryo. This interaction between the microtubule and microfilament−based cytoskeletons is dependent on the gene *sponge*. We have cloned *sponge* and are currently characterizing the structure and function of its protein product.

2. Molecular genetic studies of the Drosophila homologs of the WASP/SCAR family of cytoskeletal elements. This evolutionarily conserved family acts as a key link, bridging various signal transduction pathways and the actin−based cytoskeleton. We have studied the Drosophila homologs of both WASP and SCAR, and have identified and characterized mutant alleles in both genetic loci. Drosophila SCAR participates in a wide variety of developmental processes involving changes in cellular morphology. The Drosophila WASP homolog is required in a surprisingly specific developmental context, namely, during execution of cell−fate decisions underlying development in the peripheral nervous system and other tissues.

Y. Shaul

Transcription regulation of the hepatitis B virus (HBV); promoters, enhancers and transcription factors.

Mechanism of action of viral regulators; the X prof HBV as a transcription coactivator and the Nef protein of HIV as a protein histidine−kinase.

The role of c−Abl protein tyrosine−kinase in RFX1− mediated transcription regulation and in p73−mediated apoptosis under DNA−damage stress.

Gene therapy by DNA−correction and protein transduction.

B. Shilo

Signaling by the Drosophila EGF receptor pathway during development.

Development of the *Drosophila* tracheal system.

R. Simantov

Molecular mechanisms controlling neuronal cell death and drug addiction

1. Programmed cell death in the brain: Genes activated by neuroactive agents working via neurotransporters.

2. Involvement of serotonin transporters in neuronal plasticity, growth and neurotoxicity; studies with knockout mice.

3. Reward and reinforcement mechanisms in the nervous system: Interactions with dopamine, serotonin and glutamate networks.

T. Volk

The molecular basis for muscle−tendon interactions during embryonic development

1. The mechanism by which the RNA−binding protein "How" controls tendon cell differentiation.

2. Local activation of the Vein/EGF receptor pathway by localization of Vein at the sites of cell−cell contacts.

3. Structure−function analysis of Kakapo, a cross−linker between the actin and the microtubule networks in tendon cells.

Department of Plant Sciences

Robert Fluhr, Head

Plants offer the world its only renewable resource of foods, building material and energy. Plants have highly sophisticated short and long−term adaptive mechanisms to the environment as a result of the simple fact that they cannot alter their location during environmental change. Basic understanding of how plants react to the environment and why they grow the way they do are central to devising a rational approach to secure more food, and food of better quality. Research activities in the Department range from studies on the function and regulation of isolated genes to their interactive behavior in the context of the whole plant. We have developed extensive in−house genomic, bioinformatic and transgenic infrastructure that enables us to isolate novel genes by gene trapping, knockout or map−based cloning. Cloned genes are manipulated and studied by transgenic analysis to establish their potential in the whole plant. Our research as listed below integrates methodologies of molecular biology, protein modeling, genetics, biochemistry, and physiology.

Harnessing light energy and energy transduction in the plant cell.

Research is carried out on the basic biophysical phenomenon of photon absorption by chlorophyll through transduction of this energy to ATP and the regulation of energy flux by the plant redox state.

Adaptive response in the plant to the biotic and abiotic environment.

Molecular mechanisms that drive the cellular response are investigated under environmental perturbation. Research is directed in understanding the elements that play a role in the recognition of pathogens and the subsequent mounting of plant defense responses.

Plant metabolism and growth.

Research is centered around elucidating the pathways for essential amino acids production regulation and storage in the seed and understanding what controls cycles of differentiation and dedifferentiation in plant cells.

Plant genome organization.

Molecular tools have been developed to examine the fluidity of the plant genome as described by transposon elements and the concerted evolution of gene families and plant genomes.

A. Danon

Mode of action of redox−signal transduction factors.

Pathway of redox−signaling responsible for light− regulated translation.

RNA−binding proteins controling light−regulated translation.

M. Edelman

Modeling ligand−protein interactions.

Consensus structures for ATP binding sites.

Computer tools for analyzing molecular structures.

Tentoxin: structural mechanism of action.

Genetic engineering of aquatic plants.

M. Edelman, L. Esterman

National Center for Bioinformatic−Genetic Infrastructure.

M. Feldman

Evolution of genomes in polyploid wheat.

M. Feldman, A.A. Levy

Mechanism of polyploidy−induced sequence elimination in wheat.

Molecular response of the wheat genome to polyploidy.

M. Feldman, G. Grafi

Chromosome specific sequences and their possible role in homologous recognition and initiation of meiotic pairing.

M. Feldman, E. Millet

Use of wild germ plasm for wheat improvement: identification, mapping and transfer of useful genes from wild relatives into cultivated wheat.

Production of hybrid wheat.

R. Fluhr

Response of plants to biotic and biotic stress by kinase cascade signalling.

Plant resistance genes and their role as receptor−like proteins for pathogen generated factors. Their role in innate resistance, their architecture, structure−function relationships and evolution.

Role of reactive oxygen species in pathogen defense and signal transduction.

R. Fluhr, O. Davydov

National Center for Plant Genome Research.

Map−based cloning technologies and application of microarray technology to problems in plant growth and environmental response.

G. Galili

Molecular genetic dissection of plant metabolism.

1. Developmental, physiological and environmental signals regulating lysine metabolism.

2. Genetic engineering of lysine and threonine−overproducing plants.

3. Metabolic regulation of thiol compounds.

G. Grafi

How Do Plant Cells Dedifferentiate?

We study molecular mechanism(s) underlying the early events that accompany cellular dedifferentiation, i.e., cell−fate switch and cell−fate determination.

We use the tobacco protoplast system and tomato mutants and focus on:

1. Chromatin dynamics and the role of chromatin−associated proteins.

2. The role played by the retinoblastoma protein.

3. The role of the ubiquiton proteosome system.

4. The role of the HMG−I/Y protein.

J. Gressel

Analysis of risk of transgene introgression from wheat to grass weeds.

Tandem constructs to mitigate gene flow from transgenic crops to weeds and from mycoherbicidal agents to pathogens.

Elucidation of biochemical pathways common to crops and non−photosynthetic parasitic weeds.

Ascertaining biochemical limitations of parasitic plants, and their defenses to fungal attack.

Transgenically enhancing the virulence of fungi.

J. Gressel, G. Galili

Determine the role of modified oxidant detoxifying enzymes in conferring transient drought tolerance and tolerance to zinc deficiencies in transgenic wheat.

A. Levy

Studies on the evolution of plant transposable elements:

1. Evolution of the hAT family of elements.

2. Data mining for DNA−DNA transposons.

Homologous and non−homologous recombination in plants:

1. DNA double strand break repair.

2. Effect of bacterial recombination−related genes on recombination in plants.

3. And isolation of plant mutants and genes affecting DNA recombination.

Transposon tagging and genomics in tomato: development of a gene machine for reverse genetics; gene trapping with invasive and non−invasive reporters, and high throughput isolation of genes flanking transposons insertions.

A. Levy, M. Feldman

Variability in gene expression between wild and cultivated wheats.

A. Scherz

Quantification of atoms, groups and molecules electronegati using metal substituted bacteriochlorophylls and application to chemical reactivity.

Resolving the forces which drive membrane protein assembly.

The mechenism behind generation of reactive oxygen species (ROS) by illuminating novel bacteriochlorophyll derivatives and their application in photodynamic therapy (PDT) of tumors.

Biological Services

Menachem Rubinstein, Head

Biological Computing Unit (Dr. L. Esterman, in charge)

Databases for molecular biology and molecular modeling−management, installation and updating.

Microcomputers and workstations−applications in biological sciences.

Equipment: Digital Alpha 8200 server, several workstations, some of which are smart X−terminals.

Bioinformatics Unit (Dr. J. Prilusky, in charge)

Bioinformatics databases: Retrieval, optimization and programming.

Equipment: A Sun Enterprise 10000 server, 4 Sun SPARCstations(tm), Inherit 670(tm) Sequence Analysis System with 2 Fast Data Finder(tm) boards, 2 Digital Alpha stations.

DNA Analysis Unit (T. Mehman, in charge)

Automatic DNA sequence analysis; genotyping.

Equipment: Five automatic DNA sequencers (2 ABI model 377 and 3 ABI model 373), 672 Genescan(tm) Software. Auxiliary equipment including 4 thermal cyclers and 2 GeneQuant microspectrophotometers.

Protein analysis Unit (N. Tal and Dr. A. Rabinkov, in charge)

Preparation and HPLC separation of proteolytic digests, automatic protein and peptide microsequencing in solution and as electroblotted bands, measurement of protein−protein interactions and similar interactions.

Equipment: Protein microsequencer (Model 491, Procise), HPLC, BIAcore 2000, densitometer.

Flow Cytometry Unit (Dr. A. Sharp and E. Ariel, in charge)

Analysis and sterile sorting of cells and sub−cellular organelles. Sorting parameters are: cell number and size, granularity and shape, DNA, RNA and protein contents, surface and intracellular antigens, intracellular calcium or pH, membrane fluidity and permeability, enzyme activity, endocytosis.

Equipment: Two fluorescence−activated cell sorters (FACSTAR plus and FACSVantage), FACSCAN and FACSORT analyzer and a fluorescent microscope.

Bacteriology Unit (I. Segal, in charge)

Medium scale fermentation of microorganisms; downstream processing of fermentation products; preparation of agar plates; preparation of growth media for bacterial, algal, fungal and cell culturing; sterilization of media and equipment.

Equipment: Two 10−liter fermentors, autoclaves, continuous centrifuges, ultrasonic sonicator and other auxiliary equipment for bacterial and cell culture work.

Irradiation Unit (G. Ben−Moshe, in charge)

X−ray irradiation; Gamma ray irradiation; consultation and shielding design.

Equipment: One heavy duty and one low energy X−ray machines, two gamma ray sources.

Electronic Service Unit (A. Auerbach, in charge)

Design and assembly of new electronic equipment, modification of existing equipment, repair, upgrade and maintenance of Macintosh computers and peripheral equipment, repair and maintenance of electronic equipment.

Monoclonal and Polyclonal Antibody Unit (Dr. O. Leytner, in charge)

Development of hybridoma cells, preparation of monoclonal antibodies from existing hybridoma cells, preparation of polyclonal antibodies.

Peptide & Oligonucleotide Synthesis Unit (Dr. O. Goldberg, in charge)

Synthesis of oligonucleotides and peptides.

Equipment: Three oligonucleotide synthesizers (Expedite 8900 Nucleic Acid Synthesis System), one peptide synthesizer (ABI Model 432).

Faculty of Biology

Dean: Moshe Oren

Department of Biological Regulation

Hadassa Degani, Head

The research in the department of Biological Regulation is concentrated on molecular, cellular and physiological studies of processes that collectively control the action of cells, tissues, organs and the entire body. Extensive efforts are directed to the elucidation of the regulators and pathways of the transmission and translation of signals evoked by hormones, as well as growth and death signaling factors. These studies include: (i) characterization of interactions between growth factors, hormones and extra cellular matrix components with specific receptors; (ii) induction and mechanisms of action of programmed cell death, necrosis and cell survival; (iii) mediation of intracellular signaling via second messengers protein kinase cascades or through lipid mediators and (iv) mechanisms of angiogenesis and oncogenesis. The results of these investigations advance our basic understanding of phenomena related to reproduction as well as tumor and vascular biology. In addition, it enables us to develop useful applications that intend to improve patient management.

A diversity of experimental methodologies is used in these projects. In particular unique non invasive methodologies of Magnetic Resonance Imaging (MRI) and Spectroscopy (MRS) are being developed in this department. The research groups include students from life sciences and chemistry, residents, physicians, and guest researchers from Israel and abroad. Several projects have already incorporated clinical assessment of experimental drugs and new diagnostic methods.

H. Degani

Hormonal regulation of angiogenesis and perfusion of breast cancer; Molecular and MRI studies including clinical testing of a new method for breast cancer diagnosis.

Glucose and choline metabolism in breast cancer; The regulation and role of the corresponding transporters and transport kinetics measured by MRS.

Renal function through sodium grandients; Non−invasive, high resolution sodium MRI.

N. Dekel

Regulation of cell cycle: The use of rat oocytes as a model system.

Cell−to−cell communication: Regulation of expression, degradation and function of the gap junction protein, Cx43.

Endothelin1−mediated regulation of vascularization: role in implantation.

A. Gross

Mitochondria in apoptosis: Regulation of mitochondrial function by BCL−2 family members and caspases.

The connection between mitochondria and cell cycle: Use of yeast as a model system.

Ovarian follicle atresia as a model of apoptosis: The role of BCL−2 family members in this process.

F. Kohen

Novel derivatives of the phytoestrogen genistein as an estrogen mimetic in the cardiovascular system.

Peptides isolated from phage displayed peptide libraries as estrogen mimetics (in collaboration with Prof. Ephraim Katzir from the Department of Biological Regulation).

Anti−idiotypic antibodies as probes of molecular mimicry.

M. Liscovitch

Identification and cloning of novel eukaryotic phospholipase D genes from yeast and mammalian cells.

Localization, regulation and function of phospholipase D in lipid rafts and caveolae.

Role of caveolin and caveolae in multidrug resistance of cancer cells.

Home Page: http:// www.weizmann.ac.il/home/lhliscov/

M. Neeman

In vivo MRI analysis of angiogenesis, vascular regression, vascular maturation and lymphatic drain.

Hormonal regulation of angiogenesis and adhesion in ovarian carcinoma.

Positive and negative regulators of pre−ovulatory angiogenesis in the normal rat ovary.

Y. Salomon

Anti−cancer treatments :

1. Development of novel bacteriochlorophyll−based drugs for photochemotherapy.
2. Boron neutron capture therapy.

Reactive oxygen species, their generation by bacteriochlorophyll and light, their role in signal transduction and mechanisms of cell and tumor destruction.

Vascular biology and vascular destruction.

R. Seger

The nuclear translocation of ERK and MEK − characterization and molecular mechanisms.

Identification, characterization and cloning of two novel MAP kinase isoforms.

Signal transduction via G protein−coupled receptors.

S. Shaltiel

Modulation of vitronectin structure and function by phosphorylation and proteolysis.

Exo− and ecto− protein kinases and proteinases, in the regulation of biological processes.

Structure and function of protein kinase A and of the Kinase Splitting Membranal Proteinase (KSMP).

A. Tsafriri

The development and demise of ovarian follicles in vivo and in vitro : the role of apoptosis.

Ovulation as a tissue remodeling process: Endocrine and molecular regulation.

Molecular regulation of oocyte maturation in mammals.

Y. Yarden

The role of ErbB−2/HER2 in human cancer.

Signal transduction networks in development and disease.

Endocytosis and intracellular sorting of growth factor receptors.

Department of Immunology

Israel Pecht, Head

Research topics of our Department span the wide range from basic mechanisms in the development, recognition, inter−cellular communication, trafficking, and effector functions of the immune system to the role of these processes in autoimmune disorders, allergies and cancer. Special attention is given to the studies of immunomodulation and immunotherapy of these diseases leading to the development of specific vaccines to viruses, parasites, cancer and autoimmune diseases. Specific projects include production of specific antibodies for targeting of drugs and effector lymphocytes; raising of catalytic antibodies; studies of the repertoire and specificity of the T−cell receptor in autoimmune models for multiple sclerosis, diabetes, arthritis, and myasthenia gravis; definition of antigen recognition and mode of action of killer lymphocytes in allograft and tumor rejection; understanding the developmental process of leukemias and treating them; use of cytokines for immunotherapy of metastases and immunomodulation of lymphocyte migration; immune cell adhesion and migration; the control of inflammatory processes; development of hematopoietic stem cells and T−cells activity during aging as well as understanding antigen recognition mechanisms by their receptors and its coupling to cellular response in mast cells as a model.

R. Alon

Chemokine regulation of integrin adhevisiveness and cell motility.

Intracellular regulation of integrin functions implicated in lymphocyte adhesion to vascular endothelium and migration to target tissues.

Biophysics of selectin and integrin−mediated rolling adhesions in shear flow.

R. Arnon

Studies on antigenicity and vaccine development.

Immunochemical aspects of schistosomiasis.

Synthetic peptides and synthetic vaccines (collaboration with Prof. M. Sela).

Experimental allergic encephalomyelitis and its suppression by basic copolymers of amino acids: Relevance to multiple sclerosis (collaboration with Prof. M. Sela and Dr. D. Teitelbaum).

The possible use of antibodies for local drug delivery of the anti−cancer agent, cis−platinum (collaboration with Prof. M. Wilchek).

A. Ben−Nun

Demonstration of new primary target antigens (MOG, MOBP, ...) in multiple sclerosis and the implications for pathogenic processes and immune−specific therapy.

Epitope−directed immune−specific therapy of MOG−induced EAE mediated by altered peptides. Mechanisms of T cell modulation.

T cell receptor and ligand interaction in autoimmune disease.

Non−superantigenic bacterial toxins, T cell subsets and autoimmune disease.

Effect of encephalitogenic myelin−specific T cells and demyelinating antibodies on nerve conduction in the central nervous system in vitro.

G. Berke

Cancer Immunity: a) Tetrameric MHC−peptide complexes in cancer detection and as cancer vaccines, b) Fas/Fas−L in tumor immunity c) Tumor escape mechanisms.

Immunological memory in cancer.

Apoptosis of the heart muscle.

I.R. Cohen

Autoimmune diabetes: Pathogenesis and immune therapy.

Autoimmunity to p53 and the development of systemic lupus erythematosus (collaboration with Varda Rotter).

Regulation of immune inflammation by small carbohydrate molecules (collaboration with Ofer Lider).

Autoimmunity to hsp60 and the development of subunit vaccines against infectious diseases.

Autoimmune T cells and tissue maintenance in the nervous system (collaboration with Michal Schwartz).

L. Eisenbach

1. Indentification of human TAA peptides through differential display methods (DNA chips, SAGE) and HLA transgenic mice.

2. MNC classI and classII TAA peptides in anti−tumor immunotherapy.

3. Antigen presentation and induction of anti−tumor immunity.

Z. Eshhar

Modulation of IgE−receptor interactions in the allergic response.

Design and generation of catalytic antibodies.

Immuno−gene therapy of tumors.

S. Fuchs

The basis of D2 dopamine receptor diversity: Cloning, signal transduction, development, and correlation with disease.

The nicotinic acetylcholine receptor: Structure, function, and regulation of gene expression.

Myasthenia gravis: Regulatory mechanisms, epitopes, and immunodulation.

A. Globerson

Development of T lymphocytes in aging: Hemopoietic stem cells and the bone marrow−thymus axis.

A. Globerson, T. Lapidot

Differentiation of T lymphocytes from human hemopoietic stem cells in an *in vitro* experimental model.

A. Globerson, E. Mozes

Autoimmunity in aging: The SLE experimental model.

T. Lapidot

The developmental program of normal and leukemic human stem cells and the factors that regulate these processes *in vivo.*

The role that chemokines, cytokines, adhesion molecules and stromal cells play in human stem cells homing and repopulation *in vivo.*

Maintenance of human stem cells *in vitro* by cytokines: A functional model for human gene therapy.

O. Lider

Analysis of the effects of cytokines on lymphocyte migration.

Analysis of cell surface adhesion receptor function.

Evaluation of the enzymatic machinery required for leukolytes migration.

Chemical and functional analysis of natural inhibitors of inflammation.

E. Mozes

Systemic lupus erythematosus (SLE): Mechanisms for the induction and development and approaches for disease immunomodulation.

T cell and cytokine dysregulation in autoimmune diseases.

T cell epitopes of the human acetylcholine receptor and their analogs in myasthenia gravis.

I. Pecht

Control of immunoreceptor stimulus−response coupling by a novel, C−type lectin of mast cells.

Studies of T−cell recognition: Interactions between antigenic peptides, MHC molecules and the T−cell receptor on living cells and in solution by fluorescence methods.

Mechanisms of electron transfer in proteins with particular reference to structure−function relationships of blue copper proteins.

Y. Reisner

The role of megadose stem cell transplants in overcoming MHC barriers in sublethally irradiated recipients: A new approach for tolerance induction.

Mechanism(s) of tolerance induction by different veto cells.

Human/mouse chimera: New models for human antibody production and for induction of human CTLs against human tumors.

I. Schechter

Regulation of stage specific gene expression during the life cycle of the parasitic helminth *Schistosoma mansoni* by alternative splicing.

Structural and functional diversification of the heat−shock transcription factor of *S.mansoni* by alternative splicing.

Construction of transgenic schistosome.

M. Sela, E. Mozes

Down regulation of the clinical manifestations of experimental autoimmune myasthenia gravis by a dual altered peptide ligand.

M. Sela, R. Arnon, D. Teitelbaum

Mechanism of action of copolymer 1, a drug against expeallergic encephalomyelitis and multiple sclerosis.

M. Sela, Y. Yarden

Monoclonal antibodies to ErbB2 and their respective B cell epitopes, their roles in potential anti−tumor strategy.

I. Shachar

Involvement of the MHC class II associated, invariant chain (Ii), in B cell maturation and function.

Immature B cells and their ability to participate in the immune response.

Department of Molecular Cell Biology

Benjamin Geiger, Head

The molecular mechanisms underlying cell structures, dynamics and fate, and their involvement in embryonic development and cancer are among the primary topics of interest of the Department. These include studies on the mode of action of growth factors and the nature of signals triggered by them in target cells following binding to specific surface receptors. Growth regulation is also approached through the study of suppressor genes encoding such proteins as p53, which inhibit proliferation and which may drive cells towards differentiation or apoptosis. These studies, focusing on the mechanisms driving cells to proliferation, differentiation, or death, can elucidate the basis for cancerous transformation in a large variety of systems. Overproduction or hyperactivation of growth−promoting systems was shown to have an oncogenic (cancer−causing) effect, and a similar process may be induced when growth−suppressor or apoptosis−inducing genes fail to function. The levels at which cell structure, activity and fate are studied in this department and the focus of these studies are many and diverse, including the characterization of soluble growth factors and their receptors, the nature of complex signal transduction pathways, the action of specific regulators of cytokine action, rearrangement of genes associated with oncogenic processes, and the properties of tumor suppressor and apoptosis promoting genes. Since such processes involve networks of interacting factors, we are also interested in mathematical modeling and computerized analysis of biological gene circuits.

In addition, there is broad interest in the molecular mechanisms of cell adhesion and their involvement in the regulation of cell fate. These studies include characterization of the basic rules underlying adhesive interactions, the binding of surface−associated adhesion molecules with the cytoskeleton, and the nature of growth− and differentiation−signals triggered by adhesive interactions. Of special interest are proteins such as β−catenin, which play a crucial role in reinforcing cell−cell adhesions and triggering gene expression.

U. Alon

Systems level analysis of gene regulation networks, with E. coli as a model system.

Combining theoretical, bioinformatic and experimental methods to discover design principles of genetic networks.

A. Amsterdam

Signalling by gonadotropins and MAPK: modulation of novel genes involved in the development of the gonads.

Involvement of proto−oncogenes, oncogenes and oncoviruses in ovarian steroidogenesis and carcinogenesis.

Role of cell contacts and intracellular communication in regulation of programmed cell death in normal and neoplastic ovarian cells.

Extracellular matrix and growth factors as determinants of ovarian cell proliferation, differentiation and programmed cell death.

A. Ben−Ze'ev

The molecular basis of the role of cell adhesion and the cytoskeleton in malignant transformation.

The role of junctional plaque proteins (β−catenin and plakoglobin) in cell adhesion, signaling and transcriptional activation.

Genes regulated by β−catenin and plakoglobin: their role in cell growth, differentiation, and cancer.

A.D. Bershadsky

Integrin−mediated cell−matrix adhesions as mechanosensors: molecular requirements for the force−induced focal adhesion growth.

Cell−cell contact−dependent regulation of the actin cytoskeleton and microtubule system: Role of p120 catenin and other components of cadherin adhesion complex.

Role of myosin−driven contractility in the retrograde surface flow and cell motility.

Cooperation between neuregulin, ErbB−family receptors, and cell surface heparan sulfate proteoglycans in the regulation of cell motility and morphogenesis.

E. Canaani

Comparison of the properties of the leukemogenic ALL−1 fusion proteins with those of normal ALL−1.

Transcription profiles of primary tumors with ALL−1 rearrangements.

Functions of the human ASH1 protein.

Studies of the ALR gene.

B. Geiger

Molecular mechanisms of cell adhesion and motility in normal and cancerous cells.

Structure and signaling activity of cell−matrix and cell−cell adhesions.

Adhesion mediated regulation of cell growth, apoptosis and differentiation.

D. Ginsberg

Regulation of the activity of the E2Fs transcription factors.

E2F induced apoptosis and its inhibition during cell cycle progression.

Mechanisms underlying growth suppression by the RB related protein, p130.

Z. Kam

Cellular Biophysics

1. Computerized light microscopy, development of methods and applications to cellular and developmental biology.

2. Quantitative analysis of structural features and dynamic changes using computerized light microscopy. Lineage tracking in time−movies.

3. Neural network applied to analyze experimental data measurement of complex biological mechanisms, such as cell responses and signaling pathways, probed by genetic, molecular and morphological measurements.

U. Nudel

Structure, function and regulation of expression of the Duchenne muscular dystrophy (DMD) gene and its protein products in muscle and non−muscle cells. Prenatal diagnosis of DMD.

Dp71: the major product of the DMD gene in the brain and other non muscle tissues; analysis of possible involvement in development and in brain function by targeted gene inactivation.

The evolution of structure and function of the DMD gene and its products: Analysis in Drosophila and lower organisms.

Muscle differentiation in cell cultures − a model system for the study of cell commitment and regulation of tissue−specific gene expression. Genes determining the myogenic cell lineage (MyoD gene family and upstream genes) and their involvement in muscle cell differentiation.

M. Oren

Structure−function analysis of p53.

Relationship of p53 to programmed cell death.

Analysis of the mdm2 oncogene.

Role of p53 in senescence.

Regulation of proteins by phosphorylation, nitrosylation and acetylation.

E. Peles

Molecular mechanisms of neuron−glia interactions.

Role of Caspr family members in neuronal development.

Cellular junctions of myelinated nerves.

Generation of specialized domains along myelinated axons.

Function of Caspr proteins in generating cell−cell contact in C. elegans.

V. Rotter

Molecular mechanisms controlling the expression of p53 in normal cells and its deregulation in cancer cells

1. Involvement of p53 in cell differentiation and apoptosis: *in vivo* and *in vitro* models.

2. Cellular proteins that specifically complex with the p53 protein.

3. Cellular proteins that are induced upstream or downstream to the p53 protein following genotoxic stress.

Y. Zick

The insulin receptor as a model system for transmembrane signaling: Mode of interaction of the insulin receptor with its downstream effector molecules.

Receptor trafficking: Regulation of endocytosis and recycling of the insulin receptor.

Mammalian lectins as regulators of cell adhesion, cell growth, and apoptosis.

A. Yayon

Fibroblast growth factors, their receptor tyrosine kinases and accessory heparan−sulfate proteoglycans as regulators of cell growth and differentiation.

Molecular modeling based mapping of ligand and receptor active sites and rational design of novel modulators for cancer and other human pathologies.

Molecular understanding of Achondroplasia and other human inherited skeletal disorders caused by specific mutations in FGF receptors.

D. Zipori

Regulation of normal cell differentiation and tumor cell growth by the hemopoietic microenvironment

1. Stem cell growth and the organ stroma.

2. Characterization of the cytokine antagonist, Activin A; signal transduction and biological functions.

3. PSF, a pre mRNA splicing factor involved in processes of differentiation in stem cell systems.

Department of Neurobiology

Ephraim Yavin, Head

With the turn of the century and the decade of the brain, understanding the complexity of the nervous system has witnessed a great leap forward with the introduction and development of new concepts, methodologies and techniques in molecular biology, molecular genetics, cellular and system electrophysiology, neurocomputation and neuroimaging. From genes and morphoregulatory molecules identified originally in Drosophila and C. elegans, through those generated by the human genome project, new clues have emerged to understand the regulation of brain structure and function at the molecular and cellular levels.

A myriad of interdisciplinary projects spanning from unraveling the role of single molecules through the understanding of integrative functions of learning and behaviour in humans is carried out by nearly 20 groups of independent researchers at the Department of Neurobiology. To elucidate molecular, biochemical and electrophysiological characteristics of differentiating and mature nerve cells, in vitro model systems, such as transformed cell lines of neuronal and glial origin and primary cerebellar, hippocampal and cortex nerve cells, are employed. Among the components of the nervous system explored at the cellular and subcellular levels, surface membrane components, specific enzymes, neurotransmitters, neuromodulators, growth factors, neuroreceptors, lipid components, ionic channels and cytoskeletal constituents are investigated. Animal model systems from the electric fish and toad through chicks, rodents and primates are used at elucidating in molecular, cellular and system terms the structure, development, function, plasticity as well as regeneration, oxidative stress and aging of the nervous system. Algorithms for synaptic plasticity between groups of neurons, and the role of dendritic ion channels in synaptic input and processing of information are studied. The importance of the cross talk between the immune and the nervous system particularly during lesion, is elucidated.

The groups studying the brain at the system level strive to understand functional organization of the mammalian visual system. Using track tracing methods, the rules governing the interconnections in visual cortex are unraveled. Behavioural studies focus on principles of learning, cortical information processing, learning disabilities and addiction. Functional brain imaging of human visual cortex, particularly object vision areas are examined. Psychophysical approaches are used to define processes involved in image segmentation, learning, and memory skill acquisition, motor control and language.

E. Ahissar

Adaptive perceptual processing: Principles of thalamo−cortical processing and its formation by experience

1. Encoding, decoding and representations of vibrissal touch in the rat: Electrophysiology, neuropharmacology and modelling.

2. Encoding, sensory−motor control and learning of manual touch in humans: Psychophysics.

3. Neuronal plasticity underlying learning in the somatosensory ("barrel") cortex and its modulation by acetylcholine: Electrophysiology & neuropharmacology.

B. Attali

Molecular design and function of potassium channels

1. Molecular design, stoichiometry and gating of the IsK channel complex.

2. Potassium channels in myelinating glial cells: Molecular structure, role in myelinogenesis, and potential use in gene therapy.

3. The role of potassium channels in T lymphocyte activation, Ca2+ signaling and mitogenesis.

Y. Dudai

The role of saliency−and novelty−detectors in the acquisition and retention of memory in brain.

Mechanisms of memory consolidation, reconsolidation and extinction in the mammalian brain.

Theories of learning and memory.

I. Ginzburg

Control of expression of tau protein in normal and diseased brains (Alzheimer's).

Neuronal polarity: Control of expression of microtubule genes.

A. Grinvald, H. Slovin, M. Tsodyks, E. Ahissar, A. Arieli

1. The functional architecture underlying visual perception.

2. Cortical dynamics underlying higher brain functions in behaving monkeys.

3. The space−time dynamics of cortical activity as revealed by population activity (EEG, LFP and real−time optical imaging) coupled with single−unit and intracellular recordings.

4. The Interactions between evoked and on−going activity and their potential functional role in cortical processing.

5. The mechanisms responsible for neuroimaging based on the cortical microcirculation.

A. Karni

The characteristics and time−course of experience dependent changes in behavior (psychophysics) and brain representation (using functional MRI) and the acquisition and retention of skilled performance: what is learned, where in the brain, and when.

1. Hierarchical representation of movement sequences in the adult motor system: changes as a function of experience and the consolidation of procedural memory.

2. Functional stages in the acquisition of new language skills: mirror reading; grapheme to phoneme transformation; morphological rules.

Y. Koch

Regulation of GnRH expression in the mammary gland.

Development of cytotoxic analogs of gonadotropin−releasing hormone (GnRH).

Expression and functions of GnRH−II in the brain and in T lymphocytes.

S. Lev

Molecular Aspects of Neuronal Survival Differentiation and Degeneration.

1. Signal transduction mediated by the calcium regulated tyrosine kinase, PYK2 in neuronal cells.
2. Molecular mechanism of retinal degeneration and blindness.
3. Cellular function of a novel family of human genes related to the Drosophila retinal degeneration B (rdgB) in the central nervous system.

R. Malach

Mapping object−related areas in the human brain.

1. Gestalt effects in the human brain.
2. Dynamics of object−selective activation.
3. Principles of organization of object areas in the human brain.

H. Markram

Microcircuitry of neocortical columns.

Synaptic plasticity.

Neural coding.

D. Sagi

Human vision, with an emphasis on processes involved in image segmentation, learning, and memory.

M. Schwartz

Cross−talk between the imune and nervous system.

Physiological mechanisms of neuroprotection.

Beneficial autoimmunity.

Immunological aspects of CNS degenerative diseases.

M. Segal

Intracellular calcium in neurons.

Neuromodulation in the brain.

Physiology and behavior in transgenic mice.

I. Silman

Localization and anchorage to the plasma membrane of acetylcholinestera.

Regulation of folding and assembly of acetylcholinesterase.

Three−dimensional structure of acetylcholinesterase and acetylcholinesterase−anticholinesterase complexes.

V.I. Teichberg

Protein−protein interactions of glutamate receptors in neuronal plasticity.

In vitro evolution of a glutamate scavenging enzyme for the treatment of stroke, head trauma and amyotrophic lateral sclerosis.

Structure of glutamate receptors: Mechanism of activation and desensitization of glutamate receptors.

M. Tsodyks

Modeling of cortical neuronal populations: From microcircuits to large scale networks.

Information transmission through dynamic synapses.

Population activity in visual cortex.

Home Page: http://www.weizmann.ac.il/~bnmisha

Z. Vogel

Molecular mechanisms of opiate addiction, tolerance and withdrawal.

The cannabinoid ligands, their endogenous ligands and signal transduction.

Regulation of signaling by chronic agonist exposure.

Home Page: http://www.weizmann.ac.il/neurobiology/labs/vogel/index.html

E. Yavin

Signal transduction and protein kinase C isozymes in brain of normal and growth−retarded fetuses.

Free radicals and lipid modulators in the developing and aging brain.

Novel genes during oxidative stress in utero and role of docosahexaenoic acid.

Feinberg Graduate School

Dean: Shmuel Safran

Department of Science Teaching

Uri Ganiel, Head

The Department is composed of groups working in mathematics, physics, chemistry, computer science, earth and environmental sciences, life sciences, and science and technology for junior−high school. In all these areas there are extensive research and development projects, aimed at producing improved and up−to−date learning materials that integrate the use of modern technologies, and implementing these materials throughout the Israeli education system. Work is based on an underlying philosophy that considers curriculum development and implementation, teacher in−service development, research and evaluation as interrelated and continuous long−term activity. Therefore, research related to all aspects of curriculum development and implementation forms an integral part of the process. This research includes evaluation of pilot materials through classroom research, affective and cognitive studies, analysis of student learning difficulties and effectiveness of specific learning and teaching strategies.

Home Page (in Hebrew only): http://www.weizmann.ac.il/sci−tea/home.html

Mathematics: A. Arcavi and R. Even

Junior−High, Senior−High and Elementary School Curriculum Development: Preparation of Learning Materials

A. Arcavi, N. Hadas

Long−term design of a new curriculum for grades 10, 11 and 12 for non−academically oriented students.

A. Arcavi

Design of a new geometry curriculum based on the ideas of "realistic mathematics" for non academically oriented students in grades 8−9.

A. Friedlander

Development of enrichment materials.

Development of assessment tasks on the concept of function.

Development of activities with computerized tools in elementary schools.

Compu−Math: Long term curriculum development for learning mathematics with computerized tools, in Junior−High school.

N. Robinson

Development of learning materials for heterogeneous Junior−High school classes.

N. Zehavi

Development of computer software and its implementation.

Development of Materials for Learning and teaching mathematics with Computer Algebra Systems (CAS).

Development of mathematics programs for the Arab population .

Junior− and Senior−High School Teacher Development

A. Arcavi

Fellowship program for distinguished young teachers.

R. Even

MANOR − National center for mathematics teachers:

- Education and advancement of professional leadership of teachers.
- Support and counseling to professional development programs and activities in the regional teacher centers.
- Development of a professional teachers' community.
- Establishing a resource database.
- Research and evaluation.

Outreach Programs

R. Even

Responsibility for planning and conducting the mathematics teacher development courses and in−school guidance at the Ashdod regional teacher center.

A. Friedlander

Enriching the teaching and learning of mathematics in Tel−Aviv.

N. Zehavi

A textbook for teachers "computers and Mathematics Education".

Courses for teachers who specialize in computers and mathematics education.

Web course for teachers on the history of negative numbers.

Research and Evaluation

A. Arcavi

Research on cognitive characteristics of non academically oriented math students.

R. Even

Characterization and examination of teacher knowledge.

Development and study of research−based teacher education programs.

Preparation of research−based materials for use in teacher education.

A. Friedlander

Research on learning and teaching processes in Algebra in a computerized environment.

N. Zehavi

Research and development of Computer Algebra System (CAS) teaching methods.

Changes that CAS technology brings to teachers' professional development.

Formative evaluation of Web courses.

Effectiveness of the microcomputer software.

Physics: U. Ganiel

U. Ganiel, B. Eylon

High school curriculum development

1. Translation and adaptation of selected units from the course "Visual Quantum Mechanics" developed by the Physics Education Research Group in Kansas State University.

2. Preparing texts and materials for elective units for physics majors (lasers, chaos). Using computerized networks (internet and intranet) for distance learning of these courses.

3. Development of modules for student activities in Mechanics, Electricity and Magnetism and Optics.

4. Development of modules for inquiry learning in the context of "mini−projects".

5. Development of a new course on Light and Waves for 10th and 12th grades.

6. Development of physics programs for the Arab population.

7. Elaboration of the national physics syllabus and the matriculation examinations.

8. Preparation of materials for e−learning in mechanics and electricity that can be used in various models that integrate in−class and distance learning of physics.

B. Eylon, U. Ganiel

Research, evaluation and planning

1. Research of problem−solving processes in high school physics.

2. Study of concept learning and misconceptions in high school physics.

3. Study of processes involved in integration of technology in physics learning.

4. Formative and summative evaluation of new courses.

5. Research and development of various strategies for integration of microcomputers in physics learning processes.

6. Investigation of learning processes and teaching methods in teacher training programs.

7. Study of long−term professional development of teachers and leader−teachers.

Application of microcomputers in physics teaching

1. Development of open environments for promoting physics reasoning and inquiry learning.

2. Developing custom made programs for specific learning activities within the physics curriculum.

E. Bagno, B. Eylon, U. Ganiel

Teacher development: National center for physics teachers

1. In−service teacher training courses.

2. In−school projects for promoting the teaching of physics through the use of computers.

3. Long−term didactical courses introducing teachers to current research in physics education and its implications to the learning/teaching process.

4. Long−term frameworks for leader teachers: Three−year courses for basic training and forums for acting teacher−leaders.

5. Resource materials and frameworks for teacher development.

6. An annotated database of selected internet resources relevant to high school physics in Israel (in Hebrew).

7. One−day national conference and workshops for physics teachers in Israel.

8. A prize for outstanding teachers or teams of teachers (together with the physics department and the Amos de−Shalit fund).

Chemistry: R. Ben Zvi and A. Hofstein

R. Ben−Zvi and A. Hofstein

High school curriculum development and implementation

1. The development and implementation of a text book and teachers' guide. "synthetic polymers".

2. Preparation of resources and units for the teaching of Industrial chemistry in Israel.

3. Development of new instructional techniques to teach chemistry in high schools

    - ♦ Enquiry type experiments.
    - ♦ The use of internet for instruction.
    - ♦ Development of CAI.

4. Development of introductory (basic) modules for a new syllabus in high school chemistry. ("The development of chemistry" and "Chemistry and life").

A. Hofstein

The National chemistry teachers' center: Professional development of Chemistry teachers

1. Leadership courses and professional development of school chemistry coordinators.

2. In service training of chemistry teachers both in content and pedagogy.

3. In−service teachers training in the area of industrial chemistry (conducted by the industrial link center).

    Development of chemistry literacy: a workshop.

R. Ben−Zvi, A. Hofstein

Research and evaluation

1. Evaluation (formative and summative) of textbooks written by the group.

2. Identification of learning difficulties in the context of high school chemistry with regard to concept formation, scientific thinking and cognitive theories.

3. Classroom learning environment, motivation and achievement in high school chemistry.

4. The development of "non conventional" instructional methods for teaching chemistry and assessment of their educational effectiveness.

5. Analysis of learning difficulties and misconception in chemistry in the Israeli "Bagrut" matriculation examination.

6. Students conceptions of the basic laws of thermodynamics.

Science and technology for all (The MUTAV project): R. Mamlok and R. Ben−Zvi

(Science education for non science Oriented students in the Senior high School)

High school curriculum development and implementation

Development of modules for this program

1. Brain medicine and drugs.

2. The "Black Gold"* From Dinosaurs to Darwin (jointly with Nir Orion).

3. Scientific aspects of the police investigations (forensic−science).

4. Science in the service of the police (forensic−science).

Research and evaluation

1. Formative and summative of the above mentioned modules.

2. Teachers' and students' perceptions of science and technology.

3. Non science oriented students' conception of key ideas of thermodynamics.

Computer Science: M. Ben−Ari

M. Ben−Ari

Concurrent and Distributed Computation

Development of a high school course on concurrent and distributed computation.

Research into cognitive aspects of learning concurrency and lab software to support teaching the course.

M. Ben−Ari

Object−oriented Programming for Novices

Research into teaching OOP as an introductory computer science course: curriculum and teaching methodology, programming language, lab software and visualization.

Z. Scherz

Project Organizers

Development of an organizer as a framework for students carrying out projects in computer science.

Z. Scherz

Logic Programming (Prolog)

Preparation of a Prolog compiler for writing programs in Hebrew.

Earth Science and Environment Education Group: N. Orion

High school curriculum development for the Earth science curriculum

1. Preparing texts for a basic course "Introduction to Earth Science".
2. Development of experiments for laboratory activities.
3. Development of research projects for students named "Geotop".
4. Development of a microcomputer simulation named Geo3D for learning geological structures and for the development of spatial visualization.
5. Development of a module in environmental geology emphasizing the relationships between Earthquakes and society.
6. Development of a module named the Carbon Cycle which integrates the Earth Systems including man.
7. Development of a module "Evolution in the perspective of the geological time" which integrates the geology with biology and chemistry.
8. Development of educational field trips.
9. Development of strategies for using multimedia presentations as an educational tool.

Junior−high school Curriculum Development

Supporting the Junior−high group in curriculum development and in−service training

Kindergarten Curriculum Development

Let's rock − a curriculum for the kindergarten

In−service courses in earth−sciences

Integrating issues in the "earth sciences" in the junior−high school curriculum.

Research Evaluation and Planning

Formative and summative evaluation of new courses, learning environments and learning strategies.

Life Sciences: A. Yarden

High School Curriculum Development

Development of learning materials for elective units in biology:

1. The secrets of embryonic development: study through research: A student text.
2. An adventure in the immune system.
3. Bioinformatics.

Junior−High School Curriculum Development

Development of learning materials in biology for the science and technology curriculum:

1. Let's Characterize Life.
2. The living cell as a longitudinal axis.
3. Senses and Sensors.
4. The heart of the matter.
5. Ecology.
6. Nutrition and health.
7. Computerized learning material about the living cell.

Research and evaluation

1. Study off learning through research papers can serve as a stimulus for question−asking among high school students.
2. Investigate the possibilities to promote junior−high school students understanding of the relationships between cellular processes and function of multicellular organisms.
3. Study the interplay between procedural and declarative knowledge used by junior−high school students during classification.

Implementation

In−service teacher training courses and in−school teachers guidance.

Home page (in Hebrew): Home page (in Hebrew): http://stwi.weizmann.ac.il/G−Bio/index.html

Science and Technology in Junior−High School: B. Eylon, U. Ganiel

Preparation of learning materials for 7−9 grade

Learning Units

- Introduction to Science and Technology.
- Vacuum and particles: The particulate model of matter.
- About Fibers
- Interactions, Forces and Motion
- Scientific and Technological Communication.
- Projects as Tools for Learning.
- The Materials' Cycle in Earth's Crust.
- The World of Water.
- Simulation Based Curriculum on "Heredity".
- "The Cell "− a Strand in the Curriculum .
- Elements and Compounds.
- Inside the Atom.
- Field Trips in Science and Technology.
- Transport Systems: The Heart of the Matter.
- Bridges − Structure, Materials and Function.
- A Journey into the Living Cell.
- Systematic Inventive Thinking.
- The Art of Measurement.
- Various Learning Units on "Systems".
- Senses and Sensors.
- Various Learning Units on "Energy".
- Introduction to Spatial Reasoning in Astronomy.
- The Atmosphere.

- Systems in Industry: The Color Path.
- Health and Nutrition.

Computerized Materials

- Computerized courses and resources for the teaching the topics of "Energy − a Multidisciplinary View", "Nutrition and Health", "Nature as a Model for Imitation − The Bionic Man".
- Computer simulations for studying units dealing with "Systems".
- A Computerized environment for analyzing videotapes of motion.
- Computer programs accompanying the study of Earth−Sciences in grades 7−9.
- Computer program accompanying the study of the "cell" as a longitudinal strand (with the Center of Educational Technology).
- "The Golden Way" − A Navigational Tool for Project Based Learning in Science and Technology (with the Association for the Advancement of Science Education in the Upper Galillee).

Z. Scherz, B. Eylon, I. Hopfeld, N. Orion, O. Kedem, Y. Ben−Hur

In−service courses in science and technology for junior−high school teachers

1. Design and implementation of 3−year courses for teachers.
2. Preparation of leading science and technology educators.
3. Conducting regional long term activities in several regional teacher centers.
4. Conducting in−service teacher courses for the Arabic population.
5. A National Teacher Center for Juniour High School Teachers (in collaboration with Tel Aviv University).

B. Eylon, Z. Scherz, N. Orion, S. Rosenfeld

Research and Evaluation

1. Research on teacher and teacher−leader development in science and technology.
2. Investigation of various instructional strategies for understanding central concepts in the science and technology syllabus for junior−high school, and development of learning and thinking skills.
3. Investigation of project based learning (PBL) focusing on learning styles and the integrated development of concepts and skills.
4. Investigation of longitudinal development of conceptual frameworks and learning capabilities.
5. Investigation of learning through the course "systematic inventive thinking".

Support and Technical Services

Division of Information Systems

Computing Center

Aviva Greenman, Head

The Computing Center (WICC) both supports and supplies computing and networking expertise at the Weizmann Institute. It provides system support for workstations and personal computers (PC and Macintosh) throughout the Weizmann campus and is responsible for connecting these computers to the campus−wide network, which, in turn, is connected to country wide and international links. The WICC also provides general purpose and specialized computing facilities for the scientific and administrative departments as well as centralized standards− based mail servers.

Major energy was expended on the Year 2000 readiness program,. and as all other institutions which suitably prepared themselves, we had no significant problems.

Security has been addressed in a significant fashion and the results have been satisfying.

We are currently upgrading our major systems to High Availability status, by installing redundant auto fail−over systems. This will not only increase the reliability of our systems, but will also decrease scheduled maintenance time, as each individual server can be brought down while the alternate server carries the load.

The current campus network infrastructure is designed to absorb future network−intensive applications. The backbone of the campus is based on full mesh 622Mb ATM technology. The edge devices (private computers) are able to communicate in a 100Mb switched environment.

The IBM Mainframe, which today hosts the administrative computing applications is a 9672−R14 with 512 of memory and 113GB of disk space.

A centralized file server system is available for the UNIX environment, with regular backup services both for the centralized servers and individual user machines. There are powerful computer servers available, including a Cray 916 with 12 CPUs and 4 gigabyte of memory, a number of Sun servers, IBM RS6000s, Silicon Graphics, HPs, and DEC Alphas. The Novell Netware servers upgraded to multiprocessor servers with greatly increased disk and memory capacity.

Dial In networking to the Institute communications infrastructure continues to grow and become more versatile. Users with computers at home are now able to connect via dial−up to the Institute network at ever increasing speed , and use all the network services, such as Internet and file server access, from their remote computers.

The Library

Ilana Pollack, Chief Librarian

The Library System consists of a central library with its five faculty library branches and departmental collections. The central library serves mainly as headquarters of the Library system. The collections include approximately 260,000 books and bound volumes, about 1,400 journal subscriptions and a growing collection of networked databases (both local and remote).

The Library provides computer access to bibliographical information and holdings about books, periodicals and theses at the Institute and university libraries in Israel by using the ALEPH automated library system.

The reference services have been enhanced to include Internet resources, extending library access and delivery far beyond the Library's walls.

The Library and Information Unit's home page (www.weizmann.ac.il/WIS−library/home.htm) is the backbone of the Library's Intranet, which reaches out to library patrons enabling them sophisticated use of the Library Services. Information resources, electronic ordering and delivery of documents are embedded Services.

We provide access to thousands of electronic journals and remote databases through publishers and commercial information providers.

The Library is part of the University Libraries' Consortium which enriches our electronic collection.

The Institute archives, which include documents, pictures, sound recordings, motion pictures, internal publications, clippings and so forth, document the Institute's history and current activities.

Research Services Division

Daniel Tamari, Head

The division consists of 90 highly skilled technicians and engineers, grouped into professional working units. The division provides support to the Weizmann Institute's research program, based on an inter−departmental charging system.

Instrumentation Design and Drawing Unit

Design of custom made instrumentation, using computer−aided design systems, which are later implemented at the instrumentation workshops to create high precision lab instruments.

Precision Instrument and Engineering Workshop

Creation of custom−made lab instruments of various metals and plastic materials as required by the Institute's research staff in the central part of the campus.

Instrumentation Workshop, Physics

Creation of custom−made lab instruments of various metals as specified by the scientists in the eastern part of the campus.

Scientific Instruments Maintenance

Repairs and maintenance of lab instruments, including a large number of centrifuges.

Graphics

Preparation of materials for scientific publication, presentation and conferences using powerful computers and multi−media technology.

Photography Laboratories

Documentation of experiments, often live, at Institute laboratories, using state−of−the−art technologies, including a video studio and color lab.

Printing and Duplication

Printing, duplication and publishing most of the work produced at the Institute, assisting in the preparation of materials for various forms of scientific publication and presentation.

Glassblowing

Creation and modification of glass lab instruments.

Plastics and Polymers Laboratory

Support for development and research related to polymers and plastic users.

- Development of various polymeric materials, gels, films, membranes, coatings, etc.
- Identification of plastic materials.
- Advice and preparation of adhesives for specific users.
- Preparation of special plastic parts by casting, thermoforming, extrusion and injection molding.
- Construction of prototypes and special structures using composites, foams, elastomers, etc.

Chemical Warehouse

Supplying various chemicals to the Institute's labs from a stock which is updated regularly and providing daily transportation of the sensitive chemicals to the customer's doorstep.

General Warehouse

Providing supplies from a varied stock of lab instruments, chiefly for Life Sciences, as well as technical, office and other supplies from a varied range of items.